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Student Training Attitudes As A Moderator Of Institutional Determinants Of Ultrasonography Learning Outcomes In Selected Teaching Hospitals In Kenya

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Abstract
Ultrasound technology has emerged as an effective clinical diagnostic tool for addressing primary health care (PHC) quality healthcare concerns in Kenya. However, the application of ultrasound technology in Kenya is characterized by low quality of work output, which risks the patients' life and undermines the gains made by the ultrasound technology. The low quality of work output can be traced back to the sonographers' training, where concerns are being raised over the failing standards of training. Therefore, the study sought to establish how students' attitudes towards training moderate the relationship between institutional factors and ultrasonography training outcomes. The study used a mixed research approach employing both qualitative and quantitative methods. It targeted five Kenya Medical Training College (KMTC) campuses offering the radiography course across four counties (Level 6) and one level 5 teaching hospitals in Kenya. The target population was final year KMTC students undertaking their radiography and imaging course, the faculty members and the hospital-based instructors. Systematic random sampling was used to select 98 students, of who 45 were females and 53 males, while the census method was used to select 26 faculty members and 10 hospital-based instructors. Questionnaires for students, interview schedules for lecturers, hospital-based instructors, and Focus Group discussions for students were used for data collection. Quantitative data from the questionnaire were analyzed using descriptive statistical methods and inferential statistics. The results showed that students' attitudes significantly moderated the relationship between institutional factors and ultrasonography training outcomes among diploma-level KMTC students in Teaching Hospitals in Kenya. Students questioning the relevance of sonography training in light of shifting medical trends like PoCUS signaled a breakdown in aligning curriculum with evolving professional realities. The study, therefore, recommends reinforcing the importance and career prospects of specialized ultrasound training by integrating PoCUS concepts into the ultrasonography curriculum.

Keywords: *Ultrasound Technology, Students' Attitudes, Institutional Factors, Ultrasonography Training*

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I. Introduction

Ultrasound, particularly point-of-care ultrasound (POCUS), has become an indispensable diagnostic tool in low- and middle-income countries (LMICs) due to its portability, affordability, and adaptability (Cevik et al., 2019). Its use in primary care settings allows for bedside and even home-based evaluations, enabling early diagnosis and clinical decision-making in underserved areas with limited access to advanced imaging technologies (Kim et al., 2018; Boivin et al., 2022). As healthcare systems increasingly rely on ultrasound to close diagnostic gaps, particularly in maternal and emergency care, demand for skilled sonographers has grown substantially. Unlike modalities such as X-rays or CT scans, ultrasound is highly operator-dependent, requiring both technical skill and clinical acumen to obtain and interpret accurate images (Wakefield et al., 2018). This complexity underscores the importance of rigorous training, yet many LMICs face significant barriers to effective implementation. These include limited faculty expertise, shortages of up-to-date equipment, high student-to-machine ratios, and curriculum inconsistencies (Lujan & DiCarlo, 2006). Globally, the absence of standardized training content, duration, and trainer qualifications has further complicated efforts to integrate ultrasound into medical education frameworks (Nicholas et al., 2021; Glass et al., 2021).

Training outcomes in ultrasonography vary widely depending on regional and institutional factors. High-income countries, such as those in Europe and North America, benefit from advanced infrastructure, experienced instructors, and standardized competency-based curricula, which contribute to higher levels of student proficiency (Smith & Patel, 2024; Yang et al., 2021). In contrast, countries like India, despite deploying mobile ultrasound units and low-cost innovations, continue to struggle with faculty shortages and weak mentorship systems (Sharma & Kumar, 2024). Similarly, in sub-Saharan Africa, challenges are broad and multifaceted: South Africa and North

African nations face inconsistent faculty training and curricular implementation, while Nigeria, Ethiopia, and Rwanda report poor clinical exposure, equipment scarcity, and insufficient instructor support (Adebayo et al., 2023; El-Tallawy et al., 2021; Niyibizi et al., 2021).

In Kenya, ultrasound education has gained traction following Ministry of Health regulations that mandate higher diploma-level qualifications for licensed sonographers (Kagima et al., 2021). Institutions like the Kenya Medical Training College (KMTC) have introduced POCUS, sono-anatomy, and pathology modules into their curricula and expanded access to portable devices (Mungai et al., 2021). Despite these improvements, major constraints remain. Equipment shortages, high student-to-machine ratios, limited faculty training, and absence of a standardized curriculum continue to affect the quality of ultrasound instruction and skill acquisition (Smith & Patel, 2024). While donor partnerships and government investments have alleviated some infrastructure gaps, persistent variability in training outcomes suggests deeper, more complex influences at play.

One such underexplored influence is the role of student attitudes. Emerging evidence suggests that psychosocial factors such as motivation, self-confidence, perceived career value, mentorship quality, and peer collaboration significantly shape students' engagement and competence in ultrasound training (Jones et al., 2024; Boivin et al., 2022). Positive attitudes may mitigate institutional shortcomings by enhancing students' commitment, adaptability, and skill retention, while negative attitudes, stemming from limited mentorship, unclear career pathways, and restricted access to hands-on training, can exacerbate the effects of institutional limitations (Kagima et al., 2021). Despite the relevance of these factors, few empirical studies in Kenya have examined how student attitudes interact with institutional environments to influence ultrasonography training outcomes.

This gap is particularly concerning given that public institutions like KMTC train the majority of Kenya's sonography workforce under resource-constrained conditions. Understanding how students' training attitudes moderate the impact of institutional determinants, such as equipment availability, faculty capacity, and curriculum delivery, can provide valuable insights into improving educational quality and diagnostic competency. Addressing this knowledge gap is crucial for designing evidence-based, context-sensitive interventions that not only enhance learning outcomes but also ensure better diagnostic care delivery in Kenya's healthcare system.

II. The Problem Statement

Ultrasound training has become a vital component of medical education in Kenya, given its critical role in enhancing diagnostic capacity and improving healthcare delivery in resource-limited settings (Kagima et al., 2021). At institutions such as the Kenya Medical Training College (KMTC), students receive both theoretical instruction and hands-on ultrasound practice aimed at preparing them for bedside diagnostics and rural healthcare challenges (Mungai et al., 2021; Boivin et al., 2022). However, sonographers uniquely bear the responsibility of interpreting ultrasound images and generating diagnostic reports, requiring advanced clinical judgment and technical skills, areas where many student radiographers demonstrate significant difficulties (Teichgräber et al., 2022). These challenges raise concerns about graduates' readiness to deliver accurate diagnoses, with inadequate training potentially contributing to diagnostic errors and poor patient outcomes. Institutional constraints, including limited access to modern ultrasound equipment, high student-to-machine ratios, faculty shortages, and insufficient curriculum time—further impede effective training (Smith & Patel, 2024). Institutional factors such as the availability and maintenance of ultrasound equipment, faculty expertise, curriculum content, and student-to-machine ratios have been identified as critical determinants of ultrasound training quality (Smith & Patel, 2024; Kagima et al., 2021). However, the influence of students' attitudes, including their motivation, confidence, perceptions of mentorship quality, peer collaboration, and career prospects, on the effectiveness of training remains inadequately explored in the Kenyan context (Jones et al., 2024).

Positive attitudes may serve as a buffer, enabling students to overcome institutional constraints and enhance skill acquisition and clinical competence, while negative attitudes may further diminish training outcomes by reducing engagement and practical learning opportunities (Boivin et al., 2022). Despite ultrasound's increasing importance in clinical diagnostics, there is no standardized curriculum or consensus on training parameters in Kenya, complicating efforts to improve education quality (Nicholas et al., 2021). Furthermore, research focused on KMTC students, who constitute a significant portion of the country's sonography workforce, is limited, leaving a gap in understanding how psychosocial and institutional factors interact to influence training outcomes. This study aims to address this gap by investigating the moderating role of student attitudes on the relationship between institutional variables and ultrasonography training outcomes, thereby providing evidence-based insights to inform targeted interventions for enhancing ultrasound education and ultimately improving diagnostic accuracy and patient care in resource-limited Kenyan healthcare settings.

III. Objective

The objective of the study is to establish how students attitudes on training moderates the relationship between institutional factors and ultrasonography training outcomes among diploma level KMTC students in selected Teaching Hospitals in Kenya

IV. Materials AND Methods

Research Design

This study adopted a mixed-methods research design, incorporating both quantitative and qualitative approaches. The use of quantitative methods ensured generalizability of findings across KMTC campuses (Weinreich, 2009). Complementing this, the qualitative component, achieved through interviews and focus group discussions (FGDs), allowed for deeper exploration of experiential and contextual insights particularly from instructors and students.

Study Site

The study was conducted at 5 select KMTC campuses with affiliated Teaching Hospitals offering radiography and imaging courses. These campuses, strategically located adjacent to well-equipped public hospitals, provide an integrated platform for theoretical instruction and clinical training. The study focused on six such campuses: Nairobi (Level 6), Nakuru (Level 6), Kisumu (Level 6), Uasin Gishu (Level 6), Nyeri (Level 6), and Kericho (Level 5). The choice of these sites was informed by their provision of ultrasonography training within real clinical environments, which is essential for practical competence in imaging sciences.

Target Population

The study targeted final-year diploma students in radiography and imaging, full-time teaching faculty from the Faculty of Diagnostic Sciences, and hospital-based instructors involved in ultrasonography training. The focus on final-year students was predicated on their advanced level of exposure to both theoretical and clinical training, making them suitable respondents for assessing training outcomes. A total of 263 students, 26 faculty members, and 12 hospital-based instructors constituted the overall population of interest (N=301). These respondents were drawn exclusively from radiography departments, excluding individuals from other faculties or disciplines, as well as junior-level and part-time participants.

Sampling Procedure

A combination of probability and non-probability sampling techniques was used. Systematic random sampling was applied to select student respondents from the eligible population in each campus. Stratified proportional allocation ensured equitable representation of students across the six campuses. Conversely, a census method was employed for faculty and hospital-based instructors due to their limited numbers. Sample size determination for the student cohort was guided by Nassiuma's (2000) formula, taking into account an error margin of 4% and a coefficient of variation of 50%. This yielded a sample of 98 students. All 26 faculty members and 12 hospital-based instructors were included using the census method, bringing the total sample size to 136 respondents. Nyeri campus was set aside for pilot testing and excluded from the final sample.

Data Collection Instruments

Three instruments were utilized for primary data collection: a structured questionnaire, a semi-structured interview schedule, and a focus group discussion guide. The questionnaire was designed for student respondents and structured to collect data on perceptions, access to ultrasonography equipment, training outcomes, and moderating attitudes, using Likert-type scales to facilitate quantitative analysis. Interview schedules were administered to faculty members and hospital-based instructors to elicit expert insights on the structural, pedagogical, and logistical dynamics of ultrasonography training. FGDs were conducted with students to explore shared experiences and challenges, capturing rich qualitative data. The combination of these instruments enabled data triangulation, thus enhancing the comprehensiveness and interpretive validity of the study. Questionnaires ensured coverage and comparability, while interviews and FGDs added depth and contextual nuance to the findings.

Pilot Study and Instrument Validation

A pilot study was conducted at Nyeri KMTC campus. The objectives of piloting were to test the clarity, relevance, and reliability of the data collection tools. Based on feedback from the pilot, necessary revisions were made to item structure and wording to improve coherence and respondent comprehension. Validity of the instruments was established through expert review by specialists in medical education and radiography. Their input ensured alignment of content with the research objectives, enhancing content validity. The internal consistency of the questionnaire was assessed using Cronbach's alpha, with a threshold of $\alpha \geq 0.7$ considered

acceptable. Items not meeting this criterion were revised or removed accordingly. Reliability of qualitative instruments was ensured through accuracy reliability coding during content analysis. Coders were trained to minimize inter-rater and intra-rater inconsistencies (Krippendorff, 2004), and accuracy reliability was selected as it provides the most stringent test of reliability (Miller & Whacker, 1999). Questionnaires were afterwards self-administered, allowing respondents adequate time to complete them. Interviews and FGDs were conducted face-to-face in a semi-structured format, audio-recorded with consent, and later transcribed verbatim for analysis.

Data Analysis

Quantitative data were analyzed using the Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics including frequencies, percentages, means, and standard deviations were computed to summarize the distribution of responses. Inferential statistical analysis was conducted using bivariate regression to assess the influence of institutional determinants on ultrasonography training outcomes, both before and after accounting for the moderating role of student attitudes. The hierarchical regression model was structured as follows:

Before moderation: $Y=\beta0+\beta1X+\varepsilon$

After moderation: $Y=\beta0+\beta1XM+M+\varepsilon$

Where:

YY = Ultrasonography training outcomes

XX = Institutional determinants (composite of student perceptions and equipment availability)

MM = Student attitudes (moderating variable)

ε = Error term

Qualitative data from interviews and FGDs were analyzed through thematic content analysis. Coding was done both deductively, based on pre-identified categories (e.g., institutional support, equipment access), and inductively from emerging themes. Insights were synthesized with quantitative findings using methodological triangulation to enrich interpretation and validate patterns observed across the data strands.

This study adhered strictly to ethical research standards. Upon receiving research clearance from the National Commission for Science, Technology and Innovation (NACOSTI) and Moi University Institutional Review Board, formal permissions were sought from respective County Commissioners and hospital management. Informed consent was obtained from all participants. Participation was voluntary, with full disclosure of the study's purpose, and respondents were free to withdraw at any time. Anonymity and confidentiality were ensured through the use of coded identifiers in place of personal information. All data were securely stored and used solely for academic purposes.

V. Results

Introduction

The study achieved both a high questionnaire response rate 79(81%) and interview guides response rate 22(61%) which resulted from the self-administered method of administration of the instrument which optimized the response rates (Dillman, 2011).

Students attitudes on training and ultrasonography training outcomes

The objective of the study was to determine the influence of students attitudes on ultrasonography training among diploma level KMTC students in selected Teaching Hospitals in Kenya.

Quantitative results on students' attitudes on ultrasonography training

The objective was measured in terms of; level of training, peer training, future job prospects and mentorship. The findings are given in Table 1.

Table 1: Students attitudes on training and ultrasonography training outcomes

	SA	A	N	D	SD		Std.
Statement	Freq(%)	Freq(%)	Freq(%)	Freq(%)	Freq(%)	Mean	Dev
The ultrasound classes are usually overcrowded	31(39)	17(22)	10(13)	10(13)	11(14)	3.59	0.902
I am not sure whether I would want to become an ultrasound medical professional after the learning exposure	20(25)	29(37)	13(16)	9(11)	8(10)	3.56	0.657
The ultrasound machines are so big and it affects our learning	18(23)	25(32)	12(15)	13(16)	11(14)	3.33	0.679
My colleagues are thinking of dropping the ultrasound unit if it is possible	17(22)	35(44)	8(10)	10(13)	9(11)	3.52	0.799
With the rise of PoCUS and the fact that it is being used widely by other medical professionals, I would rather pursue other radiology courses to make me more relevant	15(19)	31(39)	14(18)	9(11)	10(13)	3.41	0.925

We do not have enough mentors to develop us into ultrasound professionals	16(20)	30(38)	11(14)	14(18)	8(10)	3.41	0.784
We do not have enough lecturers for the course	13(17)	28(36)	12(16)	18(21)	8(10)	3.25	1.046
Peer training is often encouraged in our classes in order for us to practice more	24(30)	19(24)	8(10)	8(10)	20(25)	3.24	0.854
Our lecturers show a lot of depth in ultrasound applications	24(30)	20(25)	19(24)	8(10)	8(10)	3.56	0.854
Aggregate						3.399	0.831

The findings in Table 1 shows that the aggregate mean scores of the items describing students attitudes on ultrasonography training was mean = 3.399 and standard deviation = 0.8431. The aggregate mean value is higher than the mid value of 2.5 and the standard deviation is less than unity which indicates that the respondents agreed with little variations with the statements describing the students' attitudes on ultrasonography training in their colleges. Most students strongly agreed that the ultrasound classes are usually overcrowded (39%; mean = 3.59). The students were, however, uncertain on whether the big sizes of ultrasound machines affects their learning (32%; mean = 3.33). Most of the students were also not sure whether they would want to become an ultrasound medical professional after the learning exposure (37%; mean = 3.56).

Most students also said that their colleagues were thinking of dropping the ultrasound unit if it is possible (44%; mean = 3.52). There were also indications that with the rise of PoCUS and the fact that it is being used widely by other medical professionals, most student felt they would rather pursue other radiology courses to make them more relevant (39%; mean = 3.41). Most students also agreed that they did not have enough mentors to develop them into ultrasound professionals (38%; mean = 3.41). Other findings indicated that the colleges did not enough lecturers for the course (36%; mean = 3.25). Also, there were indications that peer training is often encouraged in the classes in order for the students to do more practice (30%; mean = 3.24). Most students also strongly agreed that their lecturers show a lot of knowledge in ultrasound applications (30%; mean = 3.56). The findings indicate that a significant number of ultrasonography students were dissatisfied or unsure about the relevance of ultrasound training in the current medical landscape. The possibility of dropping the ultrasound unit may reflect concerns about the perceived difficulty or limited career opportunities in the field, particularly with the rise of Point-of-Care Ultrasound (PoCUS), which is becoming more widely used by other medical professionals. This shift might make students question the value of pursuing specialized ultrasonography training when more general medical professionals are incorporating ultrasound into their practices.

Qualitative findings on students' attitudes on training

The students were also interviewed regarding the ultrasound training being offered at the college to gauge their attitudes. The results are as follows;

Would you say you and your fellow students get adequate training in ultrasound theory and applications?
STU1: "*I would say the theory part is well-covered. Our tutors are knowledgeable and use notes and PowerPoint presentations effectively. But when it comes to practical training, we don't get enough time with the ultrasound machines due to the large number of students*."
STU3: "*Not really. We mostly learn the theory in class, but the actual application is limited. Sometimes we wait weeks before getting a chance to operate the machine during clinical rotations, and even then, it's often just observing*."

Do you find ultrasound theory and applications training interesting?
STU4: "*Yes, very much. It's interesting because we see how ultrasound helps in diagnosing real medical conditions. It makes what we learn in class feel more useful and applicable*."
STU2: "*Sometimes. The content is interesting when it's connected to actual patient cases. But when it's just theory without practical sessions, it becomes hard to stay focused*."

What concerns do you and your colleagues raise regarding their future career prospects as ultrasound specialists?
STU5: "*Our biggest concern is employment. Even after training, there are limited job openings specifically for diploma holders in ultrasonography, especially in public health facilities*."
STU6: "*Most of us worry about being deployed to facilities that don't have functional ultrasound machines or where the equipment is outdated, which makes it hard to use our skills"*

Do you have mentorship in ultrasound in your campus for students?
STU8: "*Yes, some of our lecturers are very supportive and guide us, especially when we're preparing for clinical rotations. But there is no formal mentorship program, just individual effort*."

STU7: "*Not really. We don't have a structured mentorship system. If you want mentorship, you have to approach a lecturer or a clinical instructor personally."*

The qualitative responses reinforce the quantitative findings by offering deeper insights into students' attitudes toward ultrasonography training in diploma-awarding colleges in Kenya. The aggregate mean score of 3.399 (SD = 0.8431) indicates general agreement with the statements on training, and this is echoed in interviews where students acknowledged adequate theoretical instruction but highlighted deficiencies in practical exposure. STU1 and STU3 noted limited access to ultrasound machines due to overcrowding, reflecting quantitative results where 39% strongly agreed that classes are overcrowded (mean = 3.59). Similarly, the uncertainty expressed by students regarding career prospects, illustrated by STU5 and STU6, aligns with findings that many students were unsure about becoming ultrasound professionals (mean = 3.56) or considered dropping the unit altogether (mean = 3.52). The rise of PoCUS and its integration into general medical practice further contributes to this uncertainty, making students question the long-term value of specialization. Furthermore, STU7 and STU8 pointed out the lack of formal mentorship structures, supporting the quantitative claim that 38% of students agreed they lacked enough mentors (mean = 3.41). Together, these findings underscore mixed student attitudes shaped by practical limitations, career ambiguity, and inadequate mentorship.

Ultrasonography Training Outcomes Among Radiography Diploma Level Students At The Kenya Medical Training College

The status of ultrasonography training outcomes among radiography diploma level students at the KMTC was measured through; examination scores, skill levels, sonoanatomy competency, diagnostic competence and interpretation accuracy. These results are presented in Table 2.

Table 2: Ultrasonography Training Outcomes among Radiography Diploma Level Students at the Kenya Medical Training College

	SA	A	N	D	SD		Std.
Statement	Freq(%)	Freq(%)	Freq(%)	Freq(%)	Freq(%)	Mean	Dev
I perform better in ultrasonography theory exams compared to other radiology subjects	14(18)	32(41)	20(24)	9(11)	5(6)	3.51	0.51
I perform better in ultrasonography practical exams compared to other radiology subjects	17(22)	8(10)	7(9)	16(20)	31(39)	2.54	0.814
Sonography training has improved my diagnostic capabilities	9(12)	31(39)	8(10)	20(25)	11(14)	3.09	0.773
Sonography has also improved my understanding of the human anatomy	12(15)	29(36)	12(15)	15(19)	11(14)	3.20	0.831
I am confident in my interpretation of ultrasound scans	12(14)	19(23)	12(14)	26(33)	10(12)	2.96	0.748
My interpretations of results sometimes get rejected and I have to redo the process again	15(19)	24(30)	16(20)	14(18)	10(13)	3.25	0.712
Aggregate Score						3.09	0.731

The findings in Table 2 shows that the aggregate mean scores of the items describing ultrasonography training outcomes among radiography diploma level students at the KMTC was mean = 3.091 and standard deviation = 0.731. The means is a score around the mid value of 2.5 implying that there was uncertainty on the performance of students on ultrasonography. Further, the standard deviation is less than unity which indicates that there was little variations regarding the statements describing ultrasonography training outcomes among radiography students. Most students agreed that they perform better in ultrasonography theory examinations compared to other radiology subjects (41%; mean = 3.51). However, there were strong indications that most students did not perform better in ultrasonography practical exams compared to other radiology subjects (39%; mean = 2.54). Most students were, however, uncertain on whether sonography has improved their diagnostic capabilities (39%; mean = 3.09). Most students were also uncertain on the effect of sonography training on improving their understanding of the human anatomy (36%; mean = 3.20). There were indications that most students were not confident in their interpretation of ultrasound scans (33%; mean = 2.96). The students also indicated that their interpretations of results sometimes get rejected and they have to redo the process again (30%; mean = 3.25).

Regression Analysis

Multivariate regression analysis was used to determine the significance of the relationship between all the independent variables pooled together and the dependent variable. The results were then used to test the corresponding hypothesis stated for the study. The hypotheses was tested at $t \geq 2.0$ and $p < .05$. The decision rule

was to reject the null hypotheses if the corresponding p-value was less than .05.and fail to reject the null hypotheses if the corresponding p-value is greater than .05. The findings, explanations and supporting discussions also included the r-squared, which was the model coefficient of determination, the model F-statistical values and the beta coefficient values.

Regression Model before moderation

Table 3 shows the results of the regression model before moderation.

Table 3: Regression Model before moderation

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	4.087	1.035		3.949	0.708
Institutional Determinants	0.405	0.099	0.504	4.091	0.000
R	0.504		F	15.447	
R Squared	0.254		Sig.	0.000	
Adjusted R Squared	0.238				

Dependent Variable: Ultrasonography training outcomes among diploma

Table 3 showed that the overall model adjusted R^2 is 0.238.This indicated that the model could explain up to 23.8% of the variations in the dependent variable. The rest are explained by the variables not fitted in the model. Field (2019) reported that the suitability of the multiple regression model as a whole can be checked using an F-test. Therefore, the F-statistic computed was 15.447 with a p-value of .000 which implied that the explanatory variables were jointly significant in explaining variations in the dependent variable and, therefore, the model before moderation was fitting to explain the interactions between the variables and could be further analyzed to explain the relationships.

Regarding the model coefficients, the findings suggested that the most influential variable in the model was availability of ultrasound machines ($\beta = 0.504$; $p \leq .05$), and this was the only significant variable in the joint model. The findings also indicate that taking all other independent variables at zero, a unit increase in availability of ultrasound machines would lead to a 0.405 increase in the ultrasonography training outcomes among diploma students at KMTC. The findings, therefore, suggest that the independent variable Institutional Determinants model was significant in explaining ultrasonography training outcomes among diploma students.

Moderating effect of Students Attitudes

To test the moderating effect of students' attitudes on training moderates the relationship between institutional factors and ultrasonography training outcomes among diploma level KMTC students in Teaching Hospitals in Kenya, Students attitudes as the moderator variable was introduced into the regression model as a multiplier. The regression results are presented in Table 4.

Table 4: Multiple linear regression results with moderation

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	4.759	1.01		4.7119	0.000
Institutional Determinants. Students attitudes	0.484	0.084	0.537	5.7619	0.000
Students attitudes	0.358	0.117	0.279	3.0598	0.003
R	0.622		F	7.9126	
R Squared	0.387		Sig.	0.001	
Adjusted R Squared	0.345		df	2,75	

Table 4 shows that the coefficients for the interactive term was all significant where Curricular space. The interative term, Institutional Determinants. Students attitudes coefficient is $\beta = 0.537$, $p = 0.000$and the Students attitudes coefficient (without interaction) is also significant at$\beta = 0.279$, $p = 0.003$. Mackinnon et al., (2007) observes that when the coefficients in the model with the moderating variable as a multiplier is significant and the coefficient of the moderating variable in the model with the moderating variable included but not as a multiplier is significant, then there is a moderating effect. Therefore, the hypothesis;

H01: Students attitudes of training has no significant moderating effect on the relationship between institutional determinants and ultrasonography training outcomes among diploma level KMTC students in Teaching Hospitals in Kenya

Was rejected since the R^2 after moderation ($R^2 = 0.387$) was higher than the R^2 before moderation ($R^2 = 0.254$) and the R^2 change was significant ($p \leq 0.05$). Hence, the study concluded that Students attitudes of training has a significant moderating effect on the relationship between institutional determinants and ultrasonography training outcomes among diploma level KMTC students in Teaching Hospitals in Kenya.

Discussions

The findings of this study strongly reflect the foundational principles of adult learning theory as advanced by Knowles (1984), particularly the assertion that adult learners are self-directed and thrive in learning environments where the content is problem-centered and immediately applicable to real-life tasks. The students' expressed dissatisfaction with the limited practical exposure in ultrasonography, despite adequate theoretical instruction, highlights a core tension between their learning needs and the training design. According to Knowles, adults need to know why they are learning something and how it relates to their professional goals, an aspect clearly undermined when clinical relevance is lacking. Rogers' notion of facilitative learning further reinforces this by emphasizing a climate of acceptance, empathy, and learner autonomy (Rogers & Freiberg, 1994). At KMTC, students' frustration over limited access to ultrasound machines and lack of mentoring points to a learning environment that is more instructor-centered than facilitative. This theoretical mismatch results in disengagement, confirming that without practical relevance, supportive facilitation, and learner involvement in shaping their learning journey, adult learners like KMTC students are unlikely to achieve optimal training outcomes.

The moderating role of student attitudes, especially regarding level of training, can also be understood through the lens of andragogy. One of the key assumptions in Knowles' theory is that adult learners bring prior experiences that form a critical resource for learning, and they are internally motivated when learning is task-oriented. In this study, students reported stronger performance in theoretical aspects of sonography but felt unprepared for clinical application due to limited practical training. This disconnect parallels findings by Vennemann et al. (2020) and Teichgräber et al. (2022), where insufficient hands-on experience weakened student preparedness. Adult learning theory suggests that experiential learning, where learners apply concepts in authentic scenarios, is essential for competence development. The KMTC findings reveal that the absence of this experiential layer leads to negative attitudes, as learners cannot see the practical utility of their training. Without structured opportunities for skill application, the internal motivation central to adult learning diminishes. Hence, the study underscores the critical need for training designs that prioritize experiential, problem-based learning aligned with andragogical principles, enabling students to integrate new knowledge with clinical practice effectively.

Mentorship and perceptions of future job prospects also offer important theoretical implications. Knowles emphasized that adult learners are goal-oriented and need guidance that supports autonomy and professional development. The absence of structured mentorship at KMTC undermines this guidance, leading to uncertainty and reduced confidence, outcomes inconsistent with adult learning principles. Similarly, Rogers' facilitative learning model stresses the importance of genuine, supportive teacher-learner relationships that empower students to explore and achieve personal learning goals (Müller, Johnson & Patel, 2022). The findings from this study reveal a gap in this regard, as students cited emotional and professional ambiguity about career paths in ultrasonography. These concerns reflect unmet needs for career-oriented feedback and personalized support, hallmarks of effective adult education. Furthermore, adult learners value learning that enhances their employability and aligns with real-world demands (Recker et al., 2024). When KMTC students questioned the relevance of sonography training in light of shifting medical trends like PoCUS, it signaled a breakdown in aligning curriculum with evolving professional realities. Therefore, this study validates the application of adult learning theory in medical training contexts, emphasizing the need for learner-centered, purpose-driven, and professionally relevant education systems that support student growth both academically and vocationally.

VI. Conclusions And Recommendations

The study established that students' attitudes significantly moderate the relationship between institutional factors and ultrasonography training outcomes among diploma-level KMTC students. The findings revealed that while theoretical instruction is strong, limited access to ultrasound machines, overcrowded classes, and insufficient mentorship constrain practical learning. Many students expressed uncertainty about future career prospects in ultrasonography, partly due to the growing adoption of Point-of-Care Ultrasound by other medical professionals, which reduces the perceived value of specialization. Nevertheless, students acknowledged the expertise of their lecturers and appreciated the relevance of ultrasound in medical diagnosis. The results underscore that positive student attitudes, when supported by adequate institutional resources, enhance training outcomes. Consequently, strengthening mentorship, expanding practical opportunities, and improving

institutional support are essential for sustaining student engagement and improving ultrasonography competencies.

Drawing from the foregoing findings, the study makes the following recommendations. There is need for the college management to avail career information to students through the use of the counselling department and also through mentorship programs with other practicing ultrasound specialists in the field. The study further recommends reinforcing the importance and career prospects of specialized ultrasound training by integrating PoCUS concepts into the ultrasonography curriculum. This could help students recognize the growing demand for specialized skills in ultrasonography, especially in resource-limited settings. Additionally, greater emphasis should be placed on mentorship, career guidance, and the long-term relevance of radiography and sonography careers to boost student motivation. Partnerships with healthcare facilities offering PoCUS applications could also provide students with exposure to diverse opportunities in the field, making the curriculum more appealing and career-focused.

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