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Attitudes, Preferences, And Barriers To E-Learning Among Open, Distance And E-Learning (Odel) Orthopaedic Medicine Students At The Kenya Medical Training College

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Abstract
Background: *The escalating integration of e-learning in medical education has positioned it as integral to modern teaching and learning. The diploma upgrading course in Orthopaedics and Trauma Medicine at Kenya Medical Training College (KMTC) is delivered through the Open, Distance, and e-Learning (ODeL), yet up to 12% of KMTC students do not participate in online classes. This constitutes a significant challenge in ODeL delivery and student performance, demanding an in-depth inquiry.*
Objective: *This study aimed to assess the attitudes, learning preferences, and prevailing barriers to e-learning among ODeL othopaedic students at the Kenya Medical Training College.*
Methods: *A mixed-methods cross-sectional design incorporating both qualitative and quantitative e-learning components was used in this study. A sample size of 156 students drawn from four KMTC campuses through stratified random and purposive sampling was used. Quantitative data was collected using a 5-point Likert scale questionnaire, and qualitative data using an interview guide. Data analysis involved descriptive and inferential statistics for quantitative elements, complemented by thematic analysis for qualitative narratives.*
Results: *The findings reveal a predominantly positive student disposition towards e-learning (68%), with a significant majority (70%) expressing a clear preference for a blended learning model. Prior e-learning exposure exhibited a statistically significant association with e-learning participation (OR = 3.845, p=0.001), underscoring the advantage of early exposure. Critical barriers identified included internet access limitations (60%), insufficient training on e-learning platforms (45%), and the prohibitive cost of internet data bundles (35%).*
Conclusion: *Orthopaedic ODeL students exhibit favourable attitudes towards e-learning but prefer a balanced blended instructional approach.*
Recommendations: *To enhance ODeL student participation in e-learning, strategic interventions to prevailing barriers need to be put in place. This includes a more balanced blended curriculum, and the provision of standby on-campus technical support to address emerging student concerns. Future scholarly inquiry could evaluate the long-term efficacy of e-learning in orthopaedic education, particularly on the acquisition of practical clinical skills.*
Key Words: *Attitudes, preferences, barriers, e-Learning, ODeL, orthopaedic medicine, KMTC.*

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I. Background

Institutions of higher learning are adopting distance learning strategies commonly based on the internet and e-learning [1]. This shift became more apparent and necessary following the COVID-19 pandemic as a response to the need to continue teaching and learning activities away from school. At the Kenya Medical Training College (KMTC), the influence of technology on education became more noticeable due in part to a policy directive. This directive, prompted partly by the COVID-19 pandemic, emphasized adopting online teaching to address the loss of instructional hours [2]. KMTC is a semi-autonomous government agency (SAGA), and the largest middle-level medical training institution in Kenya. The institution offers an upgrading course in Orthopaedics and Trauma Medicine (Certificate to Diploma) through Open, Distance and e-Learning (ODeL). E-learning is deemed the newer version of distance learning, and terms such as online teaching, digital learning, web-based learning, and online learning are used interchangeably with e-learning in the literature. It can be broadly categorized as synchronous (real-time teaching activities), asynchronous (pre-recorded or non-real-time teaching activities), and hybrid, i.e., a mixture of synchronous and asynchronous [3]. Synchronous e-learning in KMTC is conducted through applications such as Kenet, Zoom and Google Meet. Asynchronous e-learning, on the other hand, is usually done through a broader range of applications that include the KMTC Moodle-based e-

learning platform, WhatsApp, pre-recorded PowerPoint presentations, audio files, YouTube, and e-mail. Assessing students' attitudes, preferences, and perceived barriers to e-learning is important for effective implementation of the e-learning program [4].

Medical education is facing various challenges in teaching tomorrow's physicians. Technological advances have become integral parts of our lives, increasingly with each new generation. The COVID-19 pandemic has necessitated the adoption of new technologies in delivering medical education as alternatives to face-to-face learning. Such changes mean that medical schools must adopt new teaching methods while maintaining excellence in medical education. The new methods include electronic (e-learning) or a mix of both e-learning and face-to-face (blended learning). eLearning has started to make headway in developing countries and is believed to have huge potential for governments struggling to meet a growing demand for education while facing an escalating shortage of teachers. The use of e-learning to support the delivery of learning objectives has become a common feature in health professional education, and according to Fatani [5], will remain an important platform that supports teachers' and students' educational activities now and in the future.

We live in an era where technology is enabling us to gain knowledge at a speed previously unimaginable. Modern medical schools have to make a paradigm shift from informing students to involving them, which shifts the focus along the SPICES spectrum from teacher-centered to student-centered approach [6]. eLearning as part of blended learning has an under-exploited potential to empower learners to take charge directly of their competency development, to enable them to play a key role in self-directed learning.

Traditional education in orthopaedic and trauma medicine can be complemented by innovating the blend of face-to-face and e-learning to improve the retention of information and contextual learning. This initiative is in line with the College's competency-based curriculum. There is widespread agreement that blended learning is beneficial to students as it facilitates their learning and understanding. However, e-learning has not been fully embraced by faculty for reasons that are not well documented. The use of e-learning is gaining popularity as increasing numbers of medical colleges use the Internet as the digital repository of teaching and learning forums. E-learning provides possibilities for devising new educational tools, for learning by interactivity, self-paced study and easy access. The popularity of e-learning continues to grow in tandem to growth in educational technologies. The combination of traditional and e-learning creates a more integrated approach for both instructors and learners [7]. It is well suited for practice-based disciplines like orthopaedic and trauma medicine.

Studies reported in both the medical and non-medical literature have consistently shown that students are satisfied with e-learning. However, they do not see e-learning as replacing traditional instructor-led training but as a complement, forming part of a blended learning strategy [7]. It is therefore instructive to determine learning preferences of students when a multiplicity of approaches are used to engage them.

Fully online teaching may not be feasible considering the circumstances in most developing countries. A study by Verma [8] highlights some common downsides to remote teaching from the perspective of undergraduate medical students, including technical difficulties, easy distraction, and some staff being poorly versed with the technologies used. This study also found that the vast majority of students found online sessions to be a good use of time and proposes the incorporation of these into medical teaching as part of a 'flipped-learning' approach. Other evidence also suggests that students see online learning as complementing rather than replacing traditional methods, reinforcing the potential for an integrated role in the future, perhaps as part of a combined 'blended-learning' methodology [9].

Monaghan [10] in his study on Medical Teaching and Assessment in the era of COVID-19 makes the stirring observation that the COVID-19 circumstances may simply provide the impetus necessary to drive these teaching techniques into mainstream use. The obvious weakness of the e-learning part of blended learning is the limited personal interaction between students and teachers. However, this can be overcome by face-to-face interactions during scheduled lectures and practical sessions [7].

These developments, especially the reduction in face-to-face teaching hours, place greater emphasis on students as curators of their own learning and assign them greater responsibility for maintaining sufficient and effective involvement in their courses [11]. They have the responsibility and the opportunity to determine their approaches to learning and understanding content and concepts. These initiatives will largely depend on the integration of e-learning into mainstream teaching and learning strategies.

II. Materials And Methods

This study employed a sequential explanatory mixed-methods design [12] to comprehensively investigate the attitudes, preferences, and perceived barriers to e-learning among students pursuing the Upgrading Diploma in Orthopaedic and Trauma Medicine through Open, Distance, and e-Learning (ODeL) at the Kenya Medical Training College (KMTC). This approach allowed for an initial quantitative exploration of attitudes and preferences, followed by a deeper qualitative inquiry to understand the nuances of the identified barriers from the students' perspectives.

Study Context and Setting

The research was conducted at the Kenya Medical Training College (KMTC), a public institution and Kenya's largest healthcare workforce contributor. As of 2024, KMTC operated 83 campuses nationwide, serving approximately 50,000 students across more than 76 diverse medical courses (KMTC, 2024). Annually, KMTC graduates over 12,000 healthcare professionals, contributing to over 85% of the healthcare workforce in both public and private sectors in Kenya.

In 2023, four KMTC campuses offered the Upgrading Diploma in Orthopaedic and Trauma Medicine through ODeL: Kangundo, Nakuru, Makindu, and Port Reitz. These four campuses served as the specific study sites for this study due to their direct involvement in providing the ODeL orthopaedic program.

Study Design and Rationale

A mixed-methods cross-sectional design was chosen to capitalize on the strengths of both quantitative and qualitative research paradigms. The quantitative component was crucial for testing hypotheses, examining relationships between variables (e.g., student demographics and e-learning attitudes), and providing generalizable insights into the prevalence of certain perceptions. This objective approach allowed for statistical analysis and the identification of broader patterns across the student population.

The qualitative component was integral to achieving a comprehensive understanding of the multifaceted barriers to e-learning, which are often complex and deeply rooted in individual experiences. Drawing on the principles of interpretivism [13,14], the qualitative phase facilitated an in-depth exploration of students' lived experiences, attitudes, and beliefs regarding e-learning. This approach acknowledged that "facts" are not merely objective but are shaped by individual subjective realities. By allowing participants to articulate their perspectives in their own words, the qualitative data provided rich, contextualized insights that quantitative data alone could not capture, thereby enriching the interpretation of the quantitative findings and comprehensively addressing the research questions

Population and Sample Size Determination

The study focused on students who had successfully completed their first semester of ODeL training and were actively in their second semester of Year One (i.e., cohort 1.2). This selection criterion was strategic: students in cohort 1.2 had already accumulated a semester's worth of practical experience with e-learning strategies, offering a more informed perspective compared to newly admitted students (cohort 1.1).

The total class populations for cohort 1.2 across the four campuses in 2023 were: Kangundo (n=71), Makindu (n=70), Port Reitz (n=69), and Nakuru (n=70). This yielded a total target population of 280 ODeL orthopaedic students. A sample size of 165 participants was calculated using Yamane’s formula (Yamane 1967), and adjusted to 168 to allow for an even distribution of 42 students from each of the four study campuses, ensuring proportional representation across sites.

Stratified random sampling was employed to select participants for the quantitative component. The stratification variables were campus location (Kangundo, Makindu, Nakuru, Port Reitz) and gender. This method ensured that each campus was adequately represented and that both male and female students were included in proportions reflective of their presence within each campus's ODeL orthopaedic cohort. This minimized potential sampling bias and enhanced the representativeness of the sample for broader generalizations.

For the qualitative arm, a purposive sampling strategy was adopted. This non-probability sampling technique is ideal for qualitative research as it allows for the selection of participants who are particularly knowledgeable or experienced in the phenomenon under study, enabling rich and in-depth data collection [15]. Two students were purposively selected from each of the four campuses to participate in Focus Group Discussions (FGDs), resulting in a total of eight qualitative participants, the class representative from the four campuses.

Data Collection

A sequential data collection approach was utilized, beginning with the quantitative phase, followed by the qualitative phase. This allowed for the quantitative results to inform the areas of deeper inquiry for the qualitative component, facilitating a more integrated understanding of the research phenomenon.

Prior to data collection, the Heads of Department for Orthopaedic Trauma Medicine at each of the four campuses were formally requested to provide up-to-date lists of all ODeL orthopaedic students in their second semester of training, including their contact details (email and phone). These comprehensive lists served as the sampling frame for the study.

Quantitative data were collected using a structured electronic questionnaire developed on Google Forms. The questionnaire was designed with three distinct sections:

1. Socio-demographic Characteristics: Collected basic demographic information about the participants.
2. E-learning Preferences: Assessed students' preferences regarding e-learning modalities and platforms.

3. Attitudes and Perceived Barriers to E-learning: Explored students' attitudes towards e-learning and their perceptions of various barriers impacting their e-learning experience.

Key sections of the questionnaire were adapted from previously validated instruments to ensure content relevance and psychometric soundness. Specifically, items related to e-learning attitudes were adopted from the Test of e-Learning Related Attitudes (TeLRA) scale, as developed, reliability, and validity studied by Kisanga & Ireson [16]. This scale originally utilized a 5-point Likert scale (1=Strongly Disagree to 5=Strongly Agree), which was maintained for consistency. For positive worded items, responses were coded as 1=Strongly Disagree, 2=Disagree, 3=Agree, and 4=Strongly Agree. For negatively worded items, responses were reverse-coded as 1=Strongly Agree, 2=Agree, 3=Disagree, and 4=Strongly Disagree to ensure consistency in the interpretation of positive and negative attitudes. Additionally, three questions pertaining to preferences for teaching delivery and e-learning methods were adapted from a validated tool used in a similar study conducted in Uganda by Olum et al. [17], titled "Medical Education and E-Learning During COVID-19 Pandemic: Awareness, Attitudes, Preferences, and Barriers Among Undergraduate Medicine and Nursing Students at Makerere University, Uganda."

Pretesting and Administration

Before full-scale data collection, the electronic questionnaire was pre-tested with a pilot group of ten (10) second-year ODeL orthopaedic students from a private medical institution offering the same course through ODeL. This institution was chosen as it was not part of the main study population, ensuring no contamination of the primary sample. The pre-test aimed to identify any ambiguities, technical issues, or areas requiring clarification in the questionnaire, thereby enhancing its clarity and internal consistency. Feedback from the pilot group was used to refine the instrument before its wider administration. The electronic questionnaire was disseminated to the sampled participants via direct links sent through WhatsApp. This digital approach facilitated broad reach and efficient data collection.

Qualitative data were gathered through online Focus Group Discussions (FGDs) using a semi-structured interview guide. The guide was designed to be "direction-oriented" yet open-ended, encouraging participants to elaborate freely on their experiences and perceptions of e-learning barriers without undue restriction. This format allowed for the exploration of emerging themes and individual nuances that might not be captured by a fixed questionnaire. Virtual interviews were scheduled with the purposively selected students. Before each FGD, the researcher provided a thorough explanation of the interview guide's purpose and contents. This proactive approach aimed to alleviate any ambiguities, suspicions, or partiality, encouraging participants to provide independent, candid, and accurate information. The researcher also prioritized establishing a strong rapport with all respondents to foster a comfortable and trusting environment conducive to voluntary and rich data sharing.

Validity

Content validity was addressed through a logical analysis of the questionnaire items to ensure their comprehensiveness and representativeness of the constructs being measured (e.g., e-learning preferences, attitudes, and barriers). The adoption of the validated TeLRA scale by Kisanga & Ireson [16] and items from Olum et al. [17] was to ensure content validity of the quantitative instrument, as these tools have demonstrated their ability to adequately cover the facets of e-learning-related constructs.

Construct validity was achieved by performing factor analysis on the items designed to measure students' e-learning preferences. Factor analysis helps determine whether the underlying theoretical constructs are indeed being measured by the items, thereby providing empirical evidence for construct validity. For the qualitative arm, the open-ended nature of the interview guide enhanced its validity by allowing participants to express their experiences and perceptions in their own terms, ensuring that the collected data genuinely reflected their perspectives on e-learning barriers.

Reliability

To establish the reliability of the quantitative instrument, a pilot survey was conducted with ten (10) ODeL orthopaedic students from a different institution (North Coast Medical Training College) not included in the main study population. This pilot allowed for the assessment of the questionnaire's internal consistency and stability of responses, enabling the identification and correction of any ambiguous or inconsistent items before the main data collection phase. This iterative refinement process enhanced the overall reliability of the research tool.

Data Analysis

Quantitative data collected via Google Forms were exported and analyzed using Statistical Package for the Social Sciences (SPSS) version 22 [18]. Descriptive statistics were generated to summarize the demographic characteristics of the participants and key study variables. These included means, standard deviations,

frequencies, and percentages. Binary variables (e.g., Yes/No responses) were expressed as percentages. To examine associations between categorical independent variables (e.g., socio-demographic characteristics) and dependent variables (e.g., e-learning preferences, attitudes), Chi-square tests were employed. The strength and direction of associations were further explored using step-wise multiple regression analysis where appropriate, and prevalence odds ratios were calculated with a 95% confidence interval. A p-value of < 0.05 was considered statistically significant for all quantitative analyses. Specific hypotheses were analyzed using stepwise linear regression in SPSS to identify the most significant predictors of e-learning outcomes.

Qualitative responses obtained from the Focus Group Discussions were transcribed verbatim. The transcribed data were then subjected to thematic analysis, a systematic process for identifying, analyzing, and reporting patterns (themes) within data [19]. This involved several steps: familiarization with the data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Major themes and sub-themes that emerged from students' perceived barriers to e-learning were coded and organized into key thematic areas. The qualitative findings were presented in prose, using direct quotes to realistically capture and illustrate the students' experiences and perspectives.

Integrated Analysis

A key strength of the mixed-methods design was the triangulation of quantitative and qualitative findings. After the independent analysis of both data sets, the researcher systematically compared and contrasted the results to identify points of convergence, divergence, and complementarity. This process involved correlating themes identified in the qualitative data with statistically significant findings from the quantitative analysis. For instance, quantitative data on the prevalence of certain barriers could be enriched by qualitative narratives explaining why those barriers were significant. This integration provided a more holistic and nuanced understanding of the phenomenon under investigation.

Analyzing Attitude

Student attitude towards e-learning was measured using a Likert scale. As per the adopted TeLRA scale, responses ranged from Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1). For consistency in interpretation, positively worded items were coded directly (1-4), while negatively worded items were reverse-coded (e.g., Strongly Disagree becoming 4, and Strongly Agree becoming 1). A positive attitude was operationally defined as an average score of $\geqslant 4$ out of 5 on all five relevant items on the scale, indicating a general inclination towards agreement or strong agreement with positive statements about e-learning

Analyzing Preferences

The analysis of e-learning preferences focused on students' reported e-learning usage, their proficiency with common e-learning platforms, and their preferred teaching delivery methods. Numerical data, such as proficiency scores, were summarized using means and standard deviations. Categorical data, like types of preferred platforms or delivery methods, were presented as frequencies and percentages. To assess the associations between socio-demographic characteristics (categorical independent variables) and various e-learning preferences, Chi-square tests were performed using STATA 16.0 software. A p-value of < 0.05 was considered statistically significant.

Analyzing Barriers

Qualitative data related to perceived barriers were analyzed primarily through thematic analysis, as described above. The FGD transcripts were systematically coded, and major themes representing common e-learning challenges were identified. For the quantitative assessment of barriers, where a five-point Likert scale was used to measure the extent to which a barrier negatively affects e-learning outcomes, descriptive statistics (frequencies and percentages) were used to summarize the prevalence and perceived impact of each barrier. This allowed for a comprehensive understanding of both the "what" (quantitative prevalence) and the "why" (qualitative depth) of e-learning barriers.

III. Results

Data were collected from 156 participants, yielding a response rate of 92%. Quantitative data were analyzed using descriptive statistics, measures of association, and hypothesis testing via SPSS. Qualitative data, gathered through focus group discussion, were subjected to thematic analysis to provide rich, nuanced insights.

Demographic Characteristics of Study Participants

The majority of participants were young adults, with 70% (n=109) falling within the 20-24 age bracket (Table 1). Only a small fraction (5%, n=8) were aged above 30 years. The study sample exhibited a female-

dominated enrollment, with 65% (n=101) female participants compared to 35% (n=55) male. The majority 91% (n=142) of the students were single.

In terms of technological access, an overwhelming 99% (n=154) of the students reported owning either a smartphone or a laptop, crucial devices for e-learning. Despite this high ownership, a slight majority of students (51%, n=80) indicated no prior experience with e-learning, signifying that for many, this ODeL program was their first encounter with online learning. Reflecting this, a substantial 87% (n=136) expressed a felt need for additional e-learning training. Self-reported digital literacy skills varied, with most students (39%, n=61) rating their skills as "good," while 33% (n=51) considered them "excellent," and 28% (n=44) reported "poor" skills. Geographically, 57% (n=90) of the respondents resided in urban areas, and a notable 59% (n=92) confirmed having a designated study area at home.

Further insights into student engagement revealed that a significant proportion of them did not attend all scheduled online classes (Figure 1). The majority of the students, 62% (n=97) of the students reported incomplete attendance. Among these, female students constituted a larger proportion (60% vs 40% male), and a slight majority of them resided in rural areas (53% vs 47% urban).

Attitudes of ODeL Orthopaedic Students Towards E-Learning

Students' attitudes towards e-learning were assessed using a 5-point Likert scale, ranging from "Strongly Disagree" (1) to "Strongly Agree" (5).

The findings reveal a predominantly positive attitude towards e-learning, with 68% of participants expressing agreement or strong agreement that it is an effective and convenient learning method (Table 2). The mean attitude score was 4.1 (± 0.6) on the 5-point scale, further solidifying this positive perception. While 20% of respondents held a neutral stance, 12% expressed negative attitudes, primarily citing concerns about the lack of real-time interaction, the necessity of demonstrations for certain modules, and persistent technical internet difficulties.

Qualitative data from focus group discussions illuminated several perceived benefits. A substantial 81% of respondents quantitatively appreciated the flexibility offered by e-learning, highlighting its allowance for self-paced and time-flexible study. This was echoed in verbatim responses:

"eLearning has enabled me to work and study at the same time. I can raise my tuition fee."

"With eLearning, there's flexibility in scheduling classes. Most of the lecturers agree to listen to the students' requests to schedule the class to a more convenient time."

Furthermore, 64% of students agreed that e-learning improved their technological skills and fostered self-discipline, which is crucial for student-directed learning.

Despite the overall positive outlook, students voiced specific concerns. A majority, 58%, expressed concerns about the lack of face-to-face interaction with lecturers and peers, perceiving it as a hindrance to understanding complex orthopaedic concepts. Regarding content quality, 55% reported that e-learning platforms did not provide adequate support or access to a wide range of learning materials, such as videos, e-books, and discussion forums. An additional 25% were uncertain whether e-learning content paralleled the quality of traditional classroom lectures. A notable qualitative concern was the reliability of the KMTC e-learning platform:

"KMTC's e-learning platform is always crashing or lagging, making it really frustrating to use. However, I don't experience the same difficulty when the lecturer uses Zoom or Google Meet for online classes."

Preferences for Learning Methods

The overwhelming majority, 70% (n=109), of respondents preferred a blended learning model (Table 3), which integrates both online and face-to-face sessions. Students articulated that physical interaction, especially during practical sessions, significantly complemented theoretical e-learning. Only 15% (n=23) of students preferred a fully online model, primarily due to its convenience, while an equal 15% (n=24) still favored traditional classroom-only learning.

When it came to specific e-learning platforms (see Figure 3), Google Meet was the most favored video conferencing tool, chosen by 47% (n=72) of students. This was followed by Zoom at 28% (n=35) and the KMTC e-learning portal at 17% (n=27). The Kenet platform was the least preferred, with only 8% (n=13) of students opting for it.

Regarding the pedagogical approach (see Figure 4), 89% (n=139) of students strongly preferred synchronous e-learning methods, emphasizing their preference for live, real-time sessions. In contrast, only 11% (n=17) favored asynchronous learning delivered through pre-recorded lectures or self-paced materials.

For asynchronous content, if it were to be provided, the majority of students (78%, n=122) expressed a strong preference for engaging video content. This was followed by quizzes (16%, n=25), while text-based downloadable materials were the least preferred (6%, n=9).

Barriers to e-Learning

The study categorized perceived barriers into individual, technological, institutional, and pedagogical, assessed using a 5-point Likert scale (Strongly Disagree to Strongly Agree).

Individual student barriers were diverse. Time management emerged as a significant challenge for 55% of students, who reported struggling to balance e-learning with personal and professional commitments. Additionally, 30% of students considered self-motivation a challenge, particularly during extended periods of online learning. A notable 51% felt their digital literacy skills were inadequate, highlighting a critical gap. The absence of a suitable learning environment at home was a barrier for 35%. Additionally, the high cost of data and lack of reliable home Wi-Fi were major concerns for 57% of students.

Technological barriers were a major concern. While a majority of students (61%) reported having access to digital devices (smartphones and laptops), a significant 29% indicated they did not always have access to these essential tools. A striking 65% cited unreliable internet access as a major challenge, corroborating the qualitative feedback. Furthermore, 42% of students reported difficulties navigating and effectively utilizing the KMTC e-learning portal. Frequent power blackouts and lack of consistent access to power were cited by 52% of students as a significant technological barrier. A verbatim qualitative response highlighted the internet issue:

"Sometimes, I have a slow internet connection. So, it takes forever to load videos and simulations, and sometimes I'm not able to maintain uninterrupted attendance to an online class."

Institutional bottlenecks affected students' e-learning. A significant 63% of students cited the lack of adequate technical support as a substantial institutional barrier, impeding their ability to resolve technical issues promptly. Intermittent and weak on-campus internet was a hindrance for 56% of students when physically on campus. Furthermore, a substantial 51% reported a lack of training in digital skills and the use of the KMTC e-learning portal. However, there were positive perceptions regarding content availability, with 46% agreeing that online course content was provided, and 48% feeling their concerns were heard and addressed by the institution.

Pedagogical challenges emerged as a significant barrier to e-learning. While 59% of students acknowledged adequate communication with lecturers, a significant 64% largely lamented the lack of meaningful interaction between students and lecturers, and among students themselves. A notable 47% found lecturers to be flexible in scheduling online classes. However, a majority of students considered technical modules unsuitable for online learning, highlighting a pedagogical mismatch. A considerable proportion of students felt lecturers were not sufficiently accessible for post-class guidance, and 21% reported not receiving individualized feedback on their academic progress. Qualitative insights further elucidated these pedagogical concerns:

"Some of the modules, such as statistics in year 1.2 are too technical to understand online. I believe that for such modules, face-to-face interactive sessions with lecturer demonstrations would help me understand better."

Students offered several constructive suggestions for improving the e-learning experience, providing valuable insights for future interventions:

"It would really help us if, in the first semester, we were taught how to navigate the student e-learning portal and other online platforms. Training on basic computer skills and how to use online learning tools could also help, as some of us do not have these skills." (Addressing digital literacy and e-learning platform usability)

"Lecturers should include breakout rooms for online student discussions would make e-learning less isolating." (Enhancing interaction), and,

"A better balance between online and face-to-face learning would be ideal." (Reinforcing preference for blended learning).

Hypotheses Testing

Hypothesis 1: Relationship Between Demographic Factors and Attitudes Towards E-Learning

To determine the relationship between demographic characteristics and students' attitudes towards e-learning, stepwise linear regression was performed (n=156). The adjusted R^2 (coefficient of determination) was 0.62, indicating that 62% of the variation in attitudes towards e-learning could be explained by the demographic characteristics included in the model. This suggests a strong predictive relationship. Age ($p = 0.01$): A statistically significant relationship was observed, indicating that younger respondents were more likely to exhibit a positive attitude towards e-learning. This suggests that attitudes towards e-learning generally improve with younger age groups. There was a statistically significant positive relationship, demonstrating that students with higher digital literacy skills tended to hold a more favorable attitude towards e-learning. With age and digital literacy skills identified as significant predictors explaining 62% of the variation in e-learning attitudes, there is sufficient evidence to reject the null hypothesis, suggesting a significant relationship between demographic factors and attitudes towards e-learning.

A Shapiro-Wilk test was conducted to assess the normality of the numerical variables. Age follows a normal distribution in this sample since $p > 0.05$ ($W = 0.96$, $p = 0.08$). Attitude scores do not follow a normal distribution since $p < 0.05$ ($W = 0.91$, $p = 0.01$). Given the non-normal distribution of attitude scores, subsequent

analyses involving this variable appropriately employed the Chi-square test, a non-parametric method, where applicable.

Hypothesis 2: E-Learning Preferences Between Urban-based and Rural-based ODeL Students

Bivariate analysis was conducted to compare the preferences of urban-based (n=90) and rural-based (n=66) ODeL students for various modes of content delivery (Table 4). The analysis reveals significant differences in content delivery preferences based on student residence. Urban-based students were significantly more likely to prefer e-learning only (65.2% vs. 34.8% rural; p=0.042). Conversely, rural-based students showed a significantly stronger preference for classroom-only learning (79.2% vs. 20.8% urban; p=0.035). However, there was no significant difference between urban and rural students regarding their preference for blended learning (p=0.510). Similarly, no significant difference was observed between urban and rural students concerning their preference for synchronous versus asynchronous e-learning methods (p=0.522 and p=0.684, respectively).

These findings partially support the hypothesis that urban-based students exhibit a higher preference for pure e-learning, potentially attributable to greater exposure and prior experience with digital environments. However, the lack of significant difference in blended learning preferences suggests a common ground for both groups.

Although urban and rural students show differentiated preferences for pure e-learning or pure classroom learning, the test for blended learning preference returned a p-value of 0.510 (which is > 0.05). This means there is insufficient evidence to reject the null hypothesis that there is no difference in preference for blended learning between urban and rural students. Both urban and rural students largely prefer blended learning as the primary mode of content delivery.

Hypothesis 3: Correlation Between Students' Prior E-Learning Experience and Their Participation in Current E-Learning

Bivariate analysis was performed to examine the independent association between students' prior e-learning experience and their active participation in current e-learning. The analysis revealed a statistically significant association between prior e-learning experience and participation in current e-learning (Odds Ratio = 3.84, p=0.001). This indicates that students who had prior exposure to e-learning were nearly four times more likely to actively participate in their current ODeL orthopaedics program compared to those without prior experience (Table 5).

Decision on Hypothesis 3 (H03): With a p-value of 0.001, there is strong evidence to reject the null hypothesis. This confirms a significant and strong positive association between students' prior e-learning experience and their current participation in ODeL.

IV. Discussion

Attitudes Toward E-Learning

This study found that a clear majority, about 68%, of orthopaedic students at KMTC had a generally positive attitude toward e-learning. Most of them appreciated the flexibility it offers, the ability to access materials anytime, and the chance to learn at one's own pace. These findings echo Bączek et al. (2021), who also noted similar attitudes among medical students, particularly during the COVID-19 period when digital learning became the default. The autonomy and convenience of online platforms seem to give students a bit more control over their academic routines. In the same vein, Dhawan (2020) emphasized that e-learning can help students juggle education with work or family responsibilities—something many learners find invaluable.

That said, the data also revealed significant concerns. About 58% of respondents were worried about the limited interaction that comes with online platforms. This isn't surprising, considering that Bali and Liu (2018) found the same issue—online learning environments often reduce peer-to-peer and student-instructor engagement, making it harder to collaborate or clarify complex topics. In practical disciplines like orthopaedics, where hands-on training is everything, this lack of physical interaction can be a real stumbling block. There were also concerns about the quality of the content itself. Students pointed out that some materials felt inadequate or too generic, a sentiment that lines up with Adnan and Anwar (2020), who argued that content in under-resourced settings often doesn't meet learners' needs.

Interestingly, around 12% of students reported an outright negative attitude toward e-learning. Their reasons? Mostly technical frustrations—unreliable internet, power issues, and a sense of isolation. These are not trivial complaints. As Adedoyin and Soykan (2020) have noted, students in low- and middle-income countries (LMICs) regularly face such barriers, which can severely disrupt the learning experience. So, while the general outlook is positive, the frustrations are real and suggest that e-learning still has a long way to go to become a truly reliable and inclusive tool.

Preferences for e-Learning

When asked about preferred learning formats, a strong majority (70%) leaned toward blended learning, combining both online and face-to-face sessions. This preference makes sense, especially for orthopaedic students who need more than just theory. Blended models allow students to get theoretical content online, while still engaging in essential hands-on training in person. Kaloki et al. (2023) and Chingos et al. (2022) made similar observations, highlighting how blended formats enhance both engagement and learning outcomes in practice-oriented fields.

Another interesting insight was the widespread appreciation for Learning Management Systems (LMS). About 85% of students preferred using platforms like Moodle or Blackboard to access materials, submit assignments, and track progress. Dhawan (2020) also emphasized the importance of LMS platforms in streamlining online education. Meanwhile, tools like Zoom and Google Meet were favored by 67% of students for real-time lessons—showing just how important synchronous interaction remains, even in online formats.

Content preferences also stood out. A significant number of students (78%) said they preferred short, engaging video lectures, while 60% wanted demonstrations of orthopaedic procedures included in the materials. These preferences reinforce findings from Guo et al. (2014), who showed that shorter videos help maintain attention and improve retention. Interactive quizzes were appreciated too—by 16% of respondents—as a way to stay actively engaged and reinforce learning.

Even so, fully online learning had limited support—only 18% of students were in favor. This isn't just about preference; it reflects a broader skepticism. Like Bao (2020) and Kaloki et al. (2023) observed, students often feel that fully online models can be isolating, hard to follow, and less effective when it comes to nuanced or practical content.

Barriers to E-Learning

Barriers to effective e-learning were clearly evident in the data. Unsurprisingly, technological limitations topped the list. About 72% of respondents reported poor internet connectivity, and 65% mentioned high internet costs as a barrier. These challenges reflect broader issues in the Kenyan context, where infrastructure is unevenly distributed, especially between urban and rural areas. Adedoyin and Soykan (2020) noted that students in LMICs often face similar limitations that severely constrain the learning process.

Institutional factors also played a role. A lack of technical support (58%) and platform navigation difficulties (48%) were major concerns. As Hodges et al. (2020) pointed out, successful e-learning depends not just on access to platforms, but also on usability and ongoing support—areas that still seem to fall short.

On a personal level, many students struggled with time management (55%) and low motivation (30%). These findings are consistent with Bao (2020), who emphasized that e-learning requires a great deal of self-discipline. Broadbent and Poon (2015) made a similar point: without the structure of in-person classes, students often find it hard to stay motivated or manage their schedules effectively.

Pedagogical gaps were another recurring theme. Limited interaction (58%) and poor feedback mechanisms (35%) made students feel disconnected. These issues mirror findings by Bali and Liu (2018), who stressed that continuous engagement and timely feedback are essential—especially in health-related fields where active participation is key to learning.

V. Conclusion

The study revealed that most ODeL orthopaedic students hold a generally positive outlook on e-learning. They value its flexibility, on-demand access, and the autonomy it offers for self-paced study. Still, despite these benefits, concerns remain—particularly around limited interaction with peers and instructors, as well as ongoing technical difficulties. These issues point to areas where the current e-learning approach could be refined.

When it comes to preferences, students showed strong support for blended learning models that integrate both online and in-person components. Tools like learning management systems (LMS), video conferencing platforms, and engaging content formats—such as short video lectures and interactive quizzes—were seen as especially helpful in boosting learning outcomes and keeping students engaged.

That said, several barriers continue to hold back the full potential of e-learning. Poor internet connectivity and high data costs remain widespread, while institutional shortcomings—like limited tech support and poorly designed platforms—further complicate the experience. Add to that the personal hurdles many students face, such as time management struggles and lack of motivation, and it's clear that both structural and pedagogical adjustments are needed to make e-learning more effective and inclusive for orthopaedic training.

VI. Recommendations

To improve the e-learning experience for ODeL orthopaedic students, stronger policy interventions are essential. Policymakers at KMTC—and more broadly—should focus on expanding affordable, high-quality internet access, particularly in underserved and rural areas. Promoting digital equity through subsidized devices,

internet grants, and inclusive funding models would help close the gap for students who are otherwise left behind due to financial or infrastructural limitations.

At the institutional level, KMTC should fully embrace blended learning as a core teaching model, allowing theoretical content to be delivered online while preserving vital face-to-face clinical instruction. The modernization of e-learning platforms is also overdue; systems must be intuitive, interactive, and better tailored to students' needs. Dedicated technical support teams could play a major role in reducing frustration and dropout, while the development of practical, visually rich content—like demonstration videos and interactive quizzes—can better support skills-based learning in orthopaedics.

Looking ahead, further research is needed to deepen understanding of e-learning's long-term impact in medical education. Longitudinal studies could assess actual learning outcomes and clinical competence over time. Additionally, research exploring cultural and gender-related influences on e-learning adoption in Kenya and other LMICs would help shape more inclusive, effective strategies going forward.

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Tables And Figures

Table 1: Demographic Characteristics of the Study Participants

Variable	Category	Frequency	Percent
Age (years)	20-24	109	70
	25-29	39	25
	>30 years	8	5
Gender	Male	55	35
	Female	101	65
Campus	Kangundo	36	23
	Makindu	39	25
	Nakuru	41	26
	Port Reitz	40	26
Marital Status	Single	142	91
	Married	14	9
Prior experience in e-learning	Yes	76	49
	No	80	51
Need e-learning training	Yes	136	87
	No	20	13
Digital literacy skills	Excellent	51	33
	Good	61	39

	Poor	44	28
Residence	Rural Urban	66 90	42 57
Laptop/Smartphone ownership	Yes No	154 2	99 1
Designated study area	Yes No	92 64	59 41
Total		**156**	**100**

The table presents the demographic characteristics of the 156 ODeL orthopaedic students who participated in the study, detailing their age distribution, gender, campus location, marital status, prior e-learning experience, training needs, digital literacy, residence, device ownership, and availability of a designated study area.

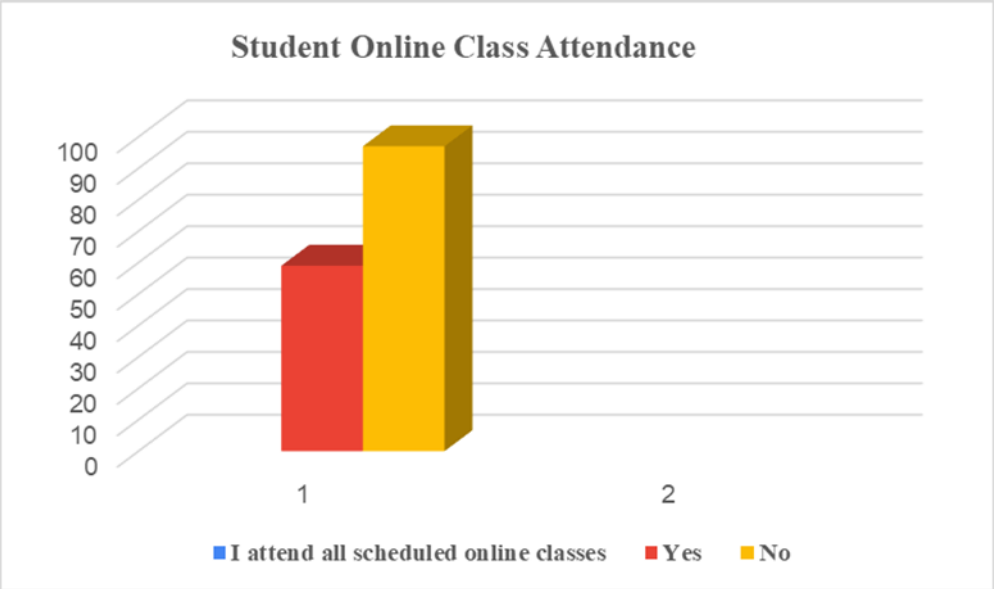

Figure 1: Students' Class Attendance Online

The figure presents students' responses to whether they attended all scheduled online classes. A majority indicated incomplete attendance (yellow) compared to those who reported complete attendance (red). Data suggest a considerable gap between intended and actual attendance patterns, with incomplete attendance being more prevalent.

Table 2: Attitudes of the Students Towards e-Learning

Attitude Variable	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
I feel comfortable using e-learning	11	9	61	50	25
I am interested in e-learning	9	13	39	64	30
e-Learning is not time-consuming	18	11	36	52	38
e-Learning is very convenient for me	14	22	44	76	36
e-Learning enhances my learning process	10	15	51	48	30
I am optimistic about e-learning	14	12	52	39	35
e-Learning is effective for acquiring clinical and technical skills	29	29	43	21	32

e-Learning is suitable for taking exams/CATs	25	23	25	39	42
I find e-learning to be cost-effective	26	16	39	38	35
Overall, I prefer e-learning, and I believe it is better than classroom learning	36	29	38	20	31
Percentage distribution	**3%**	**9%**	**20%**	**28%**	**40%**

The findings reveal generally positive perceptions on e-learning (68% , n=106) with higher agreement levels for convenience and interest, though effectiveness for clinical skills and preference over classroom learning received more mixed responses.

Table 2: E-learning Preferences of ODeL Orthopaedic Students

Variable	Categories	Frequency	Percentage
Preferred method for learning	E-learning only Classroom learning only Blended learning	23 24 109	15 15 70
Preferred e-learning platform	Google Meet Kenet KMTC e-learning portal Zoom	72 13 27 35	47 8 17 28
Preferred e-learning method	Asynchronous Synchronous	17 139	11 89
Asynchronous online content preferences	Videos Quizzes Downloadable texts	122 25 9	78 16 6

The data show a predominant preference for blended learning, synchronous delivery, and video-based materials, highlighting the students' inclination toward interactive and visually engaging formats.

Table 4: Bivariate Analysis for Urban-based vs Rural-based ODeL Students on Preferred Mode for Content Delivery

Variable	Category	Total (n=156)	Urban (n=90)	Rural (n=66)	P-value
Preferred Mode of Content Delivery	e-Learning only	23	15 (65.2%0	8 (34.8%)	0.042
	Classroom only	24	5 (20.8%)	19 (79.2%	0.035
	Blended learning	109	57 (52.1%)	52 (47.9%)	0.510
Preferred e-learning method	Synchronous	17 (10.8%)	9 (52.9%)	8 (47.1%)	0.522
	Asynchronous	139 (89.2%)	81 (58.3%)	58 (41.7%)	0.684

The analysis compares urban- and rural-based ODeL students' content delivery preferences, testing the null hypothesis of no significant difference. Results indicate statistically significant differences for e-learning only ($p = 0.042$) and classroom-only ($p = 0.035$) preferences, with urban students favouring e-learning and rural students favouring classroom learning. No significant differences were observed for blended learning or e-learning method preferences.

Table 5: Bivariate Analysis to Determine the Influence of Prior e-learning on Current e-learning (H_o2)

Variables	Odds ratios	95% CI lower	95% CI upper	P value
With prior E-learning experience (n=76)	3.84	1.71	8.63	0.001
Without prior e-learning (n=80)	1.97	0.81	4.81	0.138

The table presents findings for the association between prior e-learning experience and current participation in e-learning. Students with prior experience were significantly more likely to participate in current e-learning (OR = 3.84, 95% CI: 1.71–8.63, $p = 0.001$). No statistically significant association was found among students without prior experience (OR = 1.97, 95% CI: 0.81–4.81, $p = 0.138$).