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Co-Regulated Learning in Clinical Environments: From Individual Self-Regulation to Relational Regulation During Multidisciplinary Clinical Clerkships

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ABSTRACT : Clinical clerkships are frequently described as environments where medical students need to develop more self-control. Because learning during clerkships is inextricably linked to involvement in patient-care teams, this conceptualisation is useful but incomplete. This conceptual article makes the case that self-regulated learning (SRL) should be viewed as a relational achievement that alternates between self-, co-, and socially shared forms rather than as an individual ability. When a learner's goal-setting, method use, monitoring, emotion, and reflection are momentarily supported, redirected, or transformed by another person or a social interaction, this is known as co-regulated learning (CRL). Peers, residents, doctors, nurses, pharmacists, allied health professionals, patients, and material artefacts may all be involved in this kind of control in multidisciplinary clinical teams. In order to facilitate adaptive involvement, professional identity, and patient-safe learning, the study suggests a process model in which co-regulatory episodes are shaped by clinical affordances, network access, psychological safety, supervisory calibration, and feedback dialogue. It is incorrect to view CRL as the antithesis of autonomy. Instead, mature regulation includes understanding when a team has to work together to control a common therapeutic learning issue as well as recognising when, why, and from whom to seek help. Longitudinal team attachment, clear co-regulatory practices, interprofessional involvement, feedback follow-through, and evaluation of help-seeking and collaborative monitoring are some of the educational implications.

KEYWORDS: co-regulated learning, clinical clerkship, feedback, medical education, multidisciplinary teams, self-regulated learning, workplace learning

INTRODUCTION

Clinical clerkships, also known as co-assistantships or co-ass in Indonesia, take medical students from a somewhat regimented academic program into an unpredictable workplace where patient safety, teaching, and service delivery all take place at the same time. Incomplete information, erratic patient presentations, sudden shifts in workload, and fleeting interactions with supervisors are all things that students must learn from. Additionally, they work in multidisciplinary teams including interns, residents, attending physicians, nurses, pharmacists, dietitians, therapists, lab staff, and other professionals. While managing various learning possibilities, each profession offers a unique viewpoint on the patient. As a result, the student is unable to autonomously decide which cases will be offered, when observation will take place, how much responsibility may be taken on, or whose judgment determines safe performance. Whether ambiguity is revealed and help is sought is further influenced by stress, hierarchy, disjointed supervision, and the need to maintain credibility. SRL is still linked to medical education outcomes, especially during clerkships, according to recent research (Zheng & Sun, 2024), but social participation and regulation are inextricably linked due to the nature of clinical work.

Traditional SRL models emphasize on individual learner who sets objectives, chooses tactics, keeps track of performance, controls motivation and emotion, and evaluates outcomes. These procedures are still necessary, but an interprofessional setting with interdependence cannot be adequately framed in an individual-only manner. Clinical objectives are negotiated with supervisors; workflow and patient risk limit tactics; team members share monitoring; and performance is observed and interpreted by others to provide feedback. Therefore, re-situating SRL within a relational system rather than abandoning it is the important conceptual move. Self-, co-, and socially shared regulation should be integrated, according to Bransen et al. (2022a), because regulation evolves as tasks, expertise, and social arrangements do. An autonomous learner is one who can identify regulatory boundaries, mobilise the necessary competence, adjust independence to risk, and responsibly take part in group monitoring

rather than one who constantly operates alone. By connecting collaborative discussion with clinical problem-solving and interprofessional collaboration abilities, interprofessional teaching rounds demonstrate the educational usefulness of such involvement (Yang et al., 2025).

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A conceptual model of CRL during transdisciplinary clinical learning is developed in this paper. The boundaries between SRL, CRL, and socially shared regulation of learning are made clear; the contextual conditions and interactional mechanisms through which regulation changes are identified; and testable relationships between co-regulatory networks, psychological safety, supervisory calibration, feedback dialogue, learner agency, and team participation are proposed. By linking learning regulation to two related outcomes—patient-safe participation and interprofessional collaborative competence—the model aims to direct curriculum design and empirical research. The approach treats values and ethics, roles and responsibilities, interprofessional communication, teams, and teamwork as practices through which regulation is performed rather than as competencies acquired outside of clinical work, in accordance with the IPEC domains. As a result, CRL is positioned as a tool that teaches students how to share their knowledge, ask for assistance, negotiate roles, keep an eye on common objectives, and modify their behaviour in relation to other professions.

2. LITERATURE REVIEW

2.1 A Socio-Constructivist Perspective on Regulation

The foundation of a socio-constructivist viewpoint is the idea that engagement in historically and culturally structured activities produces learning. Higher-order capacities first emerge between individuals before being claimed and reorganised by individuals, according to the Vygotskian tradition. This development is mediated by language, questioning, modelling, feedback, and professional tools. Therefore, regulation is not only an internal executive function that comes before participation; interaction also shapes it. In clinical education, students engage with more competent or differently positioned individuals to learn how to observe, prioritise, judge, and act. A pharmacist's medication check, a resident's probing query, or a nurse's concern about worsening can rearrange the student's focus and action monitoring. By incorporating self-, co-, and socially shared regulation instead of treating social context as a background variable, contemporary regulation studies reflect this relational paradigm (Bransen et al., 2022a).

Because valid clinical engagement must be calibrated to both learner readiness and patient risk, the zone of proximal development is especially pertinent to co-assistantship. When support preserves chances for reasoning, decision-making, and reflection while enabling performance that the learner cannot yet organise independently, it is productive. A senior physician may provide pertinent support, but in a multidisciplinary setting, knowledge is dispersed. A pharmacist may encourage the reconciliation of conflicting medications, a physiotherapist may reframe functional evaluation, or a nurse may facilitate conversation with a disturbed family. These exchanges are instructive not just because they provide knowledge but also because they momentarily reorganise the student's regulatory process. In addition to teaching the learner when ongoing social regulation is required, repeated engagement can change external conversation into more complex self-questioning.

2.2 The Evolution from SRL to CRL and SSRL

SRL stands for regulation that is primarily focused on the objectives of a single learner. The student organises, puts tactics into practice, keeps an eye on performance and cognition, controls motivation and emotion, and evaluates outcomes. Information may be provided by others, but the principal ownership and regulatory goal are still personal. SRL is still essential for planning, intentional practice, and lifelong learning. Because therapeutic goals, possibilities, standards, and permits are socially negotiated, it is limited when viewed as a context-free personal capacity.

CRL explains how interactions between agents can stimulate, support, or disrupt transitional regulation. When a senior physician assists a student in transforming "improve clinical reasoning" into a case-specific objective and determines the appropriate level of autonomy, it might be asymmetrical. Complementary knowledge may also be involved, such as when a student and nurse work together to interpret minute changes in a patient's condition. While someone else temporarily directs planning, attention, monitoring, emotional regulation, or reflection, the learner may still be in charge of the learning objective. When risk grows, control may then transfer back to the supervisor, stay distributed, or return to the learner. Therefore, CRL is a dynamic bridge that facilitates the calibration and transfer of regulation rather than a straightforward cooperation or long-term reliance.

When members control a truly shared object instead of only assisting one learner's objective, SSRL takes place. A multidisciplinary team can work together to define a diagnostic issue, decide on priorities, assess the effectiveness of a care-and-communication plan, and adjust course of action in response to new information. The group is responsible for goal ownership, monitoring, and adaptation. The differences between SRL, CRL, and SSRL rely more on what is being regulated, who owns the aim, and how regulatory control is distributed than on the number of individuals physically present. A student may prepare individually, co-regulate reasoning with a resident, and then join the team to regulate a shared patient-care concern during a single clinical episode. This nested approach keeps CRL from being an imprecise synonym for teamwork, teaching, supervision, or feedback.

This developmental and networked interpretation is supported by empirical research. While the clerkship environment affects network size and tie strength, stronger and more frequent co-regulatory ties are linked to higher self-reported SRL in clerkships (Bransen et al., 2022b).

Additionally, as training advances, students tend to switch from peers to workplace supervisors for various purposes, such as goal discussion, approach selection, self-evaluation, and reflection (Bransen et al., 2022c). Therefore, as competence increases, social aid does not just disappear. Because they are able to choose partners whose knowledge meets the regulatory requirement and recognise epistemic boundaries, more advanced learners may co-regulate more selectively.

2.3. The Multidisciplinary Clinical-Rotation Context

Teaching hospitals are hierarchical professional systems, learning environments, and care organisations all at once. Students alternate between temporary teams where access to cases and conversations is determined by status, occupation, workload, and local customs. By making accountability clear, hierarchy helps safeguard patients, but it can also stifle inquiries, disclosure of ambiguity, and upward communication. Even when another profession has the most pertinent knowledge, students may prioritise the opinions of physicians due to professional boundaries. The issue is made worse by rotational discontinuity, where students frequently enter as peripheral newbies and have to figure out who to trust, how to contribute, and if input would be constructive or critical. Psychological safety and responsiveness during feedback contacts can be strengthened by longitudinal relationships and instructor awareness of cultural differences (Thomas & Gupta, 2024).

Thus, interprofessional communication is a result of legislation as well as its medium. The instructional usefulness of clinical handovers, ward rounds, bedside discussions, and casual interactions in the corridor depends on whether students may participate and whether conflicting interpretations are made discussable. Research from interprofessional teaching rounds indicates that organised involvement can improve clinical problem-solving and teamwork abilities (Yang et al., 2025). Additionally, co-created learning activities show how relational engagement can promote identity development, workplace integration, and belonging (Rae et al., 2024). These results support viewing the interdisciplinary team as a co-regulatory ecosystem, which is a network of individuals, roles, practices, and artefacts that can either repeat silence and fragmentation or increase regulatory capacity.

2.4 Mediation, Scaffolding, and Regulatory Ownership

More specificity is needed for a socio-constructivist explanation than for the broad assertion that interaction promotes learning. When social interaction alters a learner's or group's goal-setting, strategy selection, progress tracking, emotion management, or outcome evaluation, it becomes regulatory. Speech, gesture, demonstration, documentation, or a tangible artefact like a checklist, electronic record, guideline, or assessment form can all be used for mediation. These mediators negotiate their meaning within the local practice rather than making mechanical decisions about what to do. An early-warning score, for instance, might draw a student's attention to decline, but a nurse's explanation might show why the score needs to be evaluated in conjunction with long-term bedside observations. As a result, the student gains both clinical judgment and a method for controlling attention across evidence sources.

The contingent organisation of support is the subject of scaffolding. Effective scaffolding takes into account the learner's present level of comprehension, the intricacy of the situation, and the possible repercussions of making a mistake. A supervisor might first demonstrate a full assessment, then encourage specific elements, and finally watch with little assistance. However, in therapeutic practice, the widely used metaphor of decreasing support may be deceptive. Support should become more selective and responsive rather than cease to exist just because a student is a senior. When faced with ethical conflict, diagnostic ambiguity, emotional distress, or unfamiliar interprofessional negotiation, an advanced student may require significant co-regulation but little procedural coaching. Therefore, mature SRL includes the ability to identify when independent regulation is inadequate and to enlist help before uncertainty becomes dangerous.

One helpful analytical criterion is regulatory ownership. Even when knowledge is provided by others, the student maintains ownership of the learning objective in SRL. In CRL, either the parties negotiate control throughout the episode or another agent briefly takes part in regulating that student-owned aim. Participants in SSRL create and uphold a collective objective. It is also possible to dispute ownership. A student may seek introspective discussion while the supervisor views the interaction as a one-way correction; a team member may pretend to share a goal while professionals judge achievement differently; or a supervisor may enforce a goal that the student completes without internal support. These examples show why shared regulation cannot be established by observable collaboration alone. Researchers need to look at who has the power to change collective action, whose monitoring qualifies as evidence, whose objective is preferred, and who can challenge it.

2.5 Hierarchy, Psychological Safety, and Asymmetric Regulation

Due to participant differences in knowledge, formal authority, accountability, and information access, clinical CRL is often asymmetric. There is nothing intrinsically wrong about asymmetry. Novice learners benefit from clear guidance when they are still unable to identify crucial cues, and senior physicians occasionally need to take charge to protect patients. Whether asymmetry is still dialogic and responsive is the educational question. After the immediate risk has been controlled, productive regulation invites the learner's account, makes the purpose of the intervention clear, and restores a suitable level of agency. Unproductive regulation prevents students from expressing thinking and testing self-monitoring by either prematurely withdrawing support or turning all contact into command.

The ability of students to reveal the ambiguity that underpins CRL is determined by psychological safety. Pupils must be free to express uncertainty, ask for a second perspective, challenge an inconsistency, or report a mistake without fear of embarrassment or undue reputational damage. Comfort and the lack of norms are not the same as psychological safety. It allows for tough challenges in partnerships that uphold membership and dignity. In contrast to receiving decontextualised judgments, feedback research in clinical education emphasises the value of trustworthy connections, learner agency, and opportunities to act on feedback (Fuentes-Cimma et al., 2024). Teacher vulnerability and long-term relationships are particularly crucial since international students may encounter additional cultural and linguistic confusion regarding how authority is treated (Thomas & Gupta, 2024).

Professional rank and hierarchy are related. Even when nurses, pharmacists, or other associated professionals have the necessary situational knowledge, medical students may believe that doctors are the only qualified teachers. On the other hand, some professionals could consider instructing medical students to be outside of their purview or might be reluctant to correct a student in front of doctors. Therefore, cross-professional contributions must be legitimised in a co-regulatory curriculum. By specifically requesting the interpretation of another profession, acknowledging

its contribution, and allowing the student to incorporate it into an updated plan, supervisors can provide an example of this validity. Without eliminating disparities in legal accountability, these strategies transfer epistemic authority.

2.6. Communication as Distributed Regulation

Although a regulation perspective reveals that communication in diverse teams also coordinates goals, attention, emotion, and action, it is frequently defined as information sharing. Disagreement can reveal conflicting presumptions; questions can start monitoring; summaries can stabilise a shared problem representation; and closed-loop communication can confirm whether the planned action took place. Thus, ward rounds and handovers are possible regulatory infrastructures. Participation structures—who speaks, in what order, whose observations are acknowledged, and whether the team reconsiders previous judgments in light of new information—determine their worth.

Instead of just a lack of communication skills, communication failures may be a result of regulatory fragmentation. Accurate information can be shared among team members while controlling conflicting objectives, such as quick discharge, thorough diagnosis, functional readiness, and family readiness. While SSRL is made possible when the team negotiates priorities and creates a shared plan that can be monitored, CRL teaches the student how each profession frames the problem. By providing predictable opportunities for professionals to participate and by making clinical reasoning publicly inspectable, structured interprofessional rounds can facilitate this process (Yang et al., 2025). However, if contributions are habitually overruled without justification or ritualised, structure is insufficient on its own.

2.7 Theoretical Synthesis

Thus, a hierarchical and dynamic model of regulation is supported by the literature. The learner's deliberate control of motivation, emotion, behaviour, and thought is explained by SRL. CRL describes how connections excite, redistribute, or momentarily share that control. SSRL describes how a group of people work together to control a common item. Although the modes are practically linked, they are conceptually separate. When social cues are used as self-questioning, CRL can support later SRL, but it can also foster the ability to ask for assistance more wisely. By teaching students how to express objectives, make reasoning clear, identify distributed knowledge, and negotiate monitoring criteria, it can help them get ready for SSRL. On the other hand, the transition between modes may be limited by directive supervision, dangerous hierarchies, or exclusionary networks.

By focusing on how regulation is achieved in a specific clinical episode rather than whether a student is self-regulated, this synthesis changes the focus of instruction. Relevant inquiries consist of: What led to the necessity for regulation? What was subject to regulation? Which artifacts and agents took part? What was the distribution of control? What environmental circumstances made participation possible? Did ownership change, stay relational, or become collective? These inquiries lay the theoretical groundwork for a conceptual model in which co-regulatory processes and their effects on learner development, teamwork, and patient safety are shaped by network access, psychological safety, supervisory calibration, interprofessional communication, and workload.

3. DISCUSSION

3.1 Development of the Conceptual Model: Core Propositions

The Regulatory Transition: Aligning Individual and Clinical-Team Goals

Instead of just substituting CRL for SRL, the model starts with a regulatory transition. Co-ass students come into a rotation with personal objectives based on their job ambitions, perceived limitations, past feedback, and curriculum results. On the other hand, the clinical team is structured around patient-care objectives, workflow, risk management, and duties relevant to the profession. Although they overlap, these goal systems are not the same. While the team must prioritise rapid stabilisation, a student might want to practice procedures; they might want diagnostic independence while a supervisor is responsible for making prompt decisions; or they might want to concentrate on biomedical reasoning while nursing and allied health staff prioritise function, communication, and discharge readiness. Therefore, converting an individual learning goal into acceptable involvement in group activity is the first developmental job.

Anticipatory, contextual, and reflective regulation lead to goal alignment. A student can negotiate a suitable position and express a learning purpose prior to an encounter. The team adjusts accountability during care in response to shifting performance and risk. Feedback and introspection then link what happened to the student's long-term objectives. The learner does not have to give up on their own objectives or accept every service request as instructive in order to achieve alignment. It necessitates mutual adaptation: supervisors foster engagement that maintains learning within safe care, while students modify their goals to fit the patient and team. When observation, interpretation, goal modification, and subsequent action create a whole loop instead of a single judgment, workplace feedback becomes regulatory (Fuentes-Cimma et al., 2024).

Within a single episode, the transition can switch between SRL, CRL, and SSRL. A nurse contributes longitudinal observations that change the problem representation; a resident questions the prioritising and momentarily co-regulates reasoning; a student independently produces a differential diagnosis; and the team as a whole updates the care plan. Afterwards, the learner might turn the experience into a new personal objective. As a result, regulation is recursive. Instead of following a predetermined path from dependency to independence, its orientation is determined by the item being regulated, the level of patient risk, and the competence needed. This explanation is supported by studies of clerkship networks, which show that students choose various partners for goal-setting, strategy selection, self-evaluation, and reflection, and that their favourite partners vary over training phases (Bransen et al., 2022c).

Disconnection Across Professional Perspectives

A disparity in how people perceive, interpret, or value a clinical situation is referred to as disconnection. While a nurse observes declining behaviour, a pharmacist recognises medication-related danger, and a therapist stresses functional decline, a medical student may evaluate a patient largely based on diagnosis and laboratory data. Disconnection is frequently caused by professions using various knowledge traditions and occupying distinct positions in the process; thus it's not always an error. When the discrepancy is made apparent, and participants are prompted to examine how their attention and judgments are being regulated, it becomes a CRL trigger.

Epistemic curiosity is produced via productive detachment. The student reframes the situation, compares the facts, and inquires about what another expert is observing. Instead of just offering a conclusion, the other expert then discusses the reasons behind the observation. After that, complementary expertise temporarily shares regulation. Silent dismissal, professional stereotyping, or parallel monologues are the results of ineffective disconnection. Access to a variety of co-regulatory connections and the team's acceptance of cross-professional contributions determine whether it becomes instructive. Strong and frequent co-regulatory links are linked to students' SRL, and the number and strength of such networks are influenced by the clinical environment (Bransen et al., 2022b).

Disconnection can also highlight discrepancies between actual clinical practice and the formal curriculum. It's possible that a pupil learnt a perfect order of steps that goes against local customs or resource limitations. The student and team can differentiate between safe normalisation and justifiable contextual adaptation thanks to CRL. "Which view is correct?" is not the only regulatory question. However, "What must be monitored next, and what assumptions, information, and constraints produced each view?" Both clinical reasoning and interprofessional role understanding are supported by this dialogic reframing.

Cognitive Conflict Over Patient-Management Plans

When reasonable interpretations lead to different diagnostic priorities, treatment strategies, or escalation thresholds, cognitive conflict occurs. Such disagreement can reveal flawed reasoning and encourage conceptual transformation in clinical education. While a resident prioritizes stabilization, a co-ass may suggest inquiry prior to therapy; a pharmacist may challenge a dose that seems standard to the medical team; or nursing staff may oppose release due to insufficient self-care. Because the current plan cannot be sustained without reviewing the facts, objectives, and risk, these differences lead to regulatory demand.

Reasoning must be made publicly accessible in order for a dispute to result in CRL. Participants describe their predictions, the evidence they prioritise, the remaining ambiguity, and the repercussions of making a mistake. After that, the group can decide on a course of action, specify monitoring standards, and create a backup plan. Conflict in this form shifts regulation from individual assertion to reciprocal monitoring and, once the plan is owned collectively, to SSRL. Clinical problem-solving and teamwork skills can be strengthened by shared conversation, as demonstrated by structured interprofessional training rounds (Yang et al., 2025).

However, when hierarchy replaces explanation with authority, conflict can collapse into acquiescence. While immediate guidance could be required in an emergency, pupils learn to hide their reasoning and wait for commands when they receive frequent, inexplicable corrections. On the other hand, supervisors who refrain from intervening in the name of independence could allow actions that are not properly calibrated. As a result, the model suggests supervisory calibration as a key moderator: effective CRL blends explicit accountability with clarification, inquiry, and the return of proper agency following risk control.

Affective Challenges, Workload, and Hierarchy

Anxiety, embarrassment, frustration, moral anguish, ambiguity, and cognitive overload are examples of affective problems. Because emotion affects perseverance, help-seeking, attention, and feedback interpretation, they are not peripheral to regulation. Under pressure, a student may get distracted, refrain from asking questions, or view criticism as a challenge to their professional identity. Frequent rotation damages relationships before trust is built, and workload can further limit opportunities for observation and conversation. As a result, the regulatory need is both cognitive and emotional: the student must comprehend the situation while maintaining enough autonomy to interact with others.

Whether affective challenge becomes apparent and accessible for CRL depends on psychological safety. It must be possible for students to express uncertainty, acknowledge mistakes, or ask for help without fear of humiliation or undue harm to their reputation. Psychological safety is influenced by educator characteristics, cultural norms, physical settings, and long-term connections, according to research on feedback experiences (Thomas & Gupta, 2024). Normalising uncertainty, labelling emotions, setting priorities, temporarily shifting responsibilities, and conducting a debriefing are all examples of productive affective co-regulation. It upholds standards without allowing stress to be seen as a sign of personal weakness.

CRL and patient safety are also connected by the emotional route. Asking for clarification and voicing concerns are both learning and safety behaviours. When they are suppressed by hierarchy, uncertainty is kept under control until it turns into error or retreat. The team transforms vulnerability into shared monitoring when inclusive leaders ask questions and provide explanations of interventions. A professional identity that views asking for assistance as an accountable practice rather than a sign of failed autonomy can be developed via repeated experiences.

Peer-to-Peer Co-Regulation

Co-ass students with comparatively equal formal status engage in peer-to-peer CRL. Peers can practice presentations, compare interpretations of criticism, offer emotional support, and make implicit uncertainty discussable. Peers are frequently the first partners that students seek when they don't grasp standards since reputational risk may feel smaller. In addition to distributing useful information about workflow and access to learning opportunities, peer dialogue can encourage monitoring by challenging students to justify their decisions.

There are risks associated with peer regulation. Groups may replicate competitive environments, normalise avoiding supervisors, and reinforce common misconceptions. Peer CRL is most effective when it is linked to reliable clinical feedback and when peers are aware of when to raise doubts. Its goal is to offer an accessible regulatory layer that prepares questions, encourages thinking, and connects students to larger professional networks rather than to establish a closed alternative network. Interdependence, workplace integration, belonging, and identity maturity have all been linked to co-created learning communities (Rae et al., 2024).

Hierarchical Co-Regulation

Students, residents, attending physicians, and consultants are all involved in hierarchical CRL, and their connections involve unequal expertise and accountability. Its unique contribution is calibration: senior physicians may set boundaries, model expert attention, uncover performance gaps that trainees are unable to see, and modify responsibility in response to patient risk. Because they are in proximity to everyday operations and have more clinical experience, residents may be particularly significant.

Instead of only being directive, the method ought to be dialogic. The learner's purpose and reasoning are elicited by the supervisor, who also observes activity, determines the difference between the learner's present and intended performance, negotiates the next course of action, and monitors progress. The pupil becomes operationally compliant without gaining regulatory judgment if the supervisor assumes permanent authority. The learner may experience hazardous independence if control is transferred too soon. Thus, adaptive movement between modelling, urging, questioning, observation, and autonomous performance is necessary for hierarchical CRL. Accurately determining when supervision is required is its developmental endpoint rather than freedom from supervision.

Interprofessional Co-Regulation

When students manage their education and clinical involvement with nurses, pharmacists, therapists, dietitians, and other medical professionals, interprofessional CRL takes place. In contrast to hierarchical CRL, it frequently relies on complementary skills rather than only superior knowledge. Social workers may reframe contextual barriers, pharmacists may control medication rationale, therapists may control functional evaluation, and nurses may control situational awareness and patient communication. Students gain an understanding of how clinically responsible regulation is dispersed throughout a system through these interactions.

This pathway demands epistemic humility and role validity. While clinical leaders must approve those professionals as lecturers and collaborators, students must identify when another field possesses pertinent expertise. When the team adopts a shared goal—like a safe discharge plan—defines complementary responsibilities, tracks progress collaboratively, and updates the plan together, interprofessional regulation turns into SSRL. When professions share knowledge without discussing conflicting objectives, it fails. Thus, interprofessional communication is a CRL mechanism as well as an outcome that is in line with the IPEC areas of communication, roles and duties, values and ethics, and teams and teamwork.

Regulatory transition is positioned as the primary process in the model. Goals for both the team and the individual cause an initial alignment issue. Regulatory demand is produced by disconnection, cognitive conflict, and affective difficulties. The learner enters peer, hierarchical, or interprofessional CRL after evaluating task danger, interpersonal safety, and the reliability of possible partners. Participants divide control and make changes to the regulatory object through inquiry, explanation, feedback, emotional support, and negotiated monitoring. Clearer objectives, modified tactics, less ambiguity, increased risk, or a shared care plan are examples of immediate results. Later, SRL, professional identity, network competency, interprofessional cooperation, and patient-safe involvement are all impacted by recurrent incidents. Silence, flimsy compliance, concurrent professional action, reliance, and early autonomy are examples of failure routes.

3.2 Conceptual Propositions

The following hypotheses outline theoretically anticipated connections that may be investigated in subsequent studies. They are not claims of proven causation. A focused predictor, a CRL mechanism, anticipated results, and circumstances that could improve or worsen the relationship are all identified in each proposition. The propositions operate across nested levels: medical error is a safety outcome that may be impacted by a variety of individual and system factors; psychological safety is concerned with the interpersonal environment in which regulatory risk is taken; and role clarity is concerned with the structure of team participation. When taken as a whole, they clarify how social interaction might be transformed into regulatory ability in a clinical setting.

Role Clarity Accelerates the Transition from SRL to CRL

According to Proposition 1, medical students' shift from mostly solo SRL to successful CRL will be accelerated by increased clarity regarding roles, duties, and appropriate engagement within a multidisciplinary team. Understanding professional job descriptions is only one aspect of role clarity. For co-ass students, this means knowing what they can and cannot do, who oversees a task, whose knowledge is pertinent, when escalation is anticipated, and how their learning objectives may be met without interfering with patient care. These inquiries are frequently implicit in a new rotation. Instead of learning from clinical work, ambiguity compels students to waste regulatory resources understanding the social environment.

Reduced participation uncertainty is the first mechanism. Students can convert personal objectives into demands that make sense within team workflow when roles are clearly defined. A learner can find the right partner for a particular regulatory need if they are aware that a pharmacist evaluates prescription risk, a nurse maintains longitudinal bedside data, and a resident coordinates diagnostic reasoning. As a result, role clarity minimises the cost of network activation by eliminating doubt about who to contact and what kind of assistance is appropriate. Evidence that co-regulatory network size and tie strength are influenced by clerkship setting and that students' SRL is correlated with stronger, more frequent links is consistent with this process (Bransen et al., 2022b).

Better goal alignment is the second method. While students have both academic and personal learning objectives, clinical teams oversee patient care goals. The link between these objectives is negotiable when roles are clearly defined. A supervisor can set the student's contribution, observation schedule, and escalation level prior to a meeting. As risk shifts during the interaction, the team can adjust accountability. Feedback can then link involvement to the student's next objective. In the absence of clarity, students might either stay on the periphery or take advantage of chances, which would put education and service at odds. Individual objectives are more likely to cause CRL when they are clearly defined and integrated into genuine team participation.

Epistemic routing is the third mechanism. Knowledge is dispersed among professions through multidisciplinary collaboration. Students are better able to understand the difference between authority and knowledge when roles are clear. While a nurse has the most pertinent information about trajectory, a pharmacist about interactions, or a therapist about functional preparedness, a consultant can still be ultimately responsible. The student cannot treat physician-only interactions as the full co-regulatory network if they do not acknowledge these contributions. One way that visible role contributions might facilitate clinical problem solving and collaboration is through structured interprofessional teaching rounds (Yang et al., 2025).

Rigid role boundaries are not the same as role clarity. Overly strict rules can prevent cross-professional learning and lead to participants defending their jurisdiction rather than integrating viewpoints. Therefore, the suggested relationship is conditional: when roles are clear but permeable, when cross-professional inquiries are acceptable, and when the student's breadth can grow with competence, clarity speeds up CRL.

Because recurrent touch allows for more precise calibration, supervisory continuity may amplify the effect. It may be weakened by heavy workloads, frequent team changes, or conflicting messages from managers.

Perceived role-clarity scales, role mapping accuracy, supervisor-student agreement over permissible participation, and observed identification of suitable regulating partners could all be used in future research to operationalise role clarity. The frequency, variety, and aim of co-regulatory contacts; the amount of time between rotation admission and meaningful involvement; and discourse evidence of agreed-upon goals and monitoring could all be used to evaluate the transition to CRL. To determine if role clarity predicts the quicker establishment of robust, functionally diverse co-regulatory relationships, longitudinal network analysis would be particularly helpful.

Psychological Safety Enables Effective CRL

According to Proposition 2, CRL will be more successful in therapeutic settings with good psychological safety than in settings with intimidation, humiliation, or uncertain interpersonal outcomes. The common conviction that interpersonal risk-taking—asking questions, acknowledging uncertainty, questioning an assumption, or disclosing an error—can take place without disproportionately harming status, identity, or relationships is known as psychological safety. It does not indicate a lack of accountability, unqualified assurance, or low standards. In actuality, psychological safety allows for the revelation of performance gaps and insufficient reasoning, which is necessary for rigorous CRL.

Uncertainty disclosure is the main mechanism. When a regulatory necessity becomes socially accessible, CRL starts. Confusion, cognitive conflict, or emotional overload may occur in a learner, but if the need is hidden, no co-regulatory episode may occur. Learners may exhibit assurance, limit their queries to those of their peers, or quietly await instruction in frightening situations. While these tactics provide short-term identity protection, they limit supervisors' and other professionals' ability to adjust support. The learner can reveal what is unclear in safer settings, allowing for collaborative goal-setting and monitoring.

Dialogic feedback is a second mechanism. Only when the learner and partner analyse the facts, agree on a realistic goal, plan a course of action, and review performance does feedback become co-regulatory. Effective workplace feedback relies heavily on follow-through, learner agency, and trustworthy relationships (Fuentes-Cimma et al., 2024). Feedback becomes a threat signal when it is intimidating; learners may comply without understanding the message, and attention is diverted from learning to impression management. Challenge can continue to be emotionally and cognitively useful when it is psychologically safe. Teacher vulnerability and long-term relationships can be especially crucial since international students may have additional ambiguity regarding authority, language, and culturally expected reactions (Thomas & Gupta, 2024).

Upward and cross-professional voice is a third mechanism. Because they have low-status positions, students may expect unfavourable responses when they ask senior staff members questions. Psychological safety allows knowledge held by peripheral members to enter team regulation and reduces the interpersonal cost of speaking up. The opportunity and the issue are demonstrated by data from Ibero-American healthcare trainees: 88.3% of clinically experienced respondents reported recent patient safety concerns, 68.9% had stopped a colleague from making a mistake, but more than one-third had remained silent in a dangerous situation (Carrillo et al., 2024). These results demonstrate that regulatory signals are common and may be lost when voice is blocked, but they do not imply that psychological safety causes CRL.

The relationship could be multilayered and nonlinear. A learner in a hostile micro-team may not be protected by an organisation that is generally helpful, and individual confidence cannot completely make up for punishing leadership or organisational behaviours. Therefore, it is important to assess psychological safety at the individual, relationship, and team levels. Task risk is also important. Directive action in an emergency may momentarily stifle conversation without creating a dangerous environment; the crucial question is whether explanation and introspection follow. Further evidence that psychological safety can vary significantly amongst professional groups within the same context comes from interdisciplinary simulation research with pediatric residents and nurses, warning against perceiving team climate as uniform (Haviland et al., 2022).

Help-seeking, disclosure of uncertainty, feedback dialogue, and speaking up behaviour can all be used in future research to test mediation. Quality, not just frequency, should be used to gauge how effective CRL is: whether interactions alter objectives, tactics, monitoring, or following performance. Climate measures could be combined with repeated event sampling, stimulated recollection, and direct observation. Beyond learner personality, past performance, and supervisor style, multilevel models could investigate whether team psychological safety predicts fruitful regulatory episodes.

Effective CRL Is Associated with Lower Student-Related Medical Error

According to Proposition 3, a decrease in medical errors involving students in multidisciplinary teams will be positively correlated with optimal CRL. Careful specification is necessary for the claim. Staffing, workload, technology, protocols, case complexity, supervision, and organisational design all influence medical errors, which are multicausal events. A conceptual model shouldn't suggest that every unfavourable result is the result of a failed CRL or that student learning regulation alone may avert harm. Instead, by raising the likelihood that doubt is identified, shared, cross-checked, and escalated before it reaches the patient, CRL is anticipated to decrease certain mistake paths.

Distributed monitoring is the first method. The learner's knowledge and attentional limitations limit their own SRL. CRL expands monitoring to include multiple observers of many parts of the issue. A pharmacist might review a student's prescription schedule; a nurse might identify a trajectory that deviates from a snapshot assessment; a resident might identify premature closure; and a peer might point out material that was left out during handover. The team can spot inconsistencies sooner when these insights are included in a common regulatory procedure. As a result, CRL produces redundancy that is not just procedural but also cognitively significant.

Calibrated escalation is the second mechanism. While over-reliance can overburden supervisors and discourage active monitoring, novices may not recognise when their knowledge or skills are inadequate. When it comes to deciding when to halt and escalate, when to seek confirmation, and whether to proceed independently, optimal CRL develops judgment. Peer CRL can assist in expressing uncertainty, interprofessional CRL can identify risk outside the student's disciplinary framework, and hierarchical co-regulation can establish thresholds. The timing and specificity of help-seeking should be enhanced via repeated feedback loops.

Speaking up and responding is the third mechanism. Only when a safety concern is expressed, acknowledged, and put into action can it avert harm. Carrillo et al. (2024) discovered that when quiet persisted, trainees commonly experienced worries and frequently intervened to avert colleague error. This not only shows why CRL cannot be reduced to the learner's willingness to talk, but it also provides a tenable connection between voice and mistake interception. The receiver must modify the plan, clarify the signal, and react positively. Therefore, the suggested CRL–error link is predicated on psychological safety and role clarity.

Team learning following mistakes and near misses is the fourth mechanism. Non-defensive reconstruction of what participants observed, assumed, and conveyed is supported by effective CRL. Instead of placing blame on a pupil, the goal is to strengthen teamwork and individual self-control. A specific feedforward plan and an opportunity to implement it should be produced via feedback. Clinical reasoning, handover quality, cross-checking, and appropriate escalation may all be enhanced over time by this cyclical process. By portraying error disclosure as responsible engagement, it may also enhance professional identity.

The proposition is qualified by a number of boundary conditions. Excessive or poorly calibrated CRL can lead to diffusion of responsibility if no one makes the final choice; too many interruptions can break focus, and conflicting opinions can confuse. Additionally, co-regulation may replicate a false common assumption, resulting in collective rather than individual error. As a result, "optimal CRL" necessitates closed-loop communication, explicit decision ownership, credible competence, role clarity, and tracking of whether agreed actions were carried out. Only when shared regulation maintains responsibility does SSRL become protective.

Stronger designs than cross-sectional self-report are required to test this hypothesis. Observed near-miss interception, prescription or documentation errors, escalation delays, missing handover components, and verified simulation performance are some possible outcomes. While accounting for case complexity, workload, learner experience, and supervisory intensity, prospective studies could record CRL episodes and connect them to later safety incidents. While multisite longitudinal studies provide realism but necessitate rigorous attribution, simulation offers causal leverage but limited ecological validity. Instead of assuming a direct approach, mediation analyses should try speaking up, cross-checking, and escalation.

3.4 Propositional Integration

A sequential yet recursive model is formed by the three propositions. Structural access to the right regulatory partners is made possible by role clarity. By making ambiguity and disagreement palatable, psychological safety empowers students and team members to utilise that framework. Diverse observations are then transformed by effective CRL into monitoring, escalation, and modification that could detect errors. Safety results reflect into the system: although blame can lead to more ambiguity and silence, constructive evaluation can enhance roles and confidence. Therefore, rather than testing the claims separately, future research should test them collectively. A moderated mediation model is conceivable: CRL predicts safety behaviours and, more distantly, error outcomes; psychological safety enhances the translation of regulatory need into interaction; and role clarity predicts CRL through partner identification and goal alignment.

3.5 Educational Implications

Co-regulation should be explicitly stated in curricula as a result of clinical training. Students can learn how to map possible regulatory partners, create observation requests, reveal uncertainty, and turn feedback into feedforward plans during orientation. Supervisors ought to receive training on how to pose regulatory queries, such as "What are you trying to improve?" What proof are you citing? What assistance are you in need of?—before responding. Pre-encounter goal alignment, quick pauses during care, end-of-shift reflection, and follow-up on one previously agreed action are short routines that can make CRL possible despite busyness. When feasible, longitudinal attachments should be preferred since they enable partners to adjust trust, challenge, and autonomy through frequent engagement.

Additionally, evaluation needs to go beyond praising independent performance. Workplace-based evaluation can record how students use interprofessional knowledge, ask for assistance, deal with ambiguity, keep track of shared plans, and make adjustments in response to feedback. This acknowledges that secure clinical autonomy is relational rather than rewarding dependency. The learning ecology should be audited by programs, including who watches students, whose comments are accepted, whether nurses and other related professions can help, and which students are still detached. Structural injustices that are hidden by individual SRL inventories may be exposed using co-regulatory network mapping.

Additionally, the model explains why it is important to interpret current SRL findings in a relational manner. Planning and monitoring can be strengthened by instructional design, structured reflection, and feedback, according to reviews of medical students' regulation; however, their effects are mediated by interaction and the opportunities provided by a learning environment (Ballouk et al., 2022; Fatima et al., 2025; Shitarukmi et al., 2023). External assistance is not a sign that self-regulation has failed in clerkships: students' clinical performance is partially correlated with learning strategies and access to knowledgeable guidance (Zhang et al., 2022), and microanalytic approaches demonstrate that context-sensitive questioning can reveal how learners regulate prior to, during, and following a task (Andrews et al., 2023). Further research on achievement emotions, stress, and reasoning shows that affect, motivation, and cognition are interdependent rather than independent inputs (Li et al., 2023; Marsch et al., 2024; Wang & Zheng, 2023). According to the suggested model, these results suggest that a co-regulatory episode can change the learner's willingness and emotional ability to stay involved in addition to knowledge or strategy. The need to avoid deficiency theories based only on individual discipline is reinforced by Indonesian data that low accomplishment is perceived through interacting academic, motivational, strategic, and psychological issues (Lisiswanti et al., 2022).

Although information by itself cannot control learning, feedback is the most obvious potential bearer of CRL. Establishing a trustworthy relationship, interpreting performance data, determining what needs attention, creating an executable goal, and setting up a later opportunity to assess adaptation are all necessary for the learner and partner. Every step is shaped by psychological safety. The ability of participants to recognise uncertainty and interpersonal risk influences feedback conversations in general-practice training (Ajjawi et al., 2022); more comprehensive reviews also find safety in relationships, inclusion, and leader behaviour rather than learner confidence alone (McClintock et al., 2022, 2023). While institution-level initiatives suggest that explicit routines and leadership commitments can improve the conditions for speaking, questioning, and

admitting error (Porter-Stransky et al., 2024), recent empirical work demonstrates that teacher feedback can predict medical students' SRL through teacher–student interaction and belonging (Tian et al., 2025). However, accountability must be combined with psychological safety. While maintaining norms, decision ownership, and escalation, it should allow open involvement. Therefore, invitation, respect, inclusion, clarity, and reaction to voice are emphasised as mutually reinforcing practices in practical guidance for health professions education (Bump, 2025; Dong et al., 2025).

CRL is extended beyond a student-physician dyadic connection in interprofessional contexts. Access to various observational areas is made possible by a multidisciplinary team, including senior medical judgment regarding diagnostic and procedural risk, pharmacy knowledge in pharmaceutical systems, nursing surveillance throughout time, and rehabilitation perspectives on function. When supervision and role boundaries are clear, interprofessional training wards show that students can engage in collaborative care without deteriorating patient outcomes and may feel more responsible (Schlosser-Hupf et al., 2024). Additionally, structured interprofessional rounds can provide common monitoring reference points and make reasoning transparent (Yang et al., 2025). But merely bringing together professions does not guarantee co-regulation. Fragmentation may be maintained by status disparities, professional preconceptions, unclear responsibility, and parallel rather than collaborative work. According to the model, interprofessional CRL is strongest when a trigger is acknowledged as jointly relevant, each profession's participation is valid, and the team transforms conflicting information into a clear shared strategy. Through graded practice in speaking up, listening to concerns, and closing communication loops, psychological-safety competency training and patient-safety education can make these behaviours teachable (Carrillo et al., 2024b).

It is best to view the suggested outcome pathway as mediated and probabilistic. Because errors result from interrelated human, organisational, technological, and clinical circumstances, CRL cannot ensure error-free treatment. Nonetheless, it can enhance weak signal processing and detection. A pharmacist who doubts a dose makes a latent disparity actionable, a nurse who challenges an imperfect interpretation contributes longitudinal evidence, and a learner who expresses uncertainty creates an opportunity for checking. Whether or not the team receives and resolves the signal determines the safety effect. This distinction is crucial because, despite the frequent safety concerns that trainees face, withholding voice is nevertheless widespread, especially in cases where they had previously stopped a mistake (Carrillo et al., 2024a). Empirical tests should therefore differentiate between the occurrence of a worry, the start of CRL, the calibre of the reaction, and the final safety result. Circular reasoning, in which every successful interaction is labelled CRL and every error is retroactively attributed to its lack, can be avoided by using such tests.

Ultimately, CRL should be viewed as a transient regulatory responsibility configuration rather than a consistent student characteristic throughout all three assertions. Five characteristics can be used to characterise its quality: the proper identification of the regulatory need; the choice of a reliable partner; the reciprocal interpretation of the evidence; the explicit coordination of roles, goals, and the next course of action; and the transfer or retention of control that is appropriate for patient risk and competence. Increased learner independence, ongoing distributed monitoring, or purposeful escalation to a senior decision maker are all possible outcomes of a high-quality episode. The compatibility of CRL and autonomy is explained by this phrase. Clinical autonomy is the ability to plan one's own education while recognising when safe practice necessitates the expertise of another person or the joint regulation of a team. It is not isolation.

4. CONCLUSION

A more ecologically sound explanation of how co-ass students learn in interdisciplinary clinical teams is provided by co-regulated learning. Understanding regulation as fluid and relational—sometimes coordinated by an individual, sometimes mediated by a third party, and occasionally shared by a team—is the fundamental conceptual shift. SRL is repositioned rather than displaced. Learners gain the ability to control themselves, recruit others, and contribute to collective regulation in uncertain situations through repeated co-regulatory encounters. It needs reliable networks, calibrated monitoring, interprofessional involvement, psychologically safe communication, and action-oriented feedback mechanisms to design clinical education around this reality. The outcome is a more comprehensive understanding of autonomy that is compatible with both safe collaborative care and lifelong learning.

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