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Collaborative Online Interactions and Clinical Skills Acquisition of Students at Kenya Medical Training College Campuses in Rift Valley

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Abstract

The acquisition of clinical skills is a central objective of a country's health science education. However, a deficiency in quality clinical skills among students and healthcare workers persists in Kenya. Blended learning, comprising collaborative online interactions (COI) among instructors and students, possesses the capability to improve learners' skills and deliver a learning experience that is more adaptable and flexible. However, there is a lack of empirical studies investigating the relationship between collaborative online interactions and clinical skills acquisition (CSA) in Kenya. The purpose of this study was to determine the relationship between collaborative online interactions and students' acquisition of clinical skills at Kenya Medical Training College Campuses in the Rift Valley, Kenya. Specifically, the study analyzed the effects of teacher-student (T-S) and Peer-Student (P-S) interactions and discussion forums on CSA. Further, the study analyzed the effects of COI on the components of CSA. The study used a cross-sectional design. The target population for the study comprised 13,174 students and 62 heads of departments (HODs) in 16 Kenya Medical Training Colleges campuses, from which 373 students and 9 HODs were sampled using stratified random and purposive sampling. Data were collected using structured questionnaires and key informant interviews. Results showed that all the components of COI: T-S interactions ($b=0.201$, $t=6.28$, $p<0.001$), P-S interactions ($b=0.111$, $t=1.98$, $p=0.048$), and forum interactions ($b=0.125$, $t=2.34$, $p=0.018$), significantly predicted CSA. Teacher-student interactions were the most important predictor of CSA (predictive score = 0.75), followed by forum discussion (predictive score = 0.13), and, lastly, P-S interactions (predictive score = 0.12). This study recommends that medical education colleges implement instructor-guided online teacher-student and peer-student interactions, as well as online forum discussions, as part of a blended learning approach to effectively acquire clinical skills.

Keywords: *Collaborative online interactions, clinical skills, teacher-student interactions, peer-student interactions, forum discussion, blended learning*

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1. Introduction

The acquisition of clinical skills is a central objective of a country's health science education. Quality clinical skills are foundational to the practice of medicine and vital for ensuring patients' lives and safety (Elder, 2018). An ideal clinical skills curriculum should therefore bridge the gap between medical knowledge and practical application, while appropriate training methods should bring the syllabus to fruition. It is important to teach and practice these skills so that medical students can attain proficiency, master necessary techniques, and minimize the risk of medical errors. This will ensure patients' well-being, lives, and safety (Gong et al., 2021).

The fundamental problem facing Kenya's health institutions is a deficiency of quality clinical skills among students and healthcare workers in patient care (WHO [World Health Organization], 2020; Kimathi, 2017). For example, Kweya et al. (2020) reported substandard clinical performance attributed to insufficient clinical skills among diploma nursing students at Kenya Medical Training College campuses in western Kenya. In a study conducted in several hospitals in Kenya, graduate nurses' post-internship were found to be deficient in clinical skills for translating patient data and in making nursing diagnoses for patients whose conditions were worsening (Wachira et al., 2020, 2017). Similarly, Lewis et al. (2019), found a widespread deficiency in clinical performance among recent clinician graduates, particularly in providing outpatient care for primary conditions in Kenya.

Many studies attribute this deficiency to the predominance of traditional teaching approaches that focus mainly on information-giving activities in the classroom *rather than on enhancing* clinical performance (Kweya et al., 2020). Medical education is among the most stressful academic disciplines owing to its extensive curriculum, complex material, esoteric terminology, and rigorous academic requirements (Waqas et al., 2015). In addition, healthcare education requires the application of multidisciplinary and holistic approaches to enhance learners' practical competencies, clinical skills, and self-directed problem-solving (Cooney et al., 2018; Walsh & Maloney, 2018). Acquisition of clinical skills by students in medical colleges is highly dependent on the teaching strategies employed in the classroom (Cooney et al., 2018), and ample evidence suggests that the conventional lecture method is ill-suited to equip learners to meet the numerous challenges of clinical practice (Jadhav et al., 2017).

Blended learning (BL) integrates the traditional in-person (teacher-centered) with e-learning (learner-centered) methods (Prihadi et al., 2021). Blended learning may also be viewed as combining a physical learning environment with asynchronous or synchronous e-learning and is used in the classroom, laboratory, and online environments (Chaeruman et al., 2018). As a hybrid technology, BL seeks to leverage the strengths of in-person and e-learning approaches to optimize educational outcomes (Kintu et al., 2017). Blended learning can improve learners' skills and deliver a learning experience that is not only more adaptable and flexible but also tailored to individual needs. Learners can progress at their own pace and revisit complex topics as needed. Students can independently access educational materials and resources, fostering

increased motivation and engagement. The inclusion of virtual classes in blended learning facilitates interactions among learners, trainers, and peers in an online setting, promoting collaboration and social learning. Furthermore, the recording feature allows learners the flexibility to revisit class content at their convenience (Dangwal, 2017).

High-quality interactions are a necessary precondition to effective online learning (van Dorresteijn et al., 2024). Collaborative online interactions (COI) involve learners working together through digital platforms—discussion forums, video conferencing, shared documents, and virtual cases—to solve problems, reflect, and co-construct knowledge. The attribution of collaborative learning is Vygotsky's sociocultural theory, which contends that knowledge is constructed through "social interaction, negotiation, reflection, and discussion" (Parker, 1979). Collaborations among students could be beneficial. Learners could learn more through knowledge co-construction than they could have under a purely lecture approach. Besides, collaboration could improve learners' motivation, develop their social skills, and lead to deeper learning and greater understanding (Gillies, 2016; Johnson & Johnson, 2009).

Despite the potential benefits, empirical studies examining the relationship between collaborative online interactions and medical students' acquisition of clinical skills in Kenya are lacking. The purpose of this study was to determine the relationship between collaborative online interactions and the acquisition of clinical skills among students at Kenya Medical Training College (KMTC) Campuses in the Rift Valley, Kenya. The study focused on the following specific objectives: (I) to determine the relationship between teacher-student interaction and clinical skills acquisition of students at KMTC Campuses, (II) to determine the influence of peer-student interactions on clinical skills acquisition of students at KMTC Campuses, (III) to determine the influence of online forum discussions on clinical skills acquisition of students at KMTC Campuses, and (IV) to determine the influence of collaborative online interactions on the components of clinical skills acquisition of students at KMTC Campuses.

2. Literature Review

2.1 Theoretical Review

The theoretical framework comprises constructivist and self-efficacy theories. Constructivism is a learning theory that suggests that learners are not merely passive recipients of knowledge; rather, they actively construct knowledge through their experiences and interactions with their environment. From this perspective, learning is a social, collaborative process that occurs through dialogue and engagement with others (Ganly, 2007). The theory encapsulates several principles, including active learning, collaboration, self-paced learning, real-world context, reflective practice, scaffolding, and assessment for learning (Leidl et al., 2020). This theory was appropriate, as COI envisages online inter-teacher-student and student-student interactions aimed at social learning and knowledge co-construction (Gillies, 2016).

Self-efficacy theory (Bandura, 1997) holds that a student learns through physiological arousal, verbal experiences, vicarious experiences, and mastery of skills, and is based on an individual's belief in their competence to perform at a given level in solving a task. The learner achieves mastery of skills through more practice to gain competence. Vicarious experiences are obtained through observation of an expert demonstrating or performing a skill. This motivates the

student to believe in themselves that they could also perform and master the skill. Verbal persuasion, such as providing feedback to learners and other external factors, motivates the learners and improves self-efficacy. Anxiety and high levels of stress experienced by individual students are instances of physiological arousal, which could negatively affect self-arousal and therefore their performance (Bandura, 1997). Collaborative online interactions incorporate elements of vicarious learning (learners watching teachers and videos), repetition of skills for mastery, self-assessment, and verbal persuasion (encouragement by others), and thus, the self-efficacy theory was germane to this study.

2.2 Empirical Review

Clinical Skills Acquisition

The dependent variable, clinical skills acquisition, was measured using four indicators: Decision-Making Skills (DMS), Knowledge Construction (KC), Knowledge Production (KP), and Good Critical Thinking Skills (CTS). Decision-making skills assess students' confidence in diagnosing, prescribing, prioritizing tasks, and making sound clinical decisions across different learning environments (La et al., 2020). Knowledge construction assesses whether students can apply theoretical knowledge, integrate it with practical skills, communicate with the healthcare team, and collaborate to provide comprehensive care. Garrison and Kanuka (2004) argued that KC is the active process of building understanding through the synthesis of new information and the integration of prior knowledge. According to the authors, effective KC involves more than just acquiring information; it also entails the ability to critically analyze, synthesize, and apply that knowledge to real-world situations in blended learning. Knowledge construction is central to connecting conceptual understanding with clinical application.

Knowledge production involves actively creating new knowledge or transforming existing information into a usable form (Tucker et al., 2016). In blended learning environments, activities that promote knowledge production, such as collaborative projects, case studies, and practical applications, are crucial for enhancing the depth and applicability of clinical knowledge. Learners engaged in knowledge production are more likely to translate theoretical knowledge into practical skills, thereby contributing to a more comprehensive acquisition of clinical competencies. In the context of acquiring clinical skills, knowledge production is integral to shaping the depth and practical application of theoretical knowledge. Carvalho et al. (2017) conceptualised effective critical thinking skills as involving the ability to question assumptions, consider multiple perspectives, and make evidence-based decisions. They consist of analysing information, making informed judgments, and solving problems systematically. In healthcare education, CTS are pertinent to students' navigation of the complexities of patient care and making sound clinical decisions. These skills are particularly important in clinical settings where patient variables, comorbidities, and dynamic scenarios require nuanced judgment and adaptive reasoning (Sterner et al., 2023).

Collaborative Online Interactions

Various digital tools can be used to support both synchronous and asynchronous COI. The prevalent synchronous tools include real-time video conferencing, small interprofessional groups, chats and emails, document collaboration, problem-based cases, structured discussion

forums, and active facilitation (Jeong & Hmelo-Silver, 2016). Asynchronous discussion boards, micro-credential platforms (e.g., Padlet, Slack, Discord communities), and professional networks such as LinkedIn and ResearchGate extend collaborative learning beyond institutional boundaries, facilitating case discussions, shared clinical reflections, and peer feedback (Celestin et al., 2024). These environments allow learners not only to consume content but also to construct knowledge collaboratively, share clinical reasoning, and critique procedural techniques through multimedia posts, which is an approach aligned with social constructivist theory.

This study decomposed COI into a triad: teacher-student and student-peer relationships. Students' online forum discussions, because of their centrality in online interaction (Mende et al., 2020), were also included. Student-teacher interaction is the process by which the student and teacher use various teaching and learning materials to fulfill diverse duties and responsibilities through different types of learning activities. In clinical education, teacher-student interaction is pivotal in scaffolding learners toward competence, facilitating timely feedback, and clarifying complex clinical concepts. Robust interaction supports dialogue around clinical reasoning, corrects misconceptions in real time, and guides learners during supervised skills practice. Evidence from studies of blended learning interventions in health professions education demonstrates that when instructors actively engage with learners through synchronous and asynchronous channels, overall learning outcomes improve, including practical skill performance and reflective practice (Vallee et al., 2020).

Shahkarami et al. (2025) in studies on blended internal medicine clinical training found that students value instructor engagement in online sessions, particularly when it facilitates discussion of clinical cases and feedback, underscoring that interaction contributes to learners' perception of preparedness and confidence. This study postulates that teachers, as facilitators, play a critical role in guiding online discussions, clarifying abstruse concepts, providing challenges, and providing feedback. Hence, teacher-student online interactions are expected to improve acquisition of clinical skills.

Hypothesis 1: High teacher-student interaction is positively related to clinical skills acquisition

Peer collaborative interactions are engagement among learners, facilitated by both in-person and virtual settings, and contribute to the overall learning experience in blended learning. Peer collaborative interactions in blended learning environments provide students with opportunities to engage in social learning experiences. Research in health professions education shows that students engaged in peer discussion groups, group problem-solving, and shared clinical reasoning tasks report greater confidence and higher self-efficacy in skill performance than in more isolated learning formats (Niu et al., 2023).

According to Vygotsky's sociocultural theory, learning is enhanced through social interactions, especially when students collaborate with peers (Rahmatirad, 2020). Blended learning environments provide multiple platforms, such as discussion boards, breakout group tasks, and collaborative assignments, that can support these interactions. For instance, research on blended learning in a medical nutrition course found that collaborative tasks and interactive

discussions contributed to higher self-efficacy among students, which is closely associated with better clinical reasoning and application performance (Regmi et al., 2024).

The broader literature indicates that structured peer interaction, especially when guided by clear objectives and supported by technology, enhances learners' engagement and improves clinical competencies. Peer collaboration can enhance motivation and engagement, crucial factors in successful learning experiences. Students are more likely to stay motivated when working with peers, as it creates a supportive learning community (Hew & Cheung, 2014). Recent evidence further shows that peer collaboration reduces anxiety during skills practice and encourages active participation, particularly among less confident learners (Fakoya et al., 2023).

Bach and Thiel (2024) examined how learners managed an autonomous collaborative learning environment and how the quality of interaction affected learning. A quantitative, cross-sectional study using 298 undergraduate students was conducted within an online university course during the COVID-19 pandemic. The results showed that participation by all group members and an ambient group environment positively influenced learning. However, the study found no significant effect of task-related communication on the learning results.

A systematic review of collaborative learning in higher nursing education found that peer collaboration among clinical nursing students, even in virtual spaces, significantly enhanced clinical reasoning abilities. The exchange of perspectives and the collective problem-solving approach facilitated by peer collaboration appeared to deepen students' understanding of clinical scenarios (Zhang & Cui, 2018).

Hypothesis 2: High student-peer interaction is positively related to clinical skills acquisition

Collaborative online discussions are forums that encourage peer interaction and critical thinking. Shahkarami et al. (2025) reported that discussion forums, when well facilitated, allow learners to reflect on their clinical experiences, articulate reasoning, and negotiate clinical decisions with peers and instructors. Studies on blended internal medicine clerkship courses suggest that online components, including forums, contribute to improved clinical reasoning and satisfaction, demonstrating that well-structured online learning can complement in-person clinical training. Similarly, Niu et al. (2023) showed that in health education, students who engaged in peer discussion groups, group problem-solving, and shared clinical reasoning tasks reported greater confidence and higher self-efficacy in skills performance compared with more isolated learning formats.

Peramunugamage et al. (2025) investigated the relationship between learning and learner participation in Moodle-based collaborative content-creation activities. The collaborative content-creation activities were measured by analyzing Moodle log records across four modules implemented at two universities in Sri Lanka and Brazil. Regression results showed a positive correlation between learner log records and student performance on the four modules. The Vector Space Model (VSM) data mining algorithm showed that increased online learner participation could improve their learning experiences.

Learners engage in asynchronous discussions, share perspectives, and collaborate on projects, fostering collaborative learning. Virtual teamwork and communication skills are developed through collaborative interactions, which are vital components of the healthcare professional's skill set. Through forums, students can engage in case-study debates, share evidence-based references, and critique clinical approaches, all of which enhance the metacognitive and social aspects of learning (Nsengimana et al., 2021). Nevertheless, Douglas et al. (2020) found that without sufficient facilitation or clear goals, online forums may see low participation or superficial engagement, reducing their impact on deep learning and skill development. Hence, there is a need for instructional design that intentionally supports engagement through prompts, instructor presence, and alignment with assessment tasks.

> *Hypothesis 3: Quality students' online forum discussions are positively related to clinical skills acquisition*

The components of COI could have differential effects on the elements that constitute clinical skills. For example, Xie et al. (2023) reported that interactive teaching approaches combining video-based tutorials with scaffolded feedback and in-person debriefs may be necessary for psychomotor skills, whereas faculty-guided case discussion forums may better support the development of clinical reasoning.

> *Hypothesis 4: Collaborative online interactions are likely to have differential effects on the elements of CSA: decision-making skills, knowledge construction, knowledge production, and critical thinking skills*

3. Methodology

The study used a cross-sectional design to test the research hypotheses, enabling the collection of large amounts of data in a short time and the analysis of relationships among variables (VerLinden, 2010). The target population for the study consisted of all 13,174 students and 62 heads of departments (HODs) in 16 Kenya Medical Training Colleges (KMTC) campuses in the Rift Valley region (KMTC Records, 2024). The study chose KMTC because it trains over 85% of Kenya's middle-level health workforce, already implements blended learning, and, hence, its effect on skill acquisition could be assessed; it also offers courses that require the development of skill competencies (KMTC, 2019). A sample size of 385 students was calculated using Sapra's (2022) guidelines for a cross-sectional study. The formula assumes a 95% confidence level, a 5% sampling error, and a 0.5 proportion (maximum variability) in the attribute of interest (Noordzij et al., 2010).

A mix of non-probabilistic and stratified sampling was used because of a heterogeneous population. Purposive sampling was used to select 9 campuses offering both nursing and clinical medicine. The courses were chosen because they offer hospital clinical assessments with patients and involve workers who interact first with patients; hence, they could test the acquisition of clinical skills. The HOD overseeing nursing and clinical medicine was selected from each of the 9 campuses, giving a total of 18 key informants. Students were selected using stratified random sampling. First, students were selected from the 9 campuses. Then, the requisite number of students was selected according to their department: nursing or clinical medicine. Proportional representation was ensured by weighting each stratum's sample size according to its target population size. Since it ensured that every student in the population had

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an equal chance of being selected, simple random sampling (Creswell, 2014) was then used to select respondents from each stratum.

Structured questionnaires and key informant interviews (KII) were used to collect data from participants. The questionnaire had three sections: sample characteristics, COI, and CSA. The exogenous variable, collaborative online interactions, comprised three sections: teacher-student interaction, peer-student interaction, and forum discussions (Mende et al., 2020). The dependent variable, clinical skills acquisition, was measured using four indicators: DMS, KC, KP, and CTS (La et al., 2020; Carvalho et al., 2017; Tucker et al., 2016). The scale of the questions ranged from 1 (strongly disagree) to 5 (strongly agree). The KII also comprised two sections (COI and CSA) developed from Shahkarami et al. (2025), Regmi et al. (2024), Fakoya et al. (2023), Niu et al. (2023), and Vallee et al. (2020). Confirmatory factor analysis (CFA) using structural equation modelling (SEM) was conducted to determine construct validity of the latent constructs: COI and CSA (StataCorp, 2025). The study computed the Cronbach alpha coefficient to measure the reliability of the constructs. Data were collected between January and May, 2025.

To determine the effects of COI on CSA (Hypotheses 1-3), multiple linear regression (MLR) was used, with ordinary least squares. The equation estimated was as follows:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \varepsilon \quad \text{..... Model 1}$$

Where Y is CSA; β0 is the constant; β1, β2, and β3 are coefficients to be estimated; X1 is T-S interactions; X2 is P-S interactions; X3 is the forum discussions; while ε is an error term.

Since Hypothesis 4 involved the testing of several simultaneous relationships, an SEM was used to conduct the analyses more efficiently (StataCorp, 2025). The SEM path diagram estimated in the study was as follows:

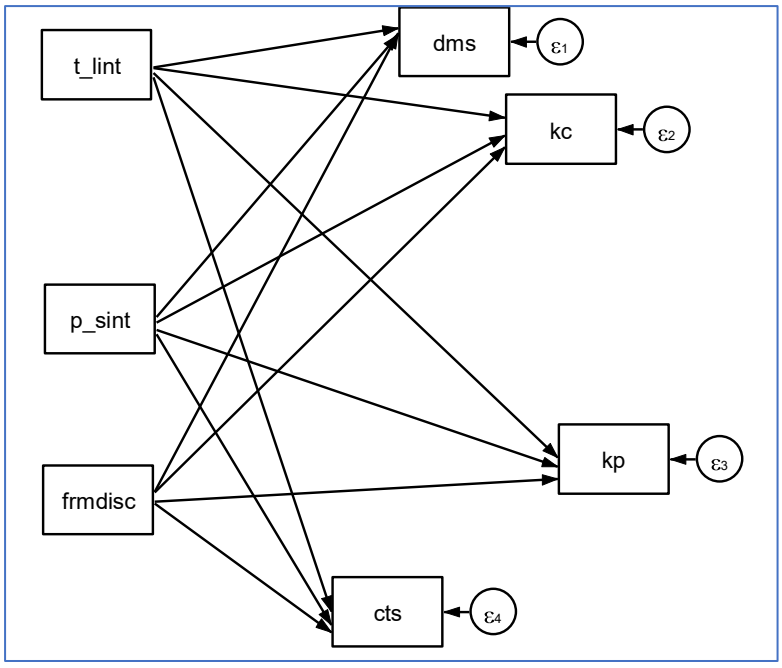

Figure 1: SEM path diagram of hypothesized relationships

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Multiple linear regression assumptions include: the independent and dependent variables should be linearly related; the variables should be uncorrelated; and the dependent variable should be continuous. homoscedastic errors/residuals; no multicollinearity; and non-autocorrelated errors (Green, 2008; Chatterjee & Simonoff, 2012). Data analyses were conducted using STATA, Version 14. Significant differences in the study were recorded at $p<0.05$.

4. Results

4.1 Sample Characteristics

Of the 385 questionnaires given out to students of the nine KMTC campuses in the Rift Valley region, all of them (385) were returned. The study also sampled all 18 department heads for in-depth interviews. Of the 10 students, 7 were studying nursing (72%, *n*=276), with the rest studying clinical medicine. The sampled students were second-years, with 55% (n=212) in Semester One and 45% (n=172) in Semester Two. There were slightly more female students (*n*=208, 54%) than males (*n*=177, 46%). There was a progressive decrease in the number of students as age increased, with 234 (61%), 130 (34%), and 21 (6%) of the students aged 17-21, 22-26, and 27-31 years, respectively.

4.2 Descriptive Results

Table 1 presents the descriptive results for collaborative online interactions.

Table 1: Collaborative online interactions

Teacher-student interactions (Mean=3.90, SD=.83 , Cronbach=.92)	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Body language and expressions used in in-person interaction contribute to a richer communication experience than online	1	5	4.14	0.76
Online discussions with my lecturer strengthen my ability to assess patients and plan appropriate care interventions	1	5	3.91	0.82
My Lecturer's online guidance improves my ability to perform patient care procedures accurately	1	5	3.90	0.84
Engaging in online learning activities with my Lecturer facilitates my understanding of patient care procedures	1	5	3.90	0.84
Consistent engagement with my lecturer online contributes to improved retention of knowledge and skills	1	5	3.86	0.86
Peer-student interaction (Mean=3.91, *SD*=.83, Cronbach=.88)	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Engaging in online discussions with my peers makes me a good team player	1	5	3.94	0.87
	1	5	3.93	0.88

Engaging in skills laboratory practice with my peers builds my competence in patient care procedures	1	5	3.92	0.89
Collaborative skills laboratory practice makes me learn patient care procedures better than online learning	1	5	3.89	0.92
Engaging with fellow students online helps me communicate well with patients	1	5	3.88	0.92
Online student-peer interactions enable me to clearly explain patient care procedures to colleagues	1	5	3.54	1.12
Online interactions with my peers enable me to integrate the knowledge shared into practice				
Forum discussions (Mean=3.72, SD=.87, Cronbach=.95)	**Min.**	**Max.**	**Mean**	**Std. Dev.**
Participating in online discussions strengthens my ability to assess patients/ plan appropriate care interventions	1	5	3.92	0.89
Face-to-face conversations lead to longer retention of skills on patient care procedures than online discussions	1	5	3.90	0.90
Face-to-face discussions deepen my understanding of the subject matter more than online sessions	1	5	3.90	0.91
Online forums enable me to gain more understanding of making evidence-based decisions	1	5	3.86	0.93
Online discussions enable me to develop a holistic understanding of patient care	1	5	3.53	1.11
Aggregate composite score	1	5	3.87	0.021

Overall, respondents commonly agreed that collaborative online interaction positively influences clinical competence, particularly through lecturer engagement and blended peer collaboration, while highlighting the continued importance of integrating face-to-face elements within blended learning models (aggregate composite mean = 3.87; SD = .021).

Findings of teacher-student interactions revealed that students agreed that online discussions with their lecturers strengthen their ability to assess patients and plan care interventions (Mean = 3.91, *SD* = 10.82), engaging in online learning activities with lecturers facilitates understanding of patient care procedures (Mean = 3.90, *SD* = .84), and that lecturers' online guidance improves accuracy in performing patient care procedures (Mean = 3.90, *SD* = .84). Most students also agreed that consistent online engagement with their lecturers enhances retention of knowledge and skills (Mean = 3.86, *SD* = .86). However, students also agreed that body language and facial expressions in face-to-face interaction contribute to richer communication than online platforms (Mean = 4.14, *SD* = .76).

The study found that online peer interaction strengthens teamwork (Mean = 3.94, SD = .87), skills laboratory practice with peers builds competence on patient care procedures (Mean =

3.93, SD = .88), improves communication with patients (Mean = 3.89, SD = .92), enables clearer explanation of patient care procedures (Mean = 3.88, SD = .92), and enables integration of knowledge shared into practice (Mean = 3.54, SD = 1.12). However, the perception that collaborative skills laboratory practice enhances the learning of patient care procedures more effectively than online interaction alone was also strong (Mean = 3.92, SD = .89).

Moreover, the study found that online forums strengthen students' ability to assess patients/ plan appropriate care interventions (Mean = 3.92, SD = .89), enabled them to gain a better understanding of making evidence-based decisions (Mean = 3.86, SD = .93), and helped them develop a holistic understanding of patient care (Mean = 3.53, SD = 1.11). The results suggested that online discussions contribute positively to critical thinking and clinical reasoning, though they may not fully substitute the depth and engagement of face-to-face dialogue.

4.3 Clinical Skills Acquisition

Table 2 presents descriptive results on clinical skills acquisition, which comprised decision-making skills, knowledge construction, knowledge production, and critical thinking skills.

Table 2: Clinical skills acquisition

Decision making skills (Mean=3.60, SD=.91, Cronbach=.84)	**Min.**	**Max.**	**Mean**	**Std. Dev.**
I use evidence-based practice to support my decisions to improve patient care outcomes	1	5	4.14	0.81
Varying learning environments enable me to prioritize tasks/make sound clinical decisions on patient management	1	5	3.97	0.86
The blended learning approach enables me to assess, prioritize, and develop appropriate patient care management	1	5	3.49	1.14
I feel confident in applying the knowledge acquired to make an accurate patient diagnosis	1	5	3.47	1.18
I can prescribe the correct treatment for patients by analyzing information from diverse sources	1	5	3.47	1.14
Knowledge construction (Mean=4.08, SD=.62, Cronbach=.92)	**Min.**	**Max.**	**Mean**	**Std. Dev.**
I collaborate with other healthcare professionals to ensure the provision of comprehensive patient care	1	5	4.17	0.72
I always communicate patient information to the healthcare team effectively	1	5	4.10	0.70
I can integrate theoretical concepts with practical skills in a variety of patient case management	1	5	4.09	0.68

I can use the skills learned on patient care procedures to address a variety of patient needs	1	5	4.06	0.71
I can apply knowledge learned to make informed decisions in patient care	1	5	4.05	0.76
Knowledge production (Mean=4.12, SD=.63, Cronbach=.93)	**Min.**	**Max.**	**Mean**	**Std. Dev.**
I maintain aseptic technique when performing all procedures for patients	1	5	4.23	0.73
I document patients' procedures accurately in their medical records	1	5	4.23	0.73
I take a good history and perform a physical examination on patients accurately during their hospital visits	1	5	4.10	0.74
I generate solutions for patients' complex problems using the knowledge learned in my training	1	5	4.07	0.74
I communicate effectively with patients using clear language to ensure they understand their treatment plans	1	5	4.05	0.77
I perform clinical procedures on patients with less supervision based on the skills acquired from training	1	5	4.04	0.74
I make well-informed, evidence-based decisions in patient management	1	5	4.04	0.78
Good critical thinking skills (Mean=4.15, SD=.63, Cronbach=.91)	**Min.**	**Max.**	**Mean**	**Std. Dev.**
I evaluate patients' outcomes to determine their response to treatment	1	5	4.18	0.68
I analyze patient assessment data to develop an appropriate plan of management	1	5	4.17	0.69
I provide effective education to patients on their conditions/treatments	1	5	4.15	0.73
I identify potential complications in patients during their management and develop preventive strategies	1	5	4.12	0.74
Aggregate composite score	1	5	3.98	0.58

Students perceive blended learning as highly effective in developing clinical decision-making, knowledge construction, knowledge production, and critical thinking (aggregate composite mean =3.98; SD = .58. The findings show high agreement that students use evidence-based

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practice to support their decisions to improve patient care outcomes (M = 4.14, SD = .786), make sound decisions by integrating lessons from blended learning approaches (M = 3.97, SD = .86), develop appropriate patient care management (M=3.49, SD=1.14), and feel confident applying knowledge to make accurate diagnoses and prescribing appropriate treatments using diverse sources of information (M for both= 3.47).

For knowledge construction, students agreed that they collaborate with professionals (M = 4.17, SD = .72). communicate effectively with teams (M = 4.10, SD = .70), integrate theory with practice (M = 4.09, SD = .68), and use the skills learned on patient care procedures (M = 4.06, SD = .71). These findings suggest that knowledge construction through blended learning enables effective patient management and team coordination.

On knowledge production, students agreed that they maintain aseptic techniques (M = 4.23, SD = .73), document patient procedures effectively (M = 4.23, SD = .73), accurately perform history taking and examinations (M = 4.10, SD = .74), solve complex problems using learned knowledge (M = 4.07, SD = .74). and communicate effectively with patients using clear language (M = 4.05, SD = .77). This means that students are translating learned knowledge and skills into competent, autonomous practice.

Results on critical thinking skills showed that students evaluate patients' outcomes to determine their response to treatment (M = 4.18, SD = .68), analyze data for management planning (M = 4.17, SD = .69), provide patient education (M = 4.15, SD = .73), and identify complications and develop preventive strategies (M = 4.12, SD = .74).

4.4 Hypotheses Tests

The study first tested the assumptions of MLR. Analyses of regression plots showed a random distribution of errors, confirming homoscedasticity. Tolerance values for all predictors ranged from 0.285 to 0.607, indicating no multicollinearity. The Durbin-Watson statistic of 1.840 falls within the acceptable range of 1 to 3, indicating uncorrelated errors. Table 3 shows the results of the MLR.

Table 3: Results of regression analysis on effects of COI on CSA

	B	SE*B*	*β*	*t*	*p-value*
(Constant)	2.294	0.132		17.38	*p*<.001
T-L interac.	0.201	0.038	0.288	6.28	*p*<.001
P-S interac.	0.111	0.056	0.158	1.98	0.048
FrmDisc	0.125	0.053	0.187	2.34	0.018
R^2	0.311				
Adjusted R^2	0.306				
F change	57.447				

Key: T-L interac. = Teacher-learner interactions; P-S interac. = peer student interaction; FrmDisc=Forum discussion.

The *R^2 in the model was 0.311, indicating* that COI could account for roughly 31% of the variance in clinical skills acquisition. This suggested that although COI could explain some of

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the variation in CSA, other factors not included in the model are also germane. Results showed that all the components of COI: T-L interactions (b=0.201, t=6.28, p<0.001), P-S interactions (b=0.111, t=1.98, p=0.048), and forum interactions (b=0.125, t=2.34, p=0.018), significantly predicted CSA. The findings showed that when T-L interactions increase by 1 unit, CSA increases by 0.201 (4.04%) (coefficient of determination = r^2 = 0.201^2), *ceteris paribus*. Similarly, when P-S interactions increase by one unit, a student's CSA goes up by 0.111, *ceteris paribus*. On the other hand, results showed that when forum discussions improve by one unit, a student's CSA increases by 0.125, *ceteris paribus*. The results supported Hypotheses 1, 2, and 3: that higher-quality teacher-student interaction, higher-quality peer-student interaction, and higher-quality students' online forum discussions are positively related to clinical skills acquisition.

The results showed that T-L interactions had the greatest effect on CSA (β = 0.288), followed by forum discussions (β = 0.187), and lastly, P-S interactions (β = 0.158). This finding was supported by results from automatic linear modeling (Figure 2), which showed that T-S interactions were the most important predictor of CSA (with a predictive score of 0.75), followed by forum discussion (predictive score = 0.13), and, lastly, P-S interactions (predictive score = 0.12).

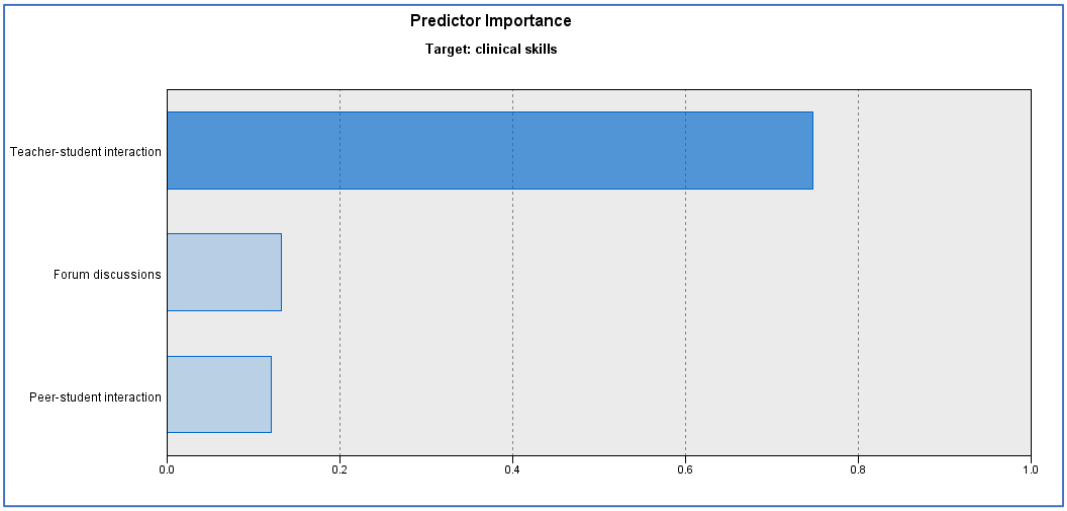

Figure 2: Predictive importance of COI components on CSA

Table 3 presents the coefficients from the SEM model relating collaborative teacher-learner interactions to decision-making skills, knowledge construction, knowledge production, and critical thinking skills.

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Table 3: Path coefficients from SEM analysis on the effects of COI on quality clinical skills

Relationship			Coefficient	S.E	*z*	*p*	95% CI	
							LL	*UL*
DMS	<---	T_Lint	.253	.064	3.953	*p*<0.0001	0.128	0.379
KC	<---	T_Lint	.216	.045	4.840		0.129	0.303
KP	<---	T_Lint	.186	.054	3.438	*p*<0.0001	0.080	0.292
CTS	<---	T_Lint	.150	.045	3.304	0.001	0.061	0.238
DMS	<---	p_sInt	.183	.093	1.968	0.001	0.0005	0.366
KC	<---	p_sInt	.115	.065	1.754	.049	-0.013	0.242
KP	<---	p_sInt	.093	.079	1.169	.079	-0.062	0.247
CTS	<---	p_sInt	.052	.066	.782	.242	-0.077	0.182
DMS	<--- frmDisc		.127	.088	1.438	.434	-0.045	0.300
KC	<--- frmDisc		.102	.062	1.649	.151	-0.018	0.222
KP	<--- frmDisc		.108	.075	1.452	.099	-0.037	0.254
CTS	<--- frmDisc		.163	.062	2.609	.146	0.041	0.285
						.009		

Key: SE=standard error; CI=confidence interval; LL=lower limit; UL=upper limit

Findings showed that T-S interactions positively and significantly influenced the acquisition of all the four components of clinical skills: DMS [*b*=0.253, 95% CI (0.128 -0.379)]; KC [*b*=0.216, 95% CI (0.129-0.303)], KP, [*b*=0.186, 95% CI (0.080 -0.292)], and CTS [*b*=0.150, 95% CI (0.061 -0.238)]. had no significant effect on DMS. Peer-student interactions were found to significantly predict DMS [*b*=0.183, 95% CI (0.0005 -0.366)] but not KC, KP, or CTS. On the other hand, student forum discussions significantly predicted the development of CTS [*b*=0.163, 95% CI (0.041 -0.285)] but not DMS, KC, or KP. The results supported Hypothesis 4, that collaborative online interactions are likely to have differential effects on the elements of CSA: decision-making skills, knowledge construction, knowledge production, and critical thinking skills.

5. Discussion

This study found that the more high-quality teacher-student interactions, the more strongly they predict learners' acquisition of clinical skills. This finding was consistent with the conclusions reported by Xie et al. (2023), Shahkarami et al. (2025), and Vallee et al. (2020). Regression and descriptive analyses confirmed that the presence of lecturers in online environments

strengthens understanding, retention, and procedural precision. However, the recognition of richer communication in physical settings suggests that blended learning models should integrate structured online lecturer engagement with periodic face-to-face interaction. These results were supported by key informant interviews with HODs. For instance, one answered:

"… When lecturers actively participate in online discussions, students understand patient care procedures better because they receive clarification in real time …" (KII_03, Male, 30th March, 2025).

Another answered:

"… Online guidance from lecturers strengthens students' ability to assess patients and plan appropriate interventions before going to clinical areas. Continuous online engagement improves retention of knowledge since students keep interacting with the lecturer even outside classroom hours …" (KII_01, Female, 25th March, 2025; KII_02, Female, 27th March, 2025).

The blended learning models should maintain strong engagement with lecturers online while incorporating periodic face-to-face sessions to optimize communication and skill mastery. Anchored in the Constructivist Theory, learning occurs through guided interaction and active engagement; thus, online lecturer facilitation supports knowledge construction. The findings also align with Self-efficacy Theory, as consistent guidance and feedback from lecturers strengthen students' confidence in performing clinical procedures. Shehzad and Charles (2023) found that instructor presence and interaction significantly enhance student engagement and perceived learning in online environments. Similarly, research in nursing education by McCutcheon et al. (2025) reported that structured online instructor guidance improves clinical reasoning. Nonetheless, Wang and Huang (2023) cautioned that a lack of nonverbal cues in online settings may reduce the depth of communication, thereby supporting students' preference for blended interaction.

High-quality peer-student interactions positively and significantly predict learners' acquisition of clinical skills. Together with descriptive results, the findings imply that peer collaboration significantly enhances teamwork, communication, and competence, but physical collaborative practice remains crucial for deeper skill mastery. Respondents indicated that discussing procedures online helps students explain clinical steps clearly and support one another's understanding. In illustrating this position, KII_O2 stated that:

"… When students discuss procedures among themselves online, they learn how to explain clinical steps clearly and support each other's understanding. Also, online peer interaction strengthens teamwork skills, which are very important in hospital settings where collaboration is required …"

(KII_07, Male, *18th April*, 2025; (KII_02, Female, 27th March, 2025).

Peer collaborative interactions within blended learning environments offer students valuable opportunities for social learning experiences, a key ingredient in both Constructivist and Self-Efficacy theories. According to Vygotsky's sociocultural theory, social interactions significantly enhance learning, particularly when students collaborate with their peers (Rahmatirad, 2020). In the realm of clinical skills acquisition, such collaborative interactions can promote a mutual understanding of concepts and techniques, enabling students to learn from one another's experiences. Peer collaboration allows students to practice clinical skills in

both simulated and real-world contexts. This practice, along with constructive feedback from peers, helps refine their skills. The findings from this study align with those reported by Niu et al. (2023), Regmi et al. (2024), Fakoya et al. (2023), Bach and Thiel (2024), and Zhang & Cui (2018).

This study found that high-quality online forum discussions significantly and positively predict learners' acquisition of clinical skills. In support of this, HODs indicated that online forums encourage students to analyze patient cases and justify their decisions with evidence.

"... Online forums encourage students to analyze patient cases and justify their decisions using evidence ..." (KII_03, Male, 30th March, 2025).

They further indicated that participating in discussion boards strengthens clinical reasoning because students must logically defend their interventions.

"... Participating in discussion boards strengthens students' clinical reasoning because they must defend their interventions logically. Also, guided online discussions enhance patient assessment skills when structured case scenarios are provided *..." (KII_O8, Female, 6th April, 2025).*

This study's findings supported conclusions by Peramunugamage et al. (2025), Shahkarami et al. (2025), Niu et al. (2023), and Nsengimana et al. (2021). Anchored in the Constructivist Theory, discussion forums provide a platform for reflective dialogue and shared meaning-making, enhancing cognitive development. Through the lens of Self-efficacy Theory, active participation in discussions builds confidence in clinical decision-making.

This study found that while T-S interactions significantly predicted the acquisition of all four components of clinical skills: DMS, KC, KP, and CTS, peer-student interactions were found to significantly predict only DMS, while student forum discussions significantly predicted only the development of CTS. This could be one of the first empirical reports to demonstrate the primacy of teacher-guided student interactions in the development of CS. This finding supports conclusions by Shahkarami et al. (2025) and Vallee et al. (2020), who argued that teachers, as facilitators, play a critical role in guiding online discussions, clarifying abstruse concepts, and providing feedback. Therefore, inasmuch as peer-student interactions and forum discussions are important in CS development, they are augmented when instructors step in to provide direction and clarity. This study also found that the prerequisites for CTS development were T-S interactions and forum discussions. Carvalho et al. (2017) argued that CTS involves the ability to question assumptions, consider multiple perspectives, and make evidence-based decisions. Forum discussions provide an appropriate environment for developing these skills, while instructors provide the requisite guidance.

6. Conclusion

This study aimed to determine the relationship between collaborative online interactions and the acquisition of clinical skills among students at Kenya Medical Training College Campuses in the Rift Valley, Kenya. The study concluded that interactive and collaborative learning environments within blended learning significantly support the development of practical clinical competence. Active engagement with lecturers and peers through online discussions, guided forums, and collaborative learning activities strengthens understanding of clinical procedures, improves teamwork and communication skills, and builds confidence in

performing patient care tasks. This study found that T-S interactions were the most important predictor of CSA (predictive score = 0.75), followed by forum discussion (predictive score = 0.13) and, lastly, P-S interactions (predictive score = 0.12). This study demonstrated the primacy of teacher involvement and guidance for an effective online learning experience. This could be one of the first empirical reports of the relationships of COI and CSA in a Kenyan medical education setting.

7. Recommendations

This study recommends that medical education colleges implement instructor-guided online teacher-student interactions, peer-student interactions, and forum discussions as part of a blended learning approach to effectively acquire clinical skills.

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