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The Moderating Role of Training Program Design in the Relationship Between Technological Changes and Academic Performance of Imaging Equipment Technology Students at KMTC Rift Valley Region, Kenya

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Abstract

Technological advancements in imaging equipment have transformed medical training worldwide, yet many students in Kenya struggle to adapt to these changes, resulting in poor academic performance in Imaging Equipment Technology (IET) courses at Kenya Medical Training College (KMTC) in Kenya. Despite significant investment in new technologies, gaps in training program design and limited access to modern equipment have contributed to suboptimal student outcomes. This study aimed to examine the moderating role of training program design on the relationship between technological changes and the academic performance of IET students. The study was anchored on the Technology Acceptance Model (TAM) and Goal Theory. A descriptive cross-sectional research design was adopted. The target population comprised 105 final-year IET students, 27 faculty members, and 4 departmental administrators across four KMTC campuses. A sample of 80 students was selected using proportionate stratified random sampling, while all faculty and administrators were included through a census due to their small numbers. Data were collected using structured questionnaires, pretested through a pilot study for content validity and reliability (Cronbach's alpha = 0.82). Descriptive analysis showed that students perceived limited access to modern imaging technologies and inadequate exposure to AI-driven equipment as major contributors to poor performance (overall mean = 3.61). Pearson correlation indicated a strong positive relationship between technological changes and student performance ($r = 0.487$, $p < 0.01$), while training program design showed a weaker but significant positive relationship ($r = 0.156$, $p < 0.05$). Multiple regression analysis before moderation revealed that technological changes significantly predicted academic performance ($\beta = 0.479$, $p < 0.05$; $R^2 = 0.24$). Training program design was found to positively moderate this relationship, showing a significant effect ($\beta = 0.406$, $p = 0.018$) demonstrating that training program design strengthened the relationship between technological changes and academic performance. The study concluded that technological changes affect IET student performance, and well-structured training programs enhance students' capacity to adapt to these changes. It is recommended that KMTC improve access to modern imaging technologies, adopt blended and problem-based learning approaches, and strengthen faculty capacity to optimize students' academic performance.

Keywords: Technological changes, training program design, academic performance, imaging equipment technology, KMTC Rift Valley Region

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Introduction

The demand for the provision of medical imaging services, in particular, has risen to an unprecedented level over the last three decades. Since the beginning of the era of X-rays by W.C. Roentgen in the year 1895, the field of radiological sciences has been improving and introducing advanced imaging techniques like Computed Tomography (CT) scans, Magnetic Resonance Imaging (MRI) scans, and Positron Emission Tomography (PET) scans (Antwi, Akudjedu & Botwe, 2021; Basser, 2022). These advancements in the field have been instrumental for the betterment of patient care by facilitating early diagnostic methods for diseases and accurately monitoring the treatment and management thereof (Feinberg & Setsompop, 2018). However, as the imaging techniques are becoming more sophisticated and embedded into the medical practice, the end outcome for the betterment of the patient depends on the proficiency level of the imaging specialist during training hours. In this regard, academic performances in medical imaging subjects are not just a measure of quality but an important safety factor since the knowledge and actions of the staff working in radiology on radiation protection also directly influence the radiations exposure risk for patients and the public (Grealish, 2016; Mojiri & Moghimbeigi, 2011).

Despite the universal significance of radiographic education quality, attaining the desired level of performance is difficult due to a range of reasons: lack of experienced coaches, inadequate resource configurations, and the inherently complicated nature of practice-based learning. Learners within the discipline have to deal with a multifaceted socio-technical environment where they may be obliged to handle critically ill clients with the added complexity of being exposed to ionizing radiation daily (Mwaniki, 2020). In resource-constrained jurisdictions within the continent, the lack of training in the theoretical underpinning of education for clinical supervisors makes them adopt a trial-and-error method in training the students assigned to them (Ondari et al., 2019). In all parts of the Sub-Saharan region, training programs have the daunting responsibility of striving to create a common body of knowledge with ever-changing modalities while conveying subspecialty knowledge (Adams, 2019; Paulu, 2018).

Imaging Equipment Technology (IET) specifically covers the specialized technology developments in the area, which include modifications in digital radiography and 3-D printing, as well as radiation dose management (Alos et al., 2015). The students also need to be tested for their competence in both theoretical and clinical trials to ensure they can carry out diagnostic procedures clearly (O'Brien et al., 2018). The training of radiographers in the country, specifically in Kenya, has been the focus of the Kenya Medical Training College (KMTC) for the last 60 years. However, the college faces a number of problems, including the lack of specialized trainers in the specific field of radiography and the lack of appropriate equipment and instructional materials in the school (Ministry of Education, 2016; Herrman, 2019). Technological advances in the area also bring about the need to constantly update and learn new things from the students as well as the teachers (Horbach & Halffman, 2018).

The efficacy of the above technological changes is largely subject to the Training Program Design, which also acts as a moderating factor in relation to the impact of rapid technological changes on student performance. A high-quality program design, considering advanced learning tools such as technology and pedagogical techniques like a mix of both theory and practice, can maximize the benefits and reduce the disadvantages of technical learning (Vavasseur et al., 2020). According to the data from the Examinations Department of the Kenya Medical Training College (2023), the KCATE program also faces a high failure rate in the IET program, with only 39% of the students clearing the IET program in their first attempt in the 2021 cohort and 43% in the 2022 cohort. The number of students clearing in the two subsequent years reflects a declining trend in comparison to the past cohort, which is a worrying trend for the quality of placement. While many research studies have been conducted in Kenya relating to the significance of refresher courses, none of them specifically focuses on the moderating effect of the program design in relation to the impact of rapid technological changes on student performance (Wanjiku, Bell & Wachira, 2018). This study, therefore, evaluates the moderating role of training program design in the relationship between technological changes and academic performance of imaging equipment technology students at KMTC Rift Valley Region, Kenya

Theoretical Framework

Technological Acceptance Model (TAM)

The Technology Acceptance Model (TAM), originally proposed by Fred Davis in 1989, remains one of the most influential frameworks for understanding how users come to accept and use a specific technology. Derived from the Theory of Reasoned Action (TRA), TAM posits that an individual's behavioral intention to use a system is determined by two primary factors: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). Perceived Usefulness is defined as the degree to which an individual believes that using a specific technology will enhance their performance, while Perceived Ease of Use is the degree to which they believe the system can be operated without significant effort (Davis, 1989). In this study, the rapid shift from analog to digital imaging acts as a significant external stimulus. For KMTC students, complex modalities like MRI or 3-D printing create high cognitive demands. If students view these changes as essential (High PU) but lack the exposure to find them manageable (Low PEOU), the resulting technology shock may lead to suboptimal academic performance. TAM highlights that external factors specifically institutional interventions indirectly influence attitudes by shaping perceptions of utility and usability. Training Program Design is critical, by incorporating Blended Learning, Learning Management Systems (LMS) and Problem-Based Learning (PBL), a well-structured curriculum can simplify complex technological concepts. This effectively increases the PEOU, thereby strengthening the positive relationship between technological advancements and student performance.

Goal Theory

Goal Theory, which was created by Locke and Latham (2002), will also serve as a guide for the study. An all-encompassing theory of motivation called goal theory places emphasis on the necessity of setting goals as sources of inner drive. The degree of performance, effort required, and goal complexity are all correlated. As long as the individual is dedicated to the objective, already possesses the skills necessary to achieve it, and doesn't have any competing objectives, the relationship will remain favorable. According to goal theory, a number of factors play a crucial role in achieving goals. These consist of feedback, specificity, challenge, and acceptance and dedication to the aim. According to Locke and Latham (2013) goal theory is a way to conceptualize what drives people. The aim theory clarifies the meaning that students attribute to their academic success as well as the reason behind that activity. According to this idea, students will probably do better if they are aware of and understand the aspects that affect how well they achieve academically.

Empirical Review

Technological Changes and Students' Performance in Imaging Technology

Technology in the workplace serves as a critical mechanism to augment or substitute labor tasks, acting as a unit of work activity designed to produce specific outputs (Autor, Dorn & Hanson, 2013). Within the medical imaging sector, mechanical and digital tools are utilized either to complement or replace manual work tasks, yet educational institutions often lack standardized frameworks to assess the impact of these disruptive changes from an instructional viewpoint (Cascio & Montealegre, 2016; Oberländer, Beinicke & Bipp, 2020). The rapid advancement of medical research has necessitated the continuous development of imaging technologies to improve patient outcomes, though the increasing complexity of cross-sectional imaging and interventional radiology has simultaneously transformed the workplace for imaging specialists (Horbach & Halffman, 2018; Atesok et al., 2015). Today, electronic acquisition and digital manipulation have ushered in a new era where image data is nearly instantaneous, enhancing access for both clinicians and patients (Bercovich & Javitt, 2018).

The industry is currently being reshaped by groundbreaking developments such as portable scanners, 3D integrated virtual reality, and artificial intelligence (AI) (Chen et al., 2022). From the accidental discovery of X-rays in 1895 to the development of MRI and CT systems in the 1970s, technology has evolved to provide non-invasive, high-resolution insights into human anatomy (Basser, 2022; Webb, 2022). Modern applications now utilize augmented intelligence, which combines human reasoning with automated algorithms to enhance diagnostic accuracy, such as Google's AI for breast cancer screening or Siemens' real-time cardiac MRI analysis (Tang et al., 2018; Malliori & Pallikarakis, 2022). Furthermore, immersive environments created by virtual and augmented reality allow students to conceptualize complex anatomical structures more effectively, while advancements in nuclear imaging allow for the precise detection of thyroid and gallbladder diseases (Byl et al., 2020; Webb, 2022).

The integration of these technologies necessitates a shift in educational competencies, as the skills required for the job are redefined by the tools available (Sousa & Rocha, 2019). Educational and training institutions must adapt their formal learning environments including content, didactics, and assessment methods to ensure that imaging specialists can keep up with evolving demands (Yang et al., 2015). Competencies are now viewed as a dynamic combination of knowledge, skills, and attitudes that must be aligned with future job requirements (Mellacher & Scheuer, 2021; Carneiro, Liu & Salvanes, 2023). For example, problem-based learning and inter-professional teamwork have been shown to significantly enhance student understanding of anatomy and radiography, with 90% of participants in cadaver-imaging studies reporting favorable impacts on their professional competency (Talarico & Painter, 2020; Chuenjitwongsa, Oliver & Bullock, 2018).

Despite the benefits, there remains a significant gap in formal AI education for radiographers. While many imaging specialists express excitement about AI, a substantial number lack a technical understanding of the distinction between machine learning and deep learning (Coakely et al., 2021). Only 8% of European radiographers reported receiving AI instruction during their pre-registration training, highlighting an urgent need for updated undergraduate medical education (UME) (Mehta et al., 2021). Recent participatory research suggests that a blended learning delivery structure, featuring customizable and contextualized content, is the ideal approach for teaching AI to imaging professionals (Van de Venter et al., 2023).

Finally, emerging technologies are influencing the career trajectories and perceptions of medical students. Some trainees fear that AI and other technologies might render specialties like diagnostic radiology obsolete, leading to a decline in residency applications (Atalay et al., 2022). Studies have shown that while newer graduates are more concerned about being replaced by technology, positive interactions with radiologists and early mentorship can mitigate these fears and reinforce a positive view of the profession (Kurowecki, Lee, Monteiro &

Finlay, 2021). This underscores the necessity of integrating modern technological exposure early in the training phase to ensure students view technological change as an aid rather than a threat to their future careers.

To guide the investigation into the relationship between technological variables and academic outcomes, the study poses the following null hypothesis:

H$_{01}$: *There is no significant relationship between students' perceptions of technological changes and their academic performance in Imaging Equipment Technology at KMTC Rift Valley Region, Kenya.*

The Moderating Role of Training Program Design

The design of training programs is a critical variable in medical education, focusing on active learning strategies, problem-solving techniques, and the integration of technology into learning environments (General Medical Council, 2017; Ramsden & Roberts, 2015). Despite its importance, the literature regarding the relative efficacy of various instructional formats remains inconsistent, reflecting the complexity of variables influencing student outcomes (The Royal College of Radiologists, 2016). A narrative review by Linaker (2015) highlights that radiology education must go beyond theoretical instruction to integrate science, clinical expertise, and data interpretation. This requires pedagogical methods such as case-based teaching, guest lectures, and autonomous learning resources to bridge the gap between classroom knowledge and clinical skill.

Blended learning, which combines traditional face-to-face instruction with online environments, has emerged as a particularly effective design for radiography students. Durán-Guerrero et al. (2019) demonstrated that medical students using a blended approach—consisting of specialized online modules and classroom sessions—scored significantly higher (median 16.5) than those in traditional control groups (median 15.0). Furthermore, Vavasseur et al. (2020) found that innovative tools like flipped classrooms and self-paced video courses significantly improved performance, especially among low-achieving students, while boasting a 99% satisfaction rate. These findings suggest that the flexibility and "pleasure in learning" afforded by modern program designs are essential drivers of student engagement and academic success.

The modernization of program delivery is further supported by the adoption of Learning Management Systems (LMS), which facilitate resource sharing, assignment submission, and real-time communication between lecturers and learners (Zain et al., 2018). Parallel to digital integration, Problem-Based Learning (PBL) remains a global gold standard for fostering critical thinking. Mpalanyi et al. (2020) found that radiography students perceive PBL as vital for improving problem-solving and practical skills, although its effectiveness is often hindered by a lack of physical learning resources and staff shortages. This indicates that while the *design* of a program (like PBL) is sound, its success is moderated by the institutional resources available to support it.

The COVID-19 pandemic served as a catalyst for the acceleration of these pedagogical shifts, forcing institutions to adopt hybrid models and online instruction (Low, 2022). While students generally favor the effectiveness of tutorials and clinical internships, the transition to purely online delivery has presented challenges, particularly for laboratory-heavy courses (Alhasan & Al-Horani, 2021). Research indicates that for online or hybrid radiography programs to be successful, they must prioritize effective instructor-student communication, case-study discussions, and creative critical thinking exercises. Consequently, a well-structured training program design does not just deliver content; it serves as a modernizing bridge that helps students navigate the complexities of imaging technology.

To examine how the structure of the curriculum influences the relationship between institutional factors and student outcomes, the study poses the following null hypothesis:

H_{02}: *Training program design does not significantly moderate the relationship between technological changes and the academic performance of Imaging Equipment Technology students at KMTC Rift Valley Region, Kenya.*

Methodology

The study adopted a mixed-methods, descriptive cross-sectional design. Quantitative data captured patterns and relationships among the study variables, while qualitative data provided explanatory insights from faculty and administrators. This design suited the focus on perceptions, instructional practice, and performance outcomes within a single time frame.

The study took place at Kenya Medical Training College (KMTC) campuses offering Imaging Equipment Technology in the Rift Valley and Nyanza regions: Eldoret, Nakuru, Kapkatet, and Kisumu. The focus was the Department of Radiography and Medical Imaging Sciences, where the Imaging Equipment Technology curriculum is delivered. These campuses were selected due to documented variations in student performance in the course.

The target population comprised 105 final-year Imaging Equipment Technology students, 27 faculty members, and 4 departmental administrators drawn from four KMTC campuses. Final-year students participated because they had completed all core units and could provide informed assessments of technological changes, instructor competence, and academic performance. Faculty members and administrators contributed instructional and institutional perspectives related to teaching competence and technology use. The study included only final-year diploma students and full-time faculty and administrators who had served in their departments for at least one year. It excluded first- and second-year students, higher diploma trainees, part-time or newly recruited lecturers, and staff from other departments to maintain relevance and data consistency.

To determine the sample size, the study employed the Kathuri and Pals (1993) method as follows.

$$n = \frac{\chi^2 Npq}{\sigma^2 (N-1) + \chi^2 pq}$$

Where;

n = required sample size

N = the given population size

P = population proportion, assumed to be 0.5 (since there are no known variances)

q = 1- *p*

σ^2 = the degree of accuracy whose value is 0.05

χ^2 = table value of chi-square for one degree of freedom, which is 3.841

Substituting these values in the equation, estimated sample size (n) was:

$$n = \frac{3.841 \times 105 \times 0.5 \times 0.5}{0.05^2 (105-1) + 3.841 \times 0.5 \times 0.5} = 79.51 \approx 80$$

The computation yielded a sample of 80 students. Simple random sampling was used to select the students, giving all eligible participants equal selection chances. Due to their small and accessible numbers, all 27 faculty members and 4 administrators were included through a census approach. Student samples were proportionally allocated across the four campuses as shown in Table 1.

Table 1: Target population, sample distribution and imaging equipment technology subjects across selected KMTC Campuses

KMTC Campus	IET Final-Year Students (Population)	IET Final-Year Students (Sample)	IET Faculty Members (Population & Sample)	IET Faculty Administrators (Population & Sample)	IET Subjects Offered
Nakuru	31	24	8	1	Radiography & Imaging; MRI; CT; Radiation Therapy; Ultrasonography
Eldoret	23	18	5	1	Radiography & Imaging; Radiation Therapy; Ultrasonography
Kapkatet	19	14	5	1	Radiography & Imaging; Ultrasonography
Kisumu	32	24	9	1	Radiography & Imaging; MRI; CT; Radiation Therapy; Ultrasonography
Total	**105**	**80**	**27**	**4**	—

Data collection used student questionnaires, interview schedules for faculty and administrators, and focus group discussions with lecturers. The questionnaires applied 5-point Likert scales to measure perceptions of technological change, instructor competence, and academic performance. Interviews and focus groups captured detailed explanations and professional experiences that supported the survey data.

The instruments underwent pilot testing at KMTC Nakuru Campus with respondents excluded from the main study. Expert review from university supervisors and KMTC instructors established content validity. Reliability testing used Cronbach's Alpha, with coefficients of 0.70 and above accepted. Qualitative data trustworthiness relied on consistent coding and peer verification.

After obtaining approvals, questionnaires were administered using a drop-and-pick approach, while interviews and FGDs were conducted in person. Ethical considerations are observed throughout the research process, with informed consent obtained from all participants, and confidentiality maintained in accordance with institutional and national guidelines.

Quantitative data were analyzed using SPSS for descriptive statistics and inferential tests, including Pearson correlation and multiple regression, to examine the direct and moderating effects of training program design on the relationship between technological changes and academic performance. Qualitative data were analyzed thematically to support and explain the quantitative findings.

The multiple regression model used in the study was specified as:

$Y=\alpha+\beta_1X_1+\beta_2M+\beta_3(X_1\times M)+\varepsilon$.....Equation 1

Where;

Y= Students' academic performance

X_1 is technological changes

M is the moderating variable training program design

$X_1 \times M$ represents the interaction effect,

α is the constant

β_1–β_3 are regression coefficients

ε is the error term.

This model assessed both the direct effect of technological changes and the moderating influence of training program design on student performance.

Results and Discussion

Demographic Characteristics of the Respondents

The study sought to determine the background characteristics of the respondents so as to obtain basic insight about the respondents. These were categorized in terms of the respondents, that is, the students and the faculty members.

Demographic Characteristics of the IET Faculty Members

The characteristics considered in the study were their; gender, age, highest level of education (for members of staff) and work experience as a lecturer in KMTC in terms of years (for members of staff). The findings on these are summarized in Table 2.

Table 2: Demographic characteristics of the IET Faculty members

Variable	Category	Frequency	Percentage(%)
Gender	Male	9	52
	Female	8	48
Age in Years	21-30 yrs	4	23
	31-40 yrs	6	37
	41-50 yrs	5	30
	Above 50	2	10
Level of Education	Higher Diploma	5	29
	Bachelors Degree	8	45
	Masters Degree	3	20
	Doctorate	1	6
Number of years taught as a lecturer in KMTC	0- 5 yrs	4	25
	5- 10 yrs	8	44
	10- 15 yrs	3	17
	15 yrs and above	2	14

The findings in Table 2 show that majority (52%) of the respondents were male although the high proportion of females indicated that there was gender parity in the IET faculty membership at KMTC. The results also indicate that majority (37%) of the respondents were aged between 31 and 40 years which implies that most of them began their teaching careers when there were already considerable technology advances and hence were likely to be more conversant with them. Concerning the level of education, the results indicate that majority (45%) of the respondents had Bachelor's degrees as their highest academic qualifications while 26% had post graduate qualifications. This suggests that the faculty of IET in both Nakuru and Kisumu campuses were staffed with highly educated members. Further, the findings indicate that most (44%) of the faculty members had worked as lecturers in KMTC for between 5 and 10 years while 31% had worked as lecturers in the college for above 10 years. These findings imply that majority of the respondents had reasonable level of experience and education for their line of work and were, therefore, expected to be conversant with the issues being investigated in the study and also give valid opinions in relation to the issues. Abere and Muturi (2015) explained that for a reliable study to be conducted, the respondents' background characteristics, such as, age, gender, educational qualifications and work experience needed to be established so as to ascertain that one sampled from a reliable population that is likely to give valid answers for the study.

Demographic Characteristics of the IET Students

The study also sought to establish the demographic characteristics of the students who participated in the study. The results are summarized in Table 3.

Table 3: Demographic characteristics of the IET students

Variable	Category	Frequency	Percentage(%)
Gender	Male	41	59
	Female	29	41
Age in Years	20-24 yrs	37	53
	25- 29 yrs	19	27
	30- 34 yrs	12	13
	35 yrs and above	2	3

The results in Table 3 indicate that majority (59%) of the respondents were male, however, the female students population in the department was also high indicating that the IET course at KMTC was well subscribed to by both genders. The results also indicate that majority (53%) of the respondents were aged between 18 and 24 years which implies that most of them were young and were conversant with the technology advances in IET and hence were expected to give valid opinions regarding the issues being investigate din the study.

Descriptive Analysis Results

Technological changes and Students' poor Performance in Imaging Technology

The first objective was to assess how students' perception of technological changes influences poor performance of Imaging Equipment Technology students at KMTC. Perception was then determined based on the argument that a mean score of 3 in Likert scale represents neutral perception, mean score of less than 3 represents negative perception and greater than 3 represents a positive perception. The range of interpreting the Likert scale mean score was given as follows: 1.0-2.4 (Negative perception), 2.5-3.4 (Neutral position), and 3.5-5.0 (Positive perception). The findings are presented in Table 4.

Table 4: Technological changes and students' poor performance in imaging technology

Statement	SA Freq(%)	A Freq(%)	N Freq(%)	D Freq(%)	SD Freq(%)	Mean	Std. Dev
Limited access to the latest imaging and equipment technology in our departments causes poor performance of students in our department	46(65.7)	23(32.9)	1(1.4)	0	0	4.64	0.512
Inadequate technologies at our department for practice with causes poor performance of students	13(18.6)	31(44.3)	20(28.6)	6(8.6)	0	3.73	0.867
Collaboration with other institutions to share current technologies so that our students can get exposed to them negatively affects students performance of in our department	18(25.7)	29(41.4)	3(4.3)	19(27.1)	1(1.4)	3.57	0.942
New technologies in our department have reduced training requirements as they are programmed to use artificial intelligence (AI)	2(2.9)	14(20.0)	1(1.4)	33(47.1)	20(28.6)	2.86	0.874
Most of the new technologies we have acquired operate on augmented AI which mean that automated reasoning is combined with a significant amount human reasoning	9(12.9)	22(31.4)	2(2.9)	31(44.3)	6(8.6)	2.97	1.139

and hence more training is needed							
New technologies offer many advantages in training and application and this affects students performance of in our department	31(44.3)	20(28.6)	6(8.6)	13(18.6)	0	3.89	0.671
The new technologies are not easy to handle thus affecting students performance of in our department	14(20)	33(47.1)	2(3)	19(27.1)	2(3)	3.59	0.834
Overall mean score						3.61	0.871

As shown in Table 4, IET students indicated that limited access to the latest imaging and equipment technology in their departments causes poor performance of students in our department (mean = 4.64). The students were also of the view that inadequate technologies at their department for practice with causes poor performance of students (mean = 3.73). The students also felt that collaboration with other institutions to share current technologies so that they can get exposed to them negatively affects their students performance (mean = 3.57). However, students were uncertain whether the new technologies in their departments have reduced training requirements as they are programmed to use artificial intelligence (AI) (mean = 2.86).

Most students were also not sure whether most of the new technologies acquired which operate on augmented AI require more training for them (mean = 2.97). Further, the students agreed that the new technologies offer many advantages in training and application and this affects students performance of in their department (mean = 3.89). The students were also of the view that the new technologies are easy to handle thus affecting students performance of in their department (mean = 3.59). Generally, the IET students at KMTC agreed in the majority of the statements (mean = 3.61). Thus, while it is evident that the students agreed with most statements regarding students' perception of technological changes influences poor performance of Imaging Equipment Technology students at KMTC, the results generally point to a negative perception of the status of technology changes in the institutions and the resulting negative effect on student performance.

Training Program Design and Students' Performance in Imaging Technology

The second objective was to assess how training program design moderates the relationship between institutional factors and the poor performance of Imaging Equipment Technology Students at KMTC. Perception was then determined based on the argument that a mean score of 3 in Likert scale represents neutral perception, mean score of less than 3 represents negative perception and greater than 3 represents a positive perception. The range of interpreting the Likert scale mean score was given as follows: 1.0-2.4 (Negative perception), 2.5-3.4 (Neutral position), and 3.5-5.0 (Positive perception).

Table 5: Training program design and students' poor performance in imaging technology

Statement	SA Freq(%)	A Freq(%)	N Freq(%)	D Freq(%)	SD Freq(%)	Mean	Std. Dev
Lecturers use of problem based learning for teaching students and this affects students' performance of in our department	13(18.6)	39(55.7)	7(10.0)	7(10.0)	4(5.7)	3.71	1.079
Students are encouraged to identify problems on their own then submit to the lecturer and class for discussion and solutions and this affects students' performance of in our department	4(5.7)	19(27.1)	20(28.6)	26(37.1)	1(1.4)	2.99	0.970
Student-centered inquiry is encouraged for problem solving and this affects students' performance of in our department	2(2.9)	28(40.0)	26(37.1)	14(20.0)	0	3.26	0.811
Our lecturers combine both classroom and online learning and this affects students' performance of in our department	11(15.7)	31(44.3)	22(31.4)	6(8.6)	0	3.67	1.012
Our lecturers share instructional materials, make class announcements, submit and return course assignments, and communicate with each other online and this affects students performance of in our department	11(15.7)	49(70.0)	8(11.4)	2(2.9)	0	3.97	0.625

We do more digital learning than face-to-face learning nowadays and this affects students performance of in our department	7(10.0)	30(42.9)	19(27.1)	13(18.6)	1(1.4)	3.76	0.955
We reserve the face to face learning modes for clinical practice sessions only and this affects students performance of in our department	16(22.9)	46(65.7)	5(7.1)	2(2.9)	1(1.4)	4.06	0.740
Overall mean score					3.631	0.885	

The results in Table 5 indicate that most lecturers use of problem based learning for teaching students and this affects the students performance (mean = 3.71). However, there was uncertainty on whether students are encouraged to identify problems on their own then submit to the lecturer and class for discussion and solutions in the IET department (mean = 2.99). Further, there was uncertainty regarding the encouragement of student-centered inquiry for problem solving and its effects on students performance of in the department (mean = 3.26). However, there were indications that the lecturers combine both classroom and online learning and this affects students performance (mean = 3.67). Also, there were strong indications that most lecturers share instructional materials, make class announcements, submit and return course assignments, and communicate with each other online and this affects students performance in the department (mean = 3.97). Most students were also of the view that they do more digital learning than face-to-face learning nowadays and this affects students performance in their department (mean = 3.76). There were also strong indications that the lecturers reserve the face to face learning modes for clinical practice sessions only and this affects students performance in their department (mean = 4.06). Overall, the respondents had a positive perception in the majority of the statements (mean = 3.631). Thus, the study concluded that there were indications that the poor performance of imaging equipment technology students at KMTC could be attributed to training program design.

Students Performance in Imaging Technology

The study finally sought to assess the perception of performance of Imaging Equipment Technology Students at KMTC. Perception was then determined based on the argument that a mean score of 3 in Likert scale represents neutral perception, mean score of less than 3 represents negative perception and greater than 3 represents a positive perception. The range of interpreting the Likert scale mean score was given as follows: 1.0-2.4 (Negative perception), 2.5-3.4 (Neutral position), and 3.5-5.0 (Positive perception). The findings are presented in Table 6.

Table 6: Students Performance in Imaging Technology

Statement	SA Freq(%)	A Freq(%)	N Freq(%)	D Freq(%)	SD Freq(%)	Mean	Std. Dev
Our students score poorly in exams	3(4.3)	18(25.7)	32(45.7)	15(21.4)	2(2.9)	3.07	0.72
Students perform poorly in the theory part of the courses	2(2.9)	10(14.3)	5(7.2)	48(68.6)	5(7.2)	2.41	0.634
Students perform poorly in the clinical part of the courses	18(25.7)	47(67.1)	4(5.7)	1(1.4)	0	4.17	0.589
The students often fail to show noticeable improvement from the beginning of term assessments and the end of term assessments	1(1.4)	8(11.4)	6(8.6)	25(35.7)	30(42.9)	1.93	0.856
Students do show confidence in clinical trials	4(5.7)	41(58.6)	10(14.3)	11(15.7)	4(5.7)	3.37	0.783
Students cannot accurately perform diagnostic tests as required by the medical/clinical officers	1(1.4)	36(51.4)	21(30.0)	12(17.1)	0	3.43	1.015
Overall mean score					3.063	0.766	

Table 6 shows that the student respondents were uncertain on whether on average they score poorly in exams (mean = 3.07). However, most students disagreed that they perform poorly in the theory part of the courses (mean = 2.41). Nevertheless, there were indications that most students perform poorly in the clinical part of the courses (mean = 4.17). Most students also agreed that they often fail to show noticeable improvement from the beginning of term assessments and the end of term assessments (mean = 1.93). However, there was uncertainty on whether students do show confidence in clinical trials (mean = 3.37). Further, there was uncertainty on whether the students cannot accurately perform diagnostic tests as required by the medical/clinical officers (mean = 3.43). Generally, the respondents had a neutral perception in the majority of the statements (mean = 3.063). Thus, the study concluded that there were indications that the student's performance in imaging and equipment technology course was poor or unsatisfactory.

Inferential Statistics Results

Correlation Analysis

Correlation analysis was conducted to determine the strength and significance of the relationships between technological changes, training program design, and students' academic performance in Imaging Equipment Technology at KMTC Rift Valley Region. The Pearson correlation coefficient (r) was used, ranging from -1.0 to +1.0. A positive r indicates that as one variable increases, the other also increases, while a negative r indicates an inverse relationship. The results of the correlation analysis are summarized in Table 7.

Table 7: Summary of Correlation Results

		Technology change	Program design	Student performance
Technology change	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	70		
Program design	Pearson Correlation	.241*	1	
	Sig. (2-tailed)	0.044		
	N	70	70	
Student performance	Pearson Correlation	.487**	0.156*	1
	Sig. (2-tailed)	0.000	0.016	
	N	70	70	70

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

The results (Table 7) show a strong, positive, and significant relationship between students' perceptions of technological changes and their academic performance ($r = 0.487$, $p < 0.01$). This suggests that inadequate investment in new technology in the IET department negatively affected students' confidence in handling technological changes, which in turn impacted their performance. The correlation between training program design and student performance was positive but weak ($r = 0.156$, $p < 0.05$), indicating that improvements in the structure and delivery of the training program could moderately enhance student outcomes. These findings demonstrate that while technological changes strongly influence student performance, the design of the training program plays a smaller but still significant role in moderating this relationship.

Hypothesis Testing

Multiple regression analysis was conducted to test the proposed hypotheses regarding the relationship between technological changes, training program design, and the academic performance of Imaging Equipment Technology (IET) students at KMTC Rift Valley Region.

H_{01}: *There is no significant relationship between students' perceptions of technological changes and their academic performance in IET at KMTC Rift Valley Region.*

Table 8: Summary of Multiple Regression Analysis (before moderation)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	15.062	3.072		4.903	0.000		
Technology Changes	0.461	0.133	0.479	3.454	0.001	0.607	1.646

a Dependent Variable: Student Performance

The initial regression model (Table 8) shows that technological changes significantly predicted students' academic performance ($\beta = 0.479$, $p = 0.001 < 0.05$). The model explained 24% of the variance in performance ($R^2 = 0.240$). The ANOVA confirmed the model's significance ($F(1,68) = 6.951$, $p = 0.001$). These results indicate that students' perceptions of technological changes strongly influence their academic performance. Consequently, H_{01} is rejected. This finding aligns with studies emphasizing that exposure to advanced imaging technologies, such as AI-enabled diagnostic tools and augmented reality simulations, enhances practical competence and performance in imaging education (Tang et al., 2018; Malliori & Pallikarakis, 2022; Sousa & Rocha, 2019). Students who lacked access to modern technologies reported lower confidence and poorer outcomes, reflecting the critical role of technology in shaping both practical and theoretical learning in IET programs (Bercovich & Javitt, 2018; Chen et al., 2022).

H_{02}: *Training program design does not significantly moderate the relationship between technological changes and academic performance of IET students at KMTC Rift Valley Region.*

After introducing training program design as a moderator, the interaction term (Technological Changes × Training Program Design) was significant ($\beta = 0.406$, $p = 0.018 < 0.05$), and the adjusted R^2 increased from 0.323 to 0.342. The results also show that training program design had a significant direct effect on performance ($\beta = 0.729$, $p < 0.05$). These findings indicate that well-structured training programs strengthen the relationship between technological changes and student outcomes. Therefore, H_{02} is rejected.

Table 9: Multiple regression analysis after including training program design as moderator

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	12.056	1.593		7.569	0.000
Technology Changes. Program Design	0.003	0.001	0.406	2.409	0.018
R	.613a		F	10.972	
R Squared	0.376		Sig.	.000b	
Adjusted R Squared	0.342		df	4,65	

These results indicate that training program design positively moderates the relationship between technological changes and academic performance. Students achieve higher academic outcomes when training programs are structured to support adaptation to technological changes, highlighting the importance of integrating effective program design with technological upgrades in IET education at KMTC Rift Valley Region. This result is supported by literature emphasizing that active learning strategies, problem-based learning, blended delivery, and effective integration of Learning Management Systems enhance students' ability to adapt to technological innovations (Durán-Guerrero et al., 2019; Vavasseur et al., 2020; Mpalanyi et al., 2020). Properly designed programs provide contextualized, hands-on experiences that complement exposure to complex imaging technologies, thereby improving both confidence and competence in clinical and diagnostic tasks.

Conclusion

The findings revealed that technological changes and training program design are critical determinants of academic performance in Imaging Equipment Technology (IET) at KMTC Rift Valley Region. There is a significant positive relationship between students' perceptions of technological changes and their performance. However, the current status is characterized by a negative perception due to limited access to modern equipment and inadequate practice technologies. The regression analysis confirmed that technological factors of the variation in student outcomes. While students feel competent in theory, where disagreement indicates they don't feel they perform poorly), there is a stark deficit in clinical performance. This indicates that the failure rate in the IET department is primarily driven by a lack of hands-on proficiency and an inability to accurately perform diagnostic tests. Training program design significantly moderates the relationship between technology and performance. The shift toward digital learning and reserving face-to-face time for clinical practice has improved the model's explanatory power, suggesting that better-structured programs can help bridge the gap created by rapid technological shifts. Though the faculty is highly educated having degrees or post-graduate qualifications) and experienced, the institutional lack of physical resources hinders their ability to translate this expertise into high student clinical performance.

Recommendations

To improve the academic and clinical performance of IET students at KMTC, the following recommendations are made:

1. KMTC management should prioritize the procurement of the latest imaging equipment. Since limited access was the highest-rated factor for poor performance , providing students with hands-on access to Digital Radiography, CT, and MRI simulators within the college is essential to reduce the current clinical performance gap.
2. Given that students felt current collaborations negatively affect performance, the college should restructure its partnerships with external hospitals. These collaborations should be formalized to ensure students are not just observers but are given structured, supervised hands-on time with modern equipment.
3. The study found that students fail to show noticeable improvement between term starts and ends. It is recommended that IET departments implement more rigorous, continuous clinical assessments rather than relying on final trials. Faculty should use Problem-Based Learning (PBL) more effectively to encourage student-centered inquiry, as this area currently shows uncertainty.
4. As students expressed uncertainty regarding Artificial Intelligence, the curriculum should be updated to include specific modules on Augmented AI and automated reasoning. This will prepare students for the shift from manual operation to technology-assisted diagnostic interpretation.
5. The college should continue to leverage the positive aspects of training program design by optimizing the Blended Learning model. Digital platforms should be used strictly for theoretical

instruction and instructional material sharing, thereby freeing up all physical contact hours for intensive, hands-on clinical practice sessions.

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