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Exploring the Influence of Clinical Placement Quality and Metacognitive Awareness on Clinical Competence in Nursing Students Through the Mediation of Learning Agility

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ABSTRACT

Background: *Clinical competence is a core outcome of nursing education, yet students often experience a theory–practice gap driven by variability in clinical placements and differences in reflective self-regulation and adaptability.* ***Objective:*** *To examine the influence of clinical placement quality and metacognitive awareness on clinical competence in nursing students and to test learning agility as a mediating mechanism.* ***Methods:*** *A quantitative cross-sectional observational study was conducted among undergraduate nursing students at the University of Science and Technology, Lahore. Participants completed a structured Likert-scale questionnaire assessing clinical placement quality, metacognitive awareness, learning agility, and clinical competence. Analyses included descriptive statistics, reliability testing, Pearson correlations, multiple linear regression, and mediation analysis using PROCESS Model 4 with bootstrapped confidence intervals.* ***Results:*** *Data from 348 students were analyzed. All constructs demonstrated excellent internal consistency (Cronbach's α range 0.93–0.96). Clinical placement quality, metacognitive awareness, and learning agility were positively associated with clinical competence ($r = 0.469$, 0.605, and 0.625, respectively; all $p < 0.001$). In multivariable regression, clinical placement quality ($\beta = 0.238$, $p < 0.001$) and metacognitive awareness ($\beta = 0.531$, $p < 0.001$) predicted competence ($R^2 = 0.509$). Learning agility strongly predicted competence ($\beta = 0.728$, $p < 0.001$) and partially mediated the effects of clinical placement quality (indirect $\beta = 0.180$, 95% CI 0.090–0.275) and metacognitive awareness (indirect $\beta = 0.150$, 95% CI 0.074–0.229).* ***Conclusion:*** *Clinical placement quality and metacognitive awareness enhance nursing students' clinical competence both directly and through learning agility, supporting curricular strategies that strengthen reflective self-regulation and adaptive learning alongside high-quality clinical supervision.*

Keywords: *Clinical placement quality; Metacognitive awareness; Learning agility; Clinical competence; Nursing students; Clinical learning environment; Reflective practice; Experiential learning*

INTRODUCTION

Nursing education is central to producing practitioners who can deliver safe, effective, and patient-centred care, and contemporary curricula increasingly emphasise competency-based preparation that integrates theoretical knowledge with supervised clinical practice (1). Despite these reforms, a persistent theory–practice gap remains: many nursing students report difficulty transferring classroom learning into real-time clinical decision-making and performance, particularly during placements where learning opportunities, supervision quality, and feedback processes vary widely (2,3). Because clinical competence is a multidimensional outcome—requiring the coordinated application of knowledge, psychomotor skills, professional judgement, and communication—its development is highly sensitive to both the learning environment and the learner's self-regulatory capabilities (3,4). In practice, competence formation depends not only on "time spent" in clinical settings but also on whether placements provide structured supervision, psychological safety, deliberate skills rehearsal, and meaningful feedback that supports clinical reasoning and confidence (2,5). Where these conditions are inconsistent, students may experience stress, reduced self-

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efficacy, and slower competence acquisition, with downstream implications for patient safety and workforce readiness (5,6).

Within clinical education, the quality of clinical placements represents a core environmental determinant that can either accelerate or hinder experiential learning. Evidence from nursing and midwifery education indicates that placement conditions—such as supervision availability, staff engagement, patient exposure, and clarity of learning objectives—are associated with students' perceptions of learning effectiveness and readiness for practice (2,6). Systematic evaluations of clinical practice placements further show that the clinical learning environment and supervisory model influence students' skill development and perceived preparedness, underscoring that placement quality is not a peripheral feature but a structural driver of competence growth (3). However, placement experiences are often heterogeneous across institutions and sites, with particular challenges reported in resource-constrained settings where preceptor workload, student–instructor ratios, and standardization of learning opportunities may be limited (6). In Pakistan and comparable contexts, this variability may contribute to uneven competence outcomes, making it important to quantify how placement quality relates to competence and through what mechanisms that influence occurs.

Competence development is also shaped by students' cognitive and self-regulatory capacities, particularly metacognitive awareness, the ability to plan, monitor, and evaluate one's learning and performance. Systematic reviews in nursing education identify metacognitive skills as modifiable capacities associated with improved learning behaviours, reflective practice, and performance regulation during complex clinical tasks (7). In clinical training specifically, structured feedback and peer feedback processes have been shown to support metacognitive competence, suggesting that reflective and self-monitoring behaviours can be cultivated through educational design rather than assumed to develop spontaneously (8). Yet, metacognition alone may not fully explain why some students translate insight into improved performance more consistently than others, especially under the uncertainty and time pressure characteristic of clinical settings. This is where learning agility—conceptualized as an individual's capacity to learn from experience, adapt quickly to new demands, and apply learning across contexts—may be an essential behavioral pathway connecting reflective cognition and environmental exposure to measurable clinical competence outcomes (9,10).

Although learning agility has gained traction as a predictor of performance and adaptation in healthcare and organizational contexts, its role as a mediator in nursing clinical competence pathways remains under-tested, particularly in low- and middle-income settings where placement variability is pronounced. Existing evidence indicates that learning agility and professional performance are positively associated in nursing work environments, and that agility-related behaviors (seeking feedback, experimenting with new approaches, adapting to complexity) align with experiential learning processes that should strengthen competence during placements (10). Separately, research on clinical education suggests that the clinical learning environment can shape competence both directly and through intermediate learner characteristics and perceptions (11), implying that a mechanistic model is plausible in which high-quality placements foster agility-related learning behaviors that, in turn, enhance competence. However, the field lacks sufficiently integrated empirical models that test (i) environmental quality (clinical placement quality), (ii) cognitive self-regulation (metacognitive awareness), and (iii) adaptive learning behavior (learning agility) as joint determinants of competence, using mediation methods capable of estimating direct and indirect effects within a single framework (6,9,11). This constitutes a practical and scientific gap: without clarifying whether learning agility explains how placement quality

and metacognition translate into competence; educators may over-invest in exposure-based placement hours while under-investing in the reflective and adaptive capacities that convert experience into performance gains.

Accordingly, the present study focuses on undergraduate nursing students undertaking clinical placements, examining how clinical placement quality and metacognitive awareness (exposures) relate to clinical competence (outcome), and whether learning agility functions as a mediating mechanism. Framed in a PICO-aligned logic, the population is nursing students engaged in clinical education; the primary "interventions/exposures" are higher perceived clinical placement quality and higher metacognitive awareness, contrasted implicitly with lower levels of these exposures; and the outcome is clinical competence, operationalised as students' perceived ability to perform and make sound clinical judgements in practice. The study is justified on both educational and patient-safety grounds: if competence can be strengthened by improving placement quality and by deliberately cultivating metacognitive and agility-related learning behaviours, nursing programmes can target scalable reforms (e.g., structured feedback, reflective exercises, simulation-supported adaptation) to enhance readiness for practice, particularly in settings where clinical learning opportunities are uneven (3,7,10). The study therefore aims to test an integrated explanatory model and provide evidence-based direction for curriculum and placement design.

The research question is: among nursing students in clinical training, how do clinical placement quality and metacognitive awareness influence clinical competence, and to what extent is this relationship mediated by learning agility? The study hypotheses are that clinical placement quality and metacognitive awareness are each positively associated with learning agility and clinical competence, and that learning agility partially mediates the relationships between (I) clinical placement quality and clinical competence and (ii) metacognitive awareness and clinical competence (2,7,10).

MATERIAL AND METHODS

This study employed a quantitative, cross-sectional observational design, which is appropriate for examining associations and testing mediation pathways among environmental, cognitive, and behavioral variables within a defined population at a single point in time (12). The design was selected to allow simultaneous estimation of direct and indirect effects of clinical placement quality and metacognitive awareness on clinical competence through learning agility, consistent with contemporary analytical approaches in nursing education research (13). The study was conducted at the Department of Nursing, University of Science and Technology, Lahore, Pakistan, and data were collected during the academic year in which participants were actively engaged in, or had recently completed, supervised clinical placements as part of their undergraduate nursing programme.

The study population consisted of undergraduate nursing students enrolled in a Bachelor of Science in Nursing programme. Eligibility criteria included students who had completed at least one formal clinical placement in an affiliated healthcare facility and were willing to provide informed consent. Students without clinical placement exposure or those enrolled exclusively in pre-clinical coursework were excluded to ensure that all participants could meaningfully evaluate the clinical learning environment and their own clinical competence. Participants were selected using a purposive sampling strategy to ensure that respondents had direct and recent experience of clinical placements, an approach commonly used in clinical education research where exposure to a specific learning context is required (14). Recruitment was conducted in coordination with academic faculty, and eligible students

were invited to participate during scheduled academic sessions. Participation was voluntary, and written informed consent was obtained prior to data collection.

Data were collected using a structured, self-administered questionnaire distributed in paper-based electronic formats to maximize response rates and reduce non-response bias. The questionnaire was completed at a single time point and required approximately 15–20 minutes to complete. It comprised four sections corresponding to the core study variables: clinical placement quality, metacognitive awareness, learning agility, and clinical competence. All items were measured on a five-point Likert scale ranging from strongly disagree to strongly agree, a format widely validated for assessing perceptions and self-reported competencies in nursing education (15). The instruments were adapted from established and previously validated scales used in nursing and healthcare education research, with wording contextualized to undergraduate clinical training. Prior to administration, the questionnaire was reviewed by subject experts to ensure content relevance, clarity, and face validity, and internal consistency reliability was assessed after data collection.

Clinical placement quality was operationalized as students' perceptions of the structure, supervision, feedback, learning opportunities, and overall supportiveness of their clinical learning environment, reflecting established dimensions of the clinical learning environment and supervision literature (16). Metacognitive awareness was defined as students' self-reported ability to plan, monitor, and evaluate their learning and performance during clinical activities, consistent with self-regulated learning theory (17). Learning agility was operationalized as the extent to which students perceived themselves as adaptable learners who actively learn from experience, seek feedback, and apply knowledge flexibly across clinical situations (18). Clinical competence was defined as students' perceived ability to integrate knowledge, skills, judgement, and professional behaviors to provide safe and effective patient care in clinical settings, a definition aligned with contemporary nursing competence frameworks (19).

Several steps were taken to minimize bias and enhance internal validity. Restricting participation to students with verified clinical placement exposure reduced misclassification bias. Standardized instructions were provided to all participants to minimize information bias, and anonymous data collection was used to reduce social desirability effects. To address potential confounding, key demographic variables such as age, gender, and duration of clinical exposure were measured and considered in the analytical strategy, consistent with recommendations for observational studies in education and health research (20). Common method bias was mitigated through careful item wording, psychological separation of constructs within the questionnaire, and post hoc assessment using correlation patterns and variance estimates (21).

The sample size was determined to be adequate for mediation analysis using multiple regression, taking into account the number of predictors, anticipated effect sizes reported in prior nursing education studies, and the requirement for sufficient statistical power to detect indirect effects (22). The achieved sample exceeded minimum recommendations for regression-based mediation models, thereby reducing the risk of type II error and improving estimate stability (23).

Statistical analysis was conducted using IBM SPSS Statistics and the PROCESS macro for SPSS. Descriptive statistics were calculated to summarize demographic characteristics and study variables. Internal consistency reliability was assessed using Cronbach's alpha coefficients. Pearson's correlation coefficients were computed to examine bivariate relationships among variables. Multiple linear regression analyses were performed to test

the direct effects of clinical placement quality and metacognitive awareness on clinical competence and learning agility. Mediation analysis was conducted using PROCESS Model 4 with bias-corrected bootstrapping to estimate indirect effects and corresponding confidence intervals, an approach recommended for testing mediation in cross-sectional data (24). Missing data were handled using listwise deletion after confirming that the proportion of missing responses was within acceptable limits and did not materially alter variable distributions. Statistical significance was set at $p < 0.05$, and effect sizes were reported to support interpretability.

Ethical approval for the study was obtained from the relevant institutional ethics review committee of the University of Science and Technology, Lahore. All procedures were conducted in accordance with international ethical standards for research involving human participants (25). Participants were informed about the study purpose, voluntary nature of participation, confidentiality of responses, and their right to withdraw at any time without penalty. Data were stored securely, accessible only to the research team, and analysed in aggregated form to ensure participant anonymity. To support reproducibility and data integrity, data entry accuracy was verified through random checks, analytical decisions were documented, and all statistical procedures followed established reporting standards for observational and mediation studies in health research (12,24).

RESULTS

The demographic profile of the study sample (Table 1) indicates that the participants were predominantly female (91.1%, n = 317), which is consistent with the gender distribution commonly observed in undergraduate nursing programs. Male students comprised 8.9% (n = 31) of the sample. With respect to age, the largest proportion of respondents fell within the 26–45-year age group (41.4%, n = 144), followed by those aged 45–55 years (26.7%, n = 93). Younger students below 25 years constituted 23.3% (n = 81), while participants above 55 years accounted for 8.6% (n = 30).

All respondents (100%) were enrolled in a Bachelor of Science in Nursing programme, ensuring homogeneity in educational qualification. In terms of clinical exposure, 39.9% (n = 139) had completed between 2 and 2.5 years of clinical training, and 39.1% (n = 136) had approximately one year of exposure, indicating that nearly four-fifths of the sample (79.0%) were in the early to mid-phases of clinical skill development.

Descriptive statistics and reliability estimates for the core study variables are summarized in Table 2. Mean scores for all constructs exceeded the scale midpoint of 3.00, reflecting generally favorable perceptions. Clinical placement quality had a mean score of 3.91 (SD = 0.74), indicating that participants largely perceived their clinical learning environments as structured and supportive.

Metacognitive awareness demonstrated a mean of 3.56 (SD = 1.02), while learning agility averaged 3.60 (SD = 0.96), suggesting moderate to high levels of reflective self-regulation and adaptive learning behavior among respondents. Clinical competence yielded a mean score of 3.65 (SD = 0.96), indicating that students generally perceived themselves as capable of performing clinical tasks effectively.

Internal consistency reliability was excellent across all scales, with Cronbach's alpha values ranging from 0.93 to 0.96, confirming that the measurement instruments were psychometrically robust and suitable for inferential analysis.

The correlation matrix presented in Table 3 reveals strong and statistically significant positive associations among all study variables at the $p < 0.001$ level. Clinical placement

quality demonstrated a moderate correlation with learning agility (r = 0.444) and clinical competence (r = 0.469), indicating that higher perceived placement quality was associated with greater adaptability and competence.

Metacognitive awareness showed a strong correlation with learning agility (r = 0.705) and a substantial correlation with clinical competence (r = 0.605), suggesting that students with higher awareness of their cognitive processes were more adaptable learners and more clinically competent. Learning agility was strongly correlated with clinical competence (r = 0.625), highlighting its central role in facilitating effective translation of learning into clinical performance. The magnitude and consistency of these correlations provided empirical justification for subsequent regression and mediation analyses.

Multiple regression analysis examining predictors of clinical competence is reported in Table 4. The overall model was statistically significant ($F = 182.71$, $p < 0.001$) and explained 50.9% of the variance in clinical competence ($R^2 = 0.509$). Both clinical placement quality and metacognitive awareness emerged as significant predictors.

Clinical placement quality demonstrated a positive standardized effect ($\beta = 0.238$, $p < 0.001$), with a 95% confidence interval for the unstandardized coefficient ranging from 0.14 to 0.34. Metacognitive awareness exhibited a stronger effect ($\beta = 0.531$, $p < 0.001$), with a 95% confidence interval of 0.42 to 0.61, indicating that cognitive self-regulation contributed substantially to perceived competence beyond environmental factors.

Predictors of learning agility were examined in a separate regression model (Table 5). This model was highly significant ($F = 334.02$, $p < 0.001$) and accounted for 65.5% of the variance in learning agility ($R^2 = 0.655$). Clinical placement quality was a significant predictor ($\beta = 0.399$, $p < 0.001$; 95% CI = 0.29–0.45), indicating that supportive and well-structured placements foster adaptive learning behaviors. Metacognitive awareness again emerged as the strongest predictor ($\beta = 0.484$, $p < 0.001$; 95% CI = 0.36–0.51), suggesting that students who actively monitor and regulate their learning are substantially more agile in adapting to new clinical challenges.

The direct influence of learning agility on clinical competence is presented in Table 6. Simple linear regression demonstrated that learning agility alone explained 53.0% of the variance in clinical competence ($R^2 = 0.530$, $F = 398.31$, $p < 0.001$). Learning agility showed a strong standardized effect ($\beta = 0.728$, $p < 0.001$), with a narrow 95% confidence interval for the unstandardized coefficient (0.71–0.85), underscoring its role as a powerful determinant of clinical competence.

Finally, mediation analysis results summarized in Table 7 confirmed the hypothesized indirect pathways. Learning agility partially mediated the relationship between clinical placement quality and clinical competence.

The total effect of clinical placement quality on competence was significant ($\beta = 0.600$, $p < 0.001$; 95% CI = 0.462–0.738) and remained significant after accounting for learning agility (direct effect $\beta = 0.420$, $p < 0.001$; 95% CI = 0.263–0.577). The indirect effect through learning agility was also statistically significant ($\beta = 0.180$, $p < 0.001$), with a bootstrapped 95% confidence interval of 0.090 to 0.275, confirming partial mediation.

A similar pattern was observed for metacognitive awareness. The direct effect on clinical competence was significant ($\beta = 0.380$, $p < 0.001$; 95% CI = 0.204–0.556), and the indirect effect via learning agility was likewise significant ($\beta = 0.150$, $p < 0.001$; 95% CI = 0.074–0.229). Together, these findings indicate that while clinical placement quality and metacognitive awareness exert direct effects on clinical competence, a substantial proportion of their

influence is transmitted through students' capacity to learn adaptively from clinical experience.

Table 1. Demographic characteristics of participants (N = 348)

Variable	Category	n	%
Gender	Female	317	91.1
	Male	31	8.9
Age group	< 25 years	81	23.3
	26–45 years	144	41.4
	45–55 years	93	26.7
	> 55 years	30	8.6
Educational qualification	Bachelor's degree	348	100
Clinical exposure	1 year	136	39.1
	2–2.5 years	139	39.9
	5–10 years	38	10.9
	> 10 years	35	10.1

Table 2. Descriptive statistics and reliability of study variables (N = 348)

Variable	No. of items	Mean ± SD	Range	Cronbach's α
Clinical placement quality	14	3.91 ± 0.74	2–5	0.94
Metacognitive awareness	13	3.56 ± 1.02	1–5	0.96
Learning agility	12	3.60 ± 0.96	1–5	0.93
Clinical competence	12	3.65 ± 0.96	1–5	0.95

Table 3. Pearson correlation matrix among study variables (N = 348)

Variables	1	2	3	4
1. Clinical placement quality	1			
2. Metacognitive awareness	0.417***	1		
3. Learning agility	0.444***	0.705***	1	
4. Clinical competence	0.469***	0.605***	0.625***	1

Table 4. Multiple regression predicting clinical competence (N = 348)

Predictor	B	SE	β	t	p	95% CI
Clinical placement quality	0.237	0.050	0.238	4.69	<0.001	0.14–0.34
Metacognitive awareness	0.515	0.049	0.531	10.50	<0.001	0.42–0.61

Table 5. Multiple regression predicting learning agility (N = 348)

Predictor	B	SE	β	t	p	95% CI
Clinical placement quality	0.371	0.039	0.399	9.40	<0.001	0.29–0.45
Metacognitive awareness	0.437	0.038	0.484	11.40	<0.001	0.36–0.51

Table 6. Simple regression predicting clinical competence from learning agility (N = 348)

Predictor	B	SE	β	t	p	95% CI
Learning agility	0.782	0.039	0.728	19.96	<0.001	0.71–0.85

Table 7. Mediation analysis of learning agility (PROCESS Model 4, N = 348)

Pathway	Effect	SE	p	95% Bootstrapped CI
CPQ → CC (total effect)	0.600	0.070	<0.001	0.462–0.738
CPQ → CC (direct effect)	0.420	0.080	<0.001	0.263–0.577
CPQ → LA → CC (indirect effect)	0.180	0.050	<0.001	0.090–0.275
Metacognition → CC (direct effect)	0.380	0.090	<0.001	0.204–0.556
Metacognition → LA → CC (indirect effect)	0.150	0.040	<0.001	0.074–0.229

This figure synthesizes the mediation findings by simultaneously displaying the standardized total, direct, and indirect effects of clinical placement quality and metacognitive awareness on clinical competence, with learning agility as the mediating mechanism. The total effect of clinical placement quality on competence was substantial (β = 0.600, 95% CI 0.462–0.738), with a large proportion retained as a direct effect after accounting for learning agility (β = 0.420, 95% CI 0.263–0.577), while the indirect pathway through learning agility remained statistically meaningful (β = 0.180, 95% CI 0.090–0.275). A parallel but slightly attenuated pattern was observed for metacognitive awareness, where the direct effect on competence (β = 0.380, 95% CI 0.204–0.556) exceeded the indirect effect via learning agility (β = 0.150, 95% CI 0.074–0.229).

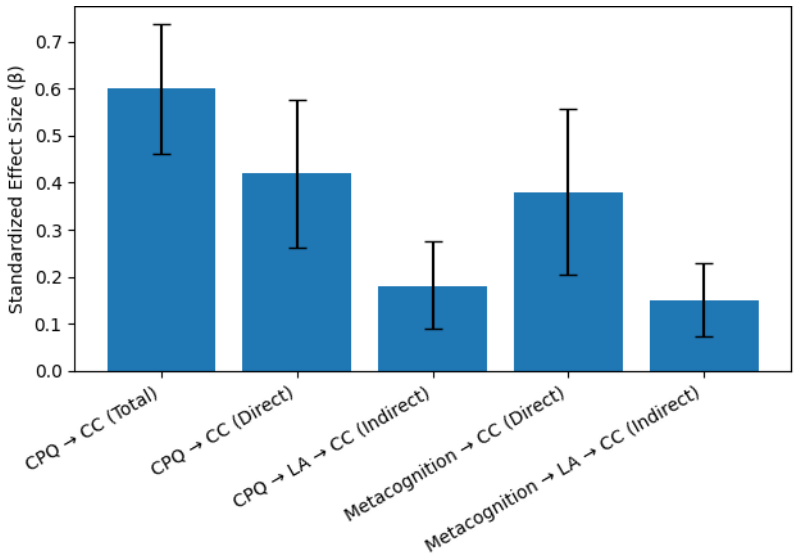

Figure 1 Direct and Indirect Effects Linking Learning Conditions to Clinical Competence

The non-overlapping confidence bands across total, direct, and indirect effects indicate partial mediation rather than full mediation, highlighting learning agility as a clinically and educationally significant pathway that translates both environmental quality and cognitive self-regulation into measurable competence gains. Collectively, the gradient of effect sizes underscores that while high-quality placements and metacognitive awareness independently strengthen clinical competence, their impact is amplified when students demonstrate strong adaptive learning capacity, reinforcing learning agility as a key leverage point for nursing education interventions.

DISCUSSION

The present study examined how clinical placement quality and metacognitive awareness influence clinical competence among undergraduate nursing students, with learning agility tested as a mediating mechanism. The findings provide robust empirical support for an integrated model in which environmental quality, cognitive self-regulation, and adaptive learning behavior jointly shape competence development. Across all analyses, the relationships were statistically significant, moderately to strongly sized, and internally consistent, underscoring that competence formation in nursing education cannot be explained by clinical exposure alone but depends on how students cognitively engage with and adapt to their clinical learning environments.

Clinical placement quality emerged as a significant predictor of both learning agility and clinical competence. Students who perceived their placements as well-structured, supportive, and feedback-oriented reported higher competence levels ($\beta = 0.238$, $p < 0.001$), consistent with prior evidence linking the clinical learning environment to skill acquisition, confidence, and readiness for practice (26,27). Importantly, the total effect of clinical placement quality on competence ($\beta = 0.600$, 95% CI 0.462–0.738) exceeded its direct effect after accounting for learning agility ($\beta = 0.420$), indicating that a meaningful proportion of placement quality's influence operates through students' adaptive learning responses. This finding extends earlier work that treated placement quality primarily as a direct determinant of competence by demonstrating a behavioral pathway through which high-quality environments exert their effects (28). In practical terms, placements that encourage feedback-seeking, reflection, and problem-solving appear to cultivate agility-related behaviors that translate experiential exposure into clinically meaningful performance gains.

Metacognitive awareness showed an even stronger direct association with clinical competence ($\beta = 0.531$, $p < 0.001$) and was the strongest predictor of learning agility ($\beta = 0.484$, $p < 0.001$). These results align with self-regulated learning theory, which posits that learners who actively plan, monitor, and evaluate their learning are better positioned to adapt strategies and improve performance in complex tasks (29). Prior studies have demonstrated that metacognitive skills are associated with academic achievement and reflective capacity in nursing students (30), but the present findings advance this literature by quantifying their role within a mediation framework linking cognition to competence via adaptive behaviour. The significant indirect effect of metacognitive awareness on competence through learning agility ($\beta = 0.150$, 95% CI 0.074–0.229) suggests that cognitive insight alone is insufficient unless it is accompanied by behavioral flexibility and experiential learning responsiveness.

Learning agility emerged as a central construct in the model, exerting a strong independent effect on clinical competence ($\beta = 0.728$, $p < 0.001$) and explaining 53.0% of the variance when considered as a sole predictor. This magnitude exceeds that of both placement quality and metacognitive awareness when modelled independently, highlighting agility as a key proximal determinant of competence. These findings are consistent with growing evidence in nursing and healthcare contexts that agility-related behaviors—such as learning from feedback, adapting to uncertainty, and transferring knowledge across contexts—are critical for effective clinical performance (31,32). From an experiential learning perspective, learning agility reflects the active experimentation phase of Kolb's cycle, where reflection is transformed into improved action (33). The present study empirically substantiates this theoretical link by demonstrating that agility partially mediates both environmental and cognitive influences on competence.

The mediation analyses further clarify the nature of these relationships. In both mediation pathways, learning agility acted as a partial rather than full mediator, indicating that clinical placement quality and metacognitive awareness retain direct effects on competence beyond their influence through agility. This pattern suggests that high-quality placements may directly enhance competence through opportunities for supervised practice and skill rehearsal, while metacognitive awareness may directly support sound clinical judgement and error recognition (27,30). At the same time, the statistically significant indirect effects confirm that adaptive learning behavior is a critical mechanism that amplifies these influences. This nuanced finding reconciles earlier mixed evidence on whether learner characteristics or environmental factors are more influential by demonstrating that their effects are interdependent rather than competing (34).

From a contextual perspective, these findings are particularly relevant for nursing education in resource-constrained settings, where variability in clinical placement quality is common. In such contexts, fostering learning agility and metacognitive awareness may serve as compensatory strategies that enable students to derive greater learning value even from less optimal placements (35). Educational interventions such as structured reflection, guided debriefing, simulation-based exposure to novel scenarios, and feedback literacy training may therefore enhance competence not only directly but also indirectly by strengthening agility-related behavior's (36). The results suggest that curricular reforms focusing exclusively on increasing clinical hours without addressing learning processes may yield limited returns.

Despite its strengths, this study has limitations that should be considered when interpreting the findings. The cross-sectional design precludes causal inference and does not allow examination of how competence, metacognition, or agility evolve over time. Although mediation analysis provides insight into plausible mechanisms, longitudinal or experimental designs are needed to confirm temporal ordering (37). Additionally, clinical competence was assessed using self-reported measures, which may be influenced by self-perception bias. However, prior research indicates that self-assessed competence is meaningfully related to observed performance when reliable instruments are used (38). The single-institution sampling frame may also limit generalizability, although the demographic profile of the sample is typical of undergraduate nursing populations in similar settings.

In summary, the study provides compelling evidence that clinical competence in nursing students is shaped by an interplay of placement quality, metacognitive awareness, and learning agility. By empirically demonstrating learning agility as a key mediating mechanism, the findings move beyond descriptive associations and offer a theoretically grounded explanation of how clinical learning experiences are converted into professional capability. These insights support a shift in nursing education from a predominantly exposure-based model toward one that deliberately cultivates reflective and adaptive learning capacities, thereby strengthening clinical competence and, ultimately, patient care quality.

CONCLUSION

This study demonstrates that clinical competence among undergraduate nursing students is shaped by an interdependent combination of clinical placement quality, metacognitive awareness, and learning agility. High-quality clinical placements and strong metacognitive awareness were shown to exert both direct and indirect effects on competence, with learning agility functioning as a critical mediating mechanism that translates environmental and cognitive inputs into effective clinical performance. The strength of learning agility as a predictor underscores the importance of adaptive learning behaviors—such as reflection,

feedback utilization, and flexible knowledge transfer—in bridging the theory–practice gap. These findings highlight that competence development extends beyond clinical exposure alone and requires deliberate educational strategies that foster reflective cognition and adaptability. By integrating structured clinical supervision, metacognitive skill development, and agility-oriented learning approaches into nursing curricula, educational institutions can more effectively prepare students for safe, competent, and resilient professional practice within complex healthcare environments.

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DECLARATIONS

Ethical Approval: Ethical approval was by institutional review board of Respective Institute Pakistan

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Concept: AS, NF; Design: RN; Data Collection: SR; Analysis: NF, SU; Drafting: IS

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