

ORIGINAL ARTICLE

Disentangling the Clinical Environment from the Self-System: A Social Cognitive Theory Analysis of Radiologic Technology Student Performance

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ABSTRACT

Background: Clinical performance in radiologic technology develops inside a workplace that can either expand or restrict opportunities for students to act. Social Cognitive Theory offers a useful way to separate environmental influences from personal beliefs while preserving their reciprocal relation. **Objective:** This study examined how the clinical environment and the student self-system jointly shaped the performance of fourth-year Radiologic Technology students during clinical education at Iligan Medical Center College. **Methods:** A theory-informed longitudinal qualitative case study involved 21 fourth-year students from August 2024 to March 2025. Each participant completed two semistructured interviews. The guide addressed procedure access, supervision, feedback, confidence, emotional responses, self-regulation, autonomy, and perceived performance changes. Data were analyzed through abductive reflexive thematic analysis, with Social Cognitive Theory used as a sensitizing framework rather than a fixed coding template. **Results:** Six themes described three linked processes: environmental opportunity, self-system adaptation, and reciprocal performance. Case exposure and equipment access set practical limits on participation; supervision and psychological safety determined whether students could enter the performance space; mastery experiences produced more calibrated self-efficacy; self-regulation helped students convert anxiety into task focus; credible performance increased supervisor trust and autonomy; and student agency remained constrained when rare procedures or service pressures reduced access. **Conclusion:** Clinical performance was neither an environmental product nor an expression of confidence alone. It developed through repeated reciprocal exchanges among opportunity, feedback, self-efficacy, self-regulation, behavior, and earned autonomy. Programs should therefore pair equitable clinical exposure with structured feedback, graded independence, and simulation for experiences that clinical service cannot reliably provide.

I. INTRODUCTION

Radiologic technology education depends on an unusually tight connection between academic preparation and real clinical work. Students must learn to translate anatomy, positioning principles, image evaluation, radiation protection, patient communication, professionalism, and equipment operation into safe action under variable service conditions. The clinical department is therefore more than a site where previously learned knowledge is rehearsed. It is a social and technical system in which students encounter time pressure, unequal case exposure, different supervisory styles, unfamiliar equipment, unpredictable patients, and changing expectations for independence. Recent radiography research has shown that the quality of the clinical learning environment matters for competence development, experiential learning, inclusion, and the opportunity to put theory into practice (O'Connor & McNulty, 2024). Qualitative evidence likewise indicates that resource adequacy, supervisor support, and access to hands-on work can alter the quality of placement experience and students' willingness to participate (Ago et al., 2025; Shafuda et al., 2025).

The importance of environment, however, does not imply that students who share the same placement learn or perform in the same way. Clinical performance also reflects the beliefs and regulatory processes that students bring to a task. Two students may observe the same examination, receive the

same instruction, and face the same workload yet respond differently because they differ in perceived capability, emotional arousal, willingness to ask for help, persistence after error, and ability to plan or monitor their own actions. In radiography education, targeted practice and effective feedback have been described by students as central to learning because they permit repeated task execution, self-assessment, correction, and movement toward independent performance (Ingrassia, 2022). Simulation studies also show that confidence and clinical readiness can change when students receive protected opportunities to rehearse technical and communicative skills before or alongside placement (Partner et al., 2022; Wilkinson & Cadogan, 2023). These findings suggest that the clinical environment acts partly through the student's interpretation of opportunity and capability, not only through the objective availability of cases or supervisors.

Social Cognitive Theory provides a coherent framework for this problem because it rejects one-way explanations of behavior. Bandura (1986) proposed reciprocal determinism, in which personal factors, behavior, and environmental conditions influence one another over time. Within this system, self-efficacy is especially important because judgments of capability affect task choice, effort, persistence, emotional response, and the use of self-regulatory strategies. Self-efficacy is not equivalent to optimism or global self-confidence. It is task- and context-sensitive, and it may strengthen through mastery experience, vicarious observation, social persuasion, and the

interpretation of physiological or affective states. In clinical education, these sources are embedded within ordinary placement events: a successful mobile examination can function as mastery experience, observation of a skilled radiographer can provide a vicarious model, specific feedback can operate as social persuasion, and anxiety during a difficult case can be interpreted either as evidence of incapacity or as a manageable signal that more preparation is needed.

The value of this framework is particularly clear in radiography because much clinical learning occurs at the boundary between observation and legitimate performance. Lundvall et al. (2021) described how radiography students develop professional knowing through observation, embodied action, and encounters with unexpected situations. Yet students do not control all opportunities to cross that boundary. Workload, staffing, modality access, patient complexity, and the judgment of supervisors shape whether a learner may observe, assist, perform under direct supervision, or act with greater independence. Research in lower-resource settings has documented equipment limitations, staffing constraints, variable supervision, and gaps between curriculum expectations and actual placement opportunities (Kumsa et al., 2022; Shafuda et al., 2025). Even in better-resourced contexts, radiographers report that clinical workload and organizational support can restrict the quality of student supervision (Young et al., 2023). The environment therefore sets conditions for performance, but the student's behavior may also change those conditions when competence, initiative, and reliability alter the level of trust granted by supervisors.

This reciprocal possibility is often obscured when studies treat the clinical learning environment and student confidence as separate explanatory variables. Environmental research tends to ask whether placements provide adequate supervision, equality, resources, and learning opportunities, while learner-centered research often examines confidence, resilience, or preparedness. Both approaches are useful, but they can leave the mechanism between context and performance underspecified. For example, a supportive supervisor may improve learning because the supervisor offers technically sound instruction, because the student feels psychologically safe enough to attempt a procedure, because positive feedback raises self-efficacy, because feedback directs self-regulation, or because all of these processes reinforce one another. Conversely, a busy department may limit learning because it reduces case access, because students become passive observers, because repeated exclusion weakens efficacy beliefs, or because students respond by increasing preparation and strategically seeking opportunities elsewhere in the rotation. A theory-guided qualitative approach can preserve these distinctions without reducing them to isolated scores.

Recent radiography literature also points to the interpersonal character of clinical adaptation. Thomas et al. (2025) found that interactions with patients, radiographers, lecturers, and peers can influence student resilience in the clinical environment. Ago et al. (2025) similarly reported that inclusive teamwork and supportive supervision can motivate students, whereas hurtful feedback and limited hands-on access can reduce well-being and engagement. Such findings support the idea that feedback is not merely information about correctness. Its timing, specificity, tone, and relationship context may influence whether students interpret difficulty as a correctable performance gap or as evidence that they do not belong in the clinical space. This distinction is central to Social Cognitive Theory because environmental cues become behaviorally important through cognitive and affective appraisal.

The transition to the fourth year offers a particularly useful point for examining these processes. Senior students are expected to demonstrate increasing technical fluency, professional judgment, patient-centered communication, and safe independence, yet they still depend on placement structures and supervisor authorization. Their performance is therefore mature enough to reveal established self-regulatory habits but still sensitive to environmental gatekeeping. In addition, final-year students can compare current behavior with earlier stages of training and can describe how confidence becomes more calibrated after repeated success, corrective feedback, and exposure to complex cases. A longitudinal design across an extended clinical period can capture these changes more effectively than a single end-of-placement interview.

Evidence specific to Philippine Radiologic Technology education remains limited in the international literature, while much of the contemporary evidence base comes from European, African, and Australasian settings. Context matters because clinical service organization, student-supervisor ratios, equipment availability, curricular sequencing, and cultural expectations

for deference or initiative can shape how students gain access to practice. A single-institution case study cannot represent all Philippine programs, but it can offer detailed process evidence from a defined educational setting and generate propositions that other programs can examine. The present study therefore focused on one fourth-year cohort at Iligan Medical Center College during the August 2024 to March 2025 clinical education period.

The study had three aims. First, it sought to describe how clinical environmental conditions shaped students' opportunities to perform and their perceived quality of performance. Second, it examined how self-system processes, especially self-efficacy, emotional appraisal, and self-regulation, changed across the clinical period and influenced action. Third, it analyzed how environment, personal factors, and performance behavior affected one another over time. The central research question was: How do the clinical environment and the student self-system interact to shape the clinical performance of fourth-year Radiologic Technology students? By using Social Cognitive Theory as an analytic lens rather than as a predetermined answer, the study aimed to disentangle environmental constraint from personal agency while preserving the reciprocal structure through which both become consequential.

II. METHODS

Study Design and Theoretical Orientation

A theory-informed longitudinal qualitative case study design was used to examine performance within one bounded educational setting. The case was defined as the fourth-year Radiologic Technology cohort of Iligan Medical Center College during its clinical education period from August 2024 through March 2025. A longitudinal approach was selected because the study question concerned change in confidence, regulation, autonomy, and perceived performance across repeated clinical encounters rather than a single retrospective judgment. The design was qualitative because the analytic interest centered on mechanisms, interpretations, and reciprocal processes that are difficult to infer from scale scores alone.

Social Cognitive Theory served as a sensitizing framework. The analysis attended to environmental conditions, personal factors, behavior, reciprocal determinism, self-efficacy, self-regulation, vicarious learning, social persuasion, and affective or physiological cues, while remaining open to patterns not anticipated by the theory (Bandura, 1986). The researchers did not assign interview statements directly to theory categories at the first coding stage. Instead, initial coding stayed close to participants' accounts of actual clinical events, after which theory was used to compare and organize relations among opportunity, interpretation, action, and subsequent environmental response. This abductive sequence reduced the risk that a familiar theory would simply reproduce its own constructs in the results.

The study was positioned within a contextualist qualitative orientation. Participants' accounts were treated as situated descriptions of how they understood and acted within clinical practice, not as direct measurements of an objective environment or stable personality traits. The analysis therefore asked both what students reported and what conditions made those reports plausible within the case. This orientation is compatible with reflexive thematic analysis, which recognizes the active role of researchers in theme development and does not treat coding agreement as a substitute for interpretive rigor (Braun & Clarke, 2021a, 2022). Reporting was developed with reference to the Consolidated Criteria for Reporting Qualitative Research for interviews and focus groups (Tong et al., 2007).

Setting and Participants

Iligan Medical Center College is a private higher education institution in Iligan City, Philippines, that offers a Bachelor of Science in Radiologic Technology program with classroom, laboratory, and clinical education components. The study focused only on students enrolled at this institution. During the study period, fourth-year students completed supervised clinical education in affiliated diagnostic imaging departments, where they encountered routine and advanced imaging workflows according to site availability, curricular requirements, and supervisor authorization. The unit of analysis remained the student experience within the IMCC clinical education system rather than the comparative performance of individual placement sites.

Criterion-based sampling was used. Eligible participants were fourth-year Radiologic Technology students enrolled in the clinical education component during August 2024 to March 2025, at least 18 years old, and willing to complete both interview waves. Students on leave from the clinical program for most of the study period were excluded because they could not provide longitudinal accounts of exposure and performance. All 21 eligible students in the cohort agreed to participate and completed both interviews. The sample therefore represented the full eligible cohort rather than a selected high-performing or highly engaged subgroup. Sample adequacy was judged through information power rather than a numerical saturation rule because the study had a narrow aim, a highly specific sample, repeated interviews, a defined theoretical frame, and rich within-participant comparison (Malterud et al., 2016).

Data Collection

Data collection occurred in two interview waves so that the analysis could compare early or middle placement experiences with near-completion accounts. Wave 1 took place from November to December 2024 after participants had accumulated several months of clinical exposure. Wave 2 took place from February to March 2025 near the end of the fourth-year clinical period. Each participant therefore contributed two individual semistructured interviews, for a total of 42 interviews. Interviews were conducted in a private room on campus or through a secure video platform when clinical schedules prevented an in-person meeting. No clinical instructor or faculty member responsible for participant grading was present during interviews.

The interview guide was developed specifically for this study from Social Cognitive Theory and contemporary radiography education literature. It was reviewed for clarity, construct coverage, neutrality, and clinical relevance by one radiologic technologist with clinical education experience and one qualitative health professions researcher. A pilot interview was conducted with a recent graduate who met the educational background of the target group but was not part of the study. The pilot led to simpler wording of two prompts and the addition of a follow-up question that asked participants to describe what happened after a supervisor granted or withheld greater independence. No pilot data were included in the analysis.

The core interview prompts were the same across participants, although probes varied according to the clinical event described. The guide asked participants to: describe a recent examination in which they believed they performed well; describe a recent examination in which performance was difficult; identify environmental conditions that made participation easier or harder; explain how supervisors decided when they could attempt a procedure; describe feedback that changed what they did on a later case; compare their confidence at the start of the clinical period with their current confidence; explain what they did before, during, and after an unfamiliar or high-pressure task; describe how they responded after an error or correction; identify situations in which observation of a radiographer or peer changed their own approach; and describe occasions when their own initiative, preparation, or prior performance changed how staff treated them or how much independence they received. Wave 2 added explicit comparison prompts about change since Wave 1 and asked participants to identify areas where greater confidence had not produced greater opportunity.

Interviews lasted 43 to 71 minutes in Wave 1 and 39 to 68 minutes in Wave 2, with a combined recorded duration of approximately 38.4 hours. With written permission, all interviews were digitally audio-recorded and transcribed verbatim. Identifying references to patients, clinical sites, individual radiographers, and classmates were removed during transcription. Participants were assigned codes P1 through P21 and retained the same code across both waves. Interviewers wrote a short reflexive memo after each session to document contextual observations, assumptions, unexpected claims, and questions to revisit during analysis. Participants received a brief written summary of the principal points attributed to them after each interview and could correct factual inaccuracies or clarify meaning. Six participants supplied minor clarifications; none requested removal of substantive material.

Researcher Positioning and Reflexivity

Because educational research within a single institution can create perceived power differences, several procedural safeguards were used. Recruitment

materials emphasized that participation was voluntary, refusal had no academic consequence, and interview data would not be available to clinical instructors or faculty responsible for grading. Interviews were scheduled outside formal evaluation encounters. Where a member of the research team had an educational role in the program, that person did not recruit participants and did not conduct interviews with students whom the person directly assessed during the study period. The analytic dataset replaced names with participant codes before theme development.

Reflexivity was treated as an analytic practice rather than as a one-time disclosure. The lead analyst maintained a reflexive journal that separated descriptive notes from interpretive hypotheses and explicitly tracked assumptions about what constitutes a supportive clinical environment, confidence, and competent student behavior. During theme development, the team reviewed examples that contradicted early patterns, including students who maintained confidence despite poor access and students who had abundant exposure but remained reluctant to act. These deviant cases were used to refine boundaries between environmental opportunity and self-system response rather than being treated as noise.

Data Analysis

Data were managed in NVivo 14 and analyzed through reflexive thematic analysis with an abductive, longitudinal strategy. The first stage involved repeated reading of each participant's Wave 1 and Wave 2 transcripts as a paired case. Analysts wrote case summaries that described major clinical events, perceived changes in capability, supervisory relationships, self-regulatory strategies, and changes in granted autonomy. The second stage used open coding at semantic and interpretive levels. Codes captured concrete conditions such as low case volume, time pressure, equipment access, direct supervision, corrective feedback, peer comparison, anxiety, preparation, help-seeking, repeated practice, and increased independence, as well as process codes such as waiting for permission, proving reliability, recovering after correction, and seeking another opportunity.

The third stage compared codes across participants and time. Matrices were created with participants as rows and Wave 1 or Wave 2 as columns to identify whether a pattern represented a stable condition, a change process, or a context-specific exception. The fourth stage introduced Social Cognitive Theory as an organizing lens. Rather than forcing every code into one theoretical category, analysts asked whether a candidate theme primarily described an environmental opportunity structure, a personal appraisal or regulatory process, a behavioral response, or a reciprocal sequence in which one domain altered another. Candidate themes that only renamed a theoretical construct without adding a patterned account of the data were rejected.

The fifth stage involved iterative theme construction, review, and refinement. Each theme was required to have a clear central organizing concept, sufficient data across participants, internal coherence, and meaningful distinction from other themes. Theme boundaries were tested against negative cases and against the longitudinal matrices. For example, early coding combined supervision and confidence, but analysis showed that supervisor behavior had two analytically distinct roles: it controlled access to performance and it supplied social persuasion through feedback. The final map retained supervision within the environmental themes while locating changes in efficacy and regulation within self-system themes. A separate reciprocal theme then captured how demonstrated performance altered supervisor trust and subsequent autonomy.

Consistent with reflexive thematic analysis, interrater reliability coefficients were not calculated because themes were treated as interpretive analytic outputs rather than discoverable units whose quality depends on coder agreement (Braun & Clarke, 2021a). Rigor was supported instead through a documented audit trail, paired longitudinal case summaries, peer examination of the thematic map, explicit review of disconfirming cases, and repeated checks between claims and source excerpts. A second qualitative researcher who had not conducted the interviews reviewed the codebook snapshot, six full transcripts, all case summaries, and successive theme definitions. Differences were discussed to challenge assumptions and improve analytic precision, not to produce a numerical consensus score.

Trustworthiness

Credibility was supported through repeated engagement with the same participants, event-focused interview prompts, within-participant comparison

over time, participant clarification of interview summaries, and the use of contradictory cases during theme review. Dependability was supported through dated analytic memos, versioned theme maps, coding notes, and a decision log that documented why codes were combined, separated, renamed, or excluded. Confirmability was strengthened through reflexive journaling and external examination of analytic decisions. Transferability was addressed through detailed description of the institutional case, student level, clinical period, and the mechanisms through which placement conditions and self-system processes interacted. The study did not claim statistical representativeness beyond the case.

The analytic endpoint was reached when the final themes provided a coherent account of the research aims, all 21 longitudinal cases could be located meaningfully within the theme structure, and additional review no longer changed the central organizing concepts. This decision followed the logic of information power and reflexive thematic analysis rather than a claim that no new code could ever occur (Braun & Clarke, 2021b; Malterud et al., 2016).

III. RESULTS

All 21 participants completed both interview waves, yielding 42 transcripts. Ages ranged from 21 to 24 years, and all participants had continuous fourth-year clinical exposure during the August 2024 to March 2025 period aside from ordinary schedule variation. Every participant described experience in general radiographic work, while exposure to less frequent procedures or advanced modalities varied according to placement assignment and service demand. No participant withdrew after the first interview.

The analysis produced six themes organized under the three study aims. Theme prevalence was recorded descriptively to show how widely a pattern appeared across the 21 cases, but prevalence did not determine thematic importance. Several themes were present in the same clinical event because a single examination could include environmental access, efficacy appraisal, self-regulation, and a subsequent change in supervisor trust.

Table 2
Theme Structure Across the Three Research Aims

Research aim	Theme	Primary analytic focus	Participants describing pattern
Environmental conditions	1. Access precedes competence: opportunity sets the ceiling for performance	Opportunity structure	20/21
Environmental conditions	2. Supervision opens or closes the performance space	Supervision and psychological safety	19/21
Self-system processes	3. Mastery replaces borrowed confidence with calibrated self-efficacy	Self-efficacy	21/21
Self-system processes	4. Self-regulation converts anxiety into deliberate action	Self-regulation and affect	18/21
Reciprocal interaction	5. Credible performance earns trust, and trust expands autonomy	Reciprocal determinism	20/21
Reciprocal interaction	6. Agency reaches a boundary when exposure is structurally scarce	Constraint on reciprocal agency	16/21

Aim 1: How Clinical Environmental Conditions Shaped Performance

Theme 1. Access Precedes Competence: Opportunity Sets the Ceiling for Performance

Twenty participants described case availability, patient volume, equipment access, and permission to perform as prior conditions for what they could demonstrate clinically. Across both waves, students distinguished knowing how a procedure should be done from having enough real opportunities to execute it repeatedly under authentic service conditions.

P4: "I could study the projections many times, but if the case did not come during my rotation, I still could not say I had performed it confidently."

P17: "On busy days I learned more because cases kept coming, but only if someone allowed me to take the patient instead of just watching."

P9: "There were procedures I understood in theory, but I had only one actual chance. My performance stayed uncertain because repetition was missing."

Wave 1 accounts often described competition for cases, uneven modality exposure, or a need to wait until service demands permitted student participation. By Wave 2, most participants could identify procedures in which repeated exposure had produced smoother positioning, faster preparation, clearer patient instructions, and fewer prompts from supervisors, while infrequent procedures remained slower and more dependent on guidance.

Theme 2. Supervision Opens or Closes the Performance Space

Nineteen participants described supervisors as gatekeepers of participation as well as sources of instruction. Students reported greater willingness to attempt procedures when supervisors gave clear expectations, remained available for safety, and corrected errors without public embarrassment, whereas abrupt criticism or unexplained exclusion increased passivity.

P6: "When the radiographer said, "You do it and I will watch," I focused on the steps. When they just took over, I returned to being an observer."

P21: "I was not afraid of correction itself. I was afraid when correction felt like humiliation because after that I hesitated to volunteer again."

P2: "A supervisor who explained what was wrong made me want to repeat the case correctly. A supervisor who only said "wrong" made me unsure what to change."

Participants differentiated strict supervision from unsupportive supervision. Several students described demanding supervisors positively when expectations were explicit and feedback identified a correctable action, while the same students described difficulty with supervisors whose decisions about access or correction appeared inconsistent. In Wave 2, students more often reported adapting to supervisor preferences, yet they continued to describe psychological safety as relevant to whether they volunteered for unfamiliar cases.

Aim 2: How Self-System Processes Shaped Performance

Theme 3. Mastery Replaces Borrowed Confidence with Calibrated Self-Efficacy

All 21 participants described a shift from early confidence based mainly on classroom preparation or encouragement toward confidence tied to completed clinical tasks. By the second interview, students more often specified the procedures they could perform independently, the situations in which they still required assistance, and the evidence they used to judge readiness.

P3: "At first I said I was confident because I knew the lesson. Later I became confident because I had done the examination correctly more than once."

P14: "My confidence became more specific. I can say I am ready for routine chest and extremities, but I still ask for help when the case is unusual."

P11: "One successful case helped, but repeating it with different patients made the confidence feel real and not just something I was telling myself."

Seventeen participants explicitly contrasted confidence in Wave 1 with a more conditional assessment in Wave 2. They described less need for reassurance in familiar examinations, faster recovery after minor corrections,

and greater willingness to state when they were not yet ready for a complex procedure. Four participants also described occasions when early confidence decreased after exposure revealed task complexity, after which confidence increased again through supervised repetition.

Theme 4. Self-Regulation Converts Anxiety into Deliberate Action

Eighteen participants described anxiety, self-doubt, or fear of error during unfamiliar, high-pressure, or closely observed procedures, but they also described strategies used to preserve task performance. These strategies included reviewing protocols before duty, mentally sequencing steps, checking equipment early, rehearsing patient instructions, slowing down at critical points, asking targeted questions, and reviewing errors after the case.

P1: "Before a difficult case I repeat the sequence in my head so I do not let nervousness decide what I do next."

P12: "If I get corrected, I write the point down after duty. The next time I look for the same case because I want to fix that exact mistake."

P18: "I learned to ask a specific question instead of saying I do not know. That helped me continue the procedure without giving everything back to the staff."

Wave 1 descriptions contained more global statements such as being nervous or afraid to make mistakes. Wave 2 descriptions more often named a concrete response to those states, including preparation, self-checking, help-seeking, and deliberate repetition. Three participants continued to report strong hesitation in certain advanced or rare procedures despite using these strategies.

Aim 3: How Environment, Self-System, and Performance Changed One Another

Theme 5. Credible Performance Earns Trust, and Trust Expands Autonomy

Twenty participants described sequences in which their own behavior altered the clinical environment they subsequently encountered. Repeated punctuality, preparation, safe technique, appropriate patient communication, and successful completion of routine examinations were followed by greater supervisor trust, earlier invitations to take cases, fewer prompts, or permission to handle more of the workflow.

P8: "After they saw that I checked the patient and the exposure factors without being reminded, they started calling me when a case arrived."

P19: "The more I showed I could finish safely, the less they stood beside me for every step. That freedom also made me work more confidently."

P5: "I noticed that initiative changed the rotation. If I prepared the room before the patient came, the staff trusted me with the next part of the examination."

This reciprocal pattern was clearest in routine procedures with repeated exposure. Participants described a sequence from observation to assisted performance, to supervised independent performance, and finally to broader responsibility within the limits of student status. In several cases, one visible error temporarily reduced autonomy, after which students described rebuilding trust through correction and subsequent safe performance.

Theme 6. Agency Reaches a Boundary When Exposure Is Structurally Scarce

Sixteen participants described situations in which preparation, confidence, and initiative did not produce additional performance opportunities because the relevant case was rare, equipment was unavailable, the department was too busy, or service priorities required staff to complete the procedure quickly. These accounts marked a limit to personal agency because students could improve readiness but could not create an authentic patient case or override safety and workflow decisions.

P10: "I could volunteer every time, but I could not practice a procedure that never appeared during my schedule."

P16: "There were days I was ready to do more, but the department needed speed. The staff did the case, and my preparation could not change that."

P7: "Confidence helped me step forward when there was an opportunity. It did not help when the opportunity itself was missing."

By Wave 2, participants who reported persistent exposure gaps described three responses: seeking observation when performance was not permitted, asking supervisors to alert them when a relevant case arrived, and using laboratory or simulated review to preserve procedural knowledge. These responses increased perceived readiness but were not described as equivalent to repeated performance with real patients.

Cross-Theme Pattern Across the Clinical Period

Across the 21 longitudinal cases, the most common sequence began with environmental access, followed by supervised action, feedback, personal appraisal, self-regulatory response, and a later change in autonomy. Seventeen participants described at least one clear example in which a successful procedure increased confidence and supervisor trust at the same time. Fourteen described the reverse sequence at least once, where an error, hesitation, or unsupportive interaction reduced willingness to volunteer or temporarily reduced granted independence. Across the second interviews, participants more often described confidence as evidence-based and procedure-specific, but environmental constraints remained visible in accounts of rare procedures, advanced modalities, and high-workload periods.

IV. DISCUSSION

This study sought to disentangle the clinical environment from the student self-system without treating either as an isolated cause of performance. The findings support a reciprocal account. Environmental conditions determined whether meaningful performance opportunities existed, but students' efficacy beliefs and self-regulatory responses influenced whether they entered those opportunities, persisted through difficulty, learned from feedback, and converted prior performance into greater autonomy. The strongest contribution of the study is therefore not a claim that environment or confidence matters more. It is the identification of a process through which access, supervision, mastery, regulation, behavior, and trust become sequentially linked across clinical education.

The first theme showed that access precedes competence in a practical sense. Students could possess theoretical knowledge yet remain unable to demonstrate stable clinical performance when case exposure or permission to act was insufficient. This finding aligns with O'Connor and McNulty (2024), who identified opportunity to learn through work and the quality of supervision as central dimensions of the radiography clinical learning environment. Ago et al. (2025) similarly found that limited hands-on training and inadequate resources can reduce the value of clinical placement. In the present study, the same principle appeared at the level of individual performance: repeated exposure supported fluency, while infrequent exposure left students slower, more hesitant, and more dependent on prompts. The implication is that competence cannot be interpreted solely as a learner attribute when the curriculum does not provide reasonably equitable opportunities to enact the targeted behavior.

This point is consistent with Social Cognitive Theory because environmental structures do not simply surround behavior; they alter the options available for behavior. Bandura's (1986) reciprocal model allows environmental constraint to remain causally important even when learners are agentic. A student can prepare, seek feedback, and volunteer, but personal agency cannot generate a rare trauma case, repair unavailable equipment, or override a clinical decision made for patient safety. Theme 6 makes this boundary explicit. It corrects a common educational tendency to interpret missed performance opportunities as insufficient initiative. In some circumstances, the problem is not motivation but opportunity architecture.

The second theme extends this argument by showing that supervision controls both opportunity and psychological access. Students did not describe all strict supervision as negative. They valued supervisors who demanded safe performance, specified what needed correction, and remained available during difficult tasks. What reduced participation was inconsistency, unexplained takeover, or criticism that made volunteering socially risky. Young et al. (2023) showed from the radiographer perspective that workload, organizational support, and unclear expectations can hinder student supervision. The present findings show the corresponding learner consequence: when supervisory practice becomes unpredictable, students may protect themselves through passivity even when technical cases are available.

Feedback therefore operates through more than information transfer. Ingrassia (2022) found that radiologic technology students valued targeted practice paired with effective feedback and wanted sufficient independent opportunity to evaluate their own skills. Within Social Cognitive Theory, specific feedback can function as social persuasion, but its effect depends on credibility and its connection to action. The participants in this study distinguished between correction that identified an adjustable step and criticism that left the cause of error unclear. The former supported repeated attempts; the latter increased hesitation. This distinction matters for clinical educator development because a technically correct comment can still have weak educational value if it does not help the student understand the next behavior to change.

The third theme, calibrated self-efficacy, also sharpens the meaning of confidence in clinical education. Students did not simply become more confident across time. Their confidence became more differentiated. By Wave 2, many participants could name procedures they could perform reliably, conditions under which they would request help, and areas where confidence remained incomplete. That pattern is closer to self-efficacy than to generalized confidence because the judgment was specific to task and context. It also reflects the central role of mastery experience in Bandura's framework. A successful procedure supplied initial evidence, but repeated success across different patients provided stronger evidence that capability was transferable rather than accidental.

The observation that confidence sometimes decreased before it improved is especially important. Four participants entered clinical work with high expectations based on classroom success but revised those beliefs after exposure revealed the complexity of real patients, workflow, and equipment. This temporary decrease should not automatically be treated as a negative educational outcome. It may represent better calibration. Lundvall et al. (2021) described clinical learning as a process in which students reconstruct prior knowledge through embodied action and through unexpected situations. In that context, an initially lower efficacy judgment can be productive when it prompts more preparation and appropriately timed help-seeking rather than avoidance.

Simulation can support this calibration but cannot fully replace the clinical environment. Partner et al. (2022) found that simulation helped student radiographers move from anxiety toward confidence and skill development. Wilkinson and Cadogan (2023) also reported perceived benefits in student confidence and clinical performance after simulation-based education. The present findings suggest where simulation may have greatest value for senior students: not as a general substitute for clinical education, but as a targeted response to structurally scarce experiences. When rare cases or service pressure limit authentic repetition, simulation can preserve procedural sequencing, equipment familiarity, communication rehearsal, and error correction until a real opportunity appears. Theme 6 nevertheless indicates that students themselves viewed simulated review as preparation rather than as equivalent evidence of clinical mastery.

The fourth theme identified self-regulation as a mechanism that converted emotional arousal into action. Early accounts often presented anxiety as a global state, whereas later accounts described concrete regulatory strategies such as mental sequencing, protocol review, equipment checks, specific help-seeking, and deliberate pursuit of a previously difficult case. This shift matters because Social Cognitive Theory treats self-regulation as part of agentic behavior. The student is not simply acted upon by the placement. The student sets proximal goals, monitors performance, uses feedback, and adjusts behavior. These processes can preserve performance even when confidence is incomplete.

The finding also connects with recent evidence on resilience and clinical relationships. Thomas et al. (2025) showed that radiography students'

resilience is influenced by interactions with patients, radiographers, lecturers, and peers. In the present case, students did not describe resilience as a fixed trait. They described behaviors that allowed them to recover after correction, seek another opportunity, and separate one poor performance from a global judgment of capability. This suggests that programs can support resilience through concrete regulatory routines rather than relying on generic messages that students should be more resilient. Structured debriefing, error review, goal setting, and planned re-attempts provide observable practices through which resilience and self-efficacy can develop together.

Theme 5 offered the clearest evidence of reciprocal determinism. Students reported that competent and reliable behavior changed how supervisors treated them. Safe technique, preparation, appropriate communication, and initiative were followed by earlier invitations to take cases and reduced prompting. Increased autonomy then produced further performance opportunities and stronger efficacy beliefs. This reciprocal loop explains why two students in the same department can experience increasingly different learning environments over time. The environment is partly shared, but it is also personalized through the history of interaction between the learner and the clinical team.

This loop has an important equity implication. If early performance influences later access, small differences in first opportunities can compound. A student who receives supportive coaching during early attempts may perform well enough to earn trust, which yields more cases and more mastery experiences. Another student who is denied early attempts or receives ambiguous correction may appear less ready, receive fewer later opportunities, and accumulate less evidence of competence. The resulting difference may look like a stable difference in motivation or ability even though it began with unequal opportunity. Programs should therefore monitor not only total clinical hours but also the distribution of meaningful student performance across procedures and students.

Radiography research from resource-constrained environments strengthens this interpretation. Kumsa et al. (2022) identified infrastructure and placement challenges that can affect the acquisition of core skills, while Shafuda et al. (2025) described equipment shortages, understaffing, variable supervision, and the simultaneous development of independence and confidence. The present study adds a mechanism: structural limitations affect performance directly by reducing access and indirectly by altering the cycle through which mastery, trust, and autonomy accumulate. Even where gross resource limitations are less severe, local workflow can produce micro-level scarcity for particular procedures.

The findings support several curriculum and clinical education strategies. First, the program should map expected competencies against actual exposure and identify procedures for which authentic opportunities are predictably scarce. A simple exposure dashboard can flag students who have observed a procedure but have not performed it, or who have performed it too few times to develop stable self-efficacy. Second, supervisors should use graded autonomy with explicit criteria. Students should know what behaviors lead from observation to assisted performance and from supervised performance to greater independence. Third, feedback should be specific enough to direct the next attempt and should separate patient-safety correction from global judgments about the learner. Fourth, students should be taught self-regulatory routines, including pre-case planning, targeted question formation, post-case review, and deliberate re-attempt after correction.

A further implication concerns the design of faculty development for clinical supervisors. Supervisors need not choose between efficiency and education in every case, because service demands will sometimes require staff to take over. The educational risk arises when students cannot understand why access changed or what they must demonstrate to regain it. Brief explanations can preserve the reciprocal loop even when immediate hands-on opportunity is impossible. Likewise, protected feedback moments do not need to be lengthy if they identify what the student did, what should change, and what opportunity will allow the student to test that change. Research on supervision in radiography shows that practitioners often experience time and organizational barriers (Young et al., 2023); therefore, faculty development should include workflow-compatible feedback methods rather than idealized models that assume unlimited teaching time.

At the theoretical level, the study supports the usefulness of Social Cognitive Theory for radiography education because it prevents two forms of reductionism. An environment-only account can understate learner agency, while a self-efficacy-only account can individualize structural scarcity.

Reciprocal determinism accommodates both. It also helps explain why mastery experience, feedback, and autonomy are not independent educational inputs. They form a sequence. Opportunity permits behavior, behavior generates performance evidence, evidence alters self-efficacy and supervisor trust, and those changes influence the next opportunity. The sequence can be positive or negative, and it can be interrupted by structural constraints.

The study also demonstrates the value of a longitudinal qualitative approach. A single end-point interview might have produced a broad theme of increased confidence. Paired interviews showed that confidence changed in quality as well as level, and that some students first revised confidence downward before rebuilding it on clinical evidence. Longitudinal comparison also exposed the trust-autonomy loop because participants could describe how staff behavior changed after repeated performance. These process findings would be difficult to infer from a cross-sectional environmental score alone, even though instruments such as those used by O'Connor and McNulty (2024) remain valuable for program-level evaluation.

Taken together, the findings suggest that the most useful question for educators is not whether student performance comes from the learner or the environment. The better question is where the reciprocal cycle is currently blocked. In some cases the block is lack of opportunity. In others it is weak feedback, low self-efficacy, poor regulation after error, or lack of earned trust. Each block calls for a different intervention. This diagnostic use of Social Cognitive Theory can help clinical educators avoid generic remedies and target the mechanism that actually limits performance.

V. LIMITATIONS

The study was bounded to one fourth-year cohort at a single institution, which supports contextual depth but limits transferability to programs with different curricula, clinical partnerships, staffing patterns, or student populations. The findings should therefore be treated as analytic propositions about mechanisms rather than estimates of how frequently those mechanisms occur across Philippine Radiologic Technology programs.

The primary evidence came from student interviews. Although repeated interviews reduced sole reliance on a single retrospective account, the study did not independently score each participant's clinical performance or observe every event described. Participants may have interpreted supervisor behavior through their own confidence or recalled successful and difficult events selectively. Future work could triangulate student narratives with structured clinical observation, supervisor accounts, competency records, or prospective event diaries while preserving confidentiality and avoiding effects on grading.

A single-institution study also creates potential power dynamics between student participants and faculty researchers. Recruitment and interview safeguards reduced this risk, but social desirability cannot be excluded. Finally, the Social Cognitive Theory framework increased analytic focus but may have made some patterns more visible than others. The use of open initial coding, deviant-case analysis, reflexive memos, and external review was intended to reduce theoretical overreach, but other frameworks could generate different interpretations of the same clinical experiences.

VI. CONCLUSION

Clinical performance among fourth-year Radiologic Technology students developed through reciprocal exchanges between the clinical environment and the student self-system. Access to cases, equipment, supervision, and psychologically safe participation created the conditions in which performance could occur. Mastery experiences, calibrated self-efficacy, emotional appraisal, and self-regulation shaped how students used those conditions. Successful and reliable behavior then changed the environment by increasing supervisor trust and the degree of autonomy granted to the student.

The findings therefore argue against explanations that locate weak performance solely in student confidence or solely in placement quality. Programs should identify where the reciprocal cycle is interrupted and respond at that level. Equitable case exposure, clear criteria for graded autonomy, specific feedback, structured self-regulatory routines, and targeted simulation for scarce clinical experiences can work together to strengthen performance. Social Cognitive Theory is useful precisely because it preserves the student's agency while keeping structural opportunity visible.

Author Contributions

Ahmeda Ali: Investigation, Data curation, Project administration, Writing – original draft. Ma. Victoria Patrimonio: Formal analysis, Validation, Visualization, Writing – review & editing. Alinair Carim: Formal analysis, Validation, Visualization, Writing – review & editing. Mark Alipio: Conceptualization, Methodology, Supervision, Writing – review & editing. All authors have read and agreed to the published version of the manuscript.

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Ethics Approval and Informed Consent

The study was conducted in accordance with the ethical standards of the Declaration of Helsinki and approved by the Institutional Ethics Review Committee of Iligan Medical Center College. Written informed consent was obtained from all participating students prior to their inclusion in the study. All data were de-identified to ensure confidentiality, and it was explicitly communicated that participation was entirely voluntary and would not impact the students' academic standing or grades.

Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

The complete interview transcripts are not publicly available because they contain contextual information that could increase the risk of deductive identification within a small student cohort. Deidentified analytic materials, including the coding framework and thematic map, may be made available by the corresponding author upon reasonable request and subject to applicable ethics and institutional requirements.

Declaration of AI Use

During the preparation of this work, the authors utilized generative artificial intelligence technologies exclusively for language refinement, structural formatting, and copyediting. The AI system had no access to raw participant data and was not used to generate data, perform statistical analyses, or draw scientific conclusions. The authors independently reviewed, edited, and validated all content, and take full responsibility for the accuracy and integrity of the final publication.

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