

Association of innovative-teaching learning strategies on student academic performance in undergraduate health sciences at Masinde Muliro University of Science and Technology, Kenya

Janephaar Abuti Ogot¹
Gladys Mengich²
Harun Chemjor³

¹ogotabuti@gmail.com
²gmengich@mmust.ac.ke
³hchemjor@mmust.ac.ke

^{1,2,3}Masinde Muliro University of Science and Technology, Kenya

<https://doi.org/10.51867/ajernet.7.4.62>

ABSTRACT

Health professions education increasingly requires teaching approaches that develop critical thinking, clinical reasoning, collaboration and practice-ready competencies. This study determined the association between innovative teaching and learning strategies and academic performance among undergraduate Health Sciences students at Masinde Muliro University of Science and Technology, Kenya. The study was anchored in Social Cognitive Theory, which posits that knowledge is actively constructed through social interaction, collaboration, and meaningful engagement with authentic learning tasks rather than passively received through didactic instruction. From this theoretical perspective, innovative teaching strategies such as Problem-Based Learning, Peer-Assisted Learning, Case-Based Learning, Collaborative Learning and Interprofessional Education create social learning environments in which students co-construct knowledge, learn from peers and instructors, and develop shared understandings of clinical practice. An institution-based analytical cross-sectional design was employed. Using stratified random sampling, 223 students were selected from nine undergraduate Health Sciences programmes. Data were collected using a structured self-administered questionnaire and analysed using frequencies, percentages, weighted scores and Pearson's Chi-square tests at a significance level of $p < .05$. Most respondents were aged 20–24 years (90.6%), while 49.8% were third-year students. The most frequently utilised strategies were Peer-Assisted Learning (80.8%), Problem-Based Learning (76.7%), Evidence-Based Medicine (75.4%), Flipped Classrooms (74.9%) and Interprofessional Education (74.8%). Students generally perceived innovative strategies as beneficial: 85.7% agreed that peer collaboration enhanced critical thinking, 80.3% reported improved knowledge and skills retention, and 76.2% indicated improved classroom and practical performance. Overall, 97.4% of respondents were classified as having good academic performance. Significant associations were established between academic performance and Problem-Based Learning, Interprofessional Education, Skills-Based Laboratory Learning, Flipped Classrooms, Case-Based Learning, Collaborative Learning, Evidence-Based Medicine and Peer-Assisted Learning ($p < .05$). However, Computer-Assisted Learning, Community-Based Education, Simulation-Based Learning, Gamification, and Social Media and Online Learning were not significantly associated with performance ($p > .05$). Consistent with Social Cognitive Theory, the strategies demonstrating the strongest associations were those that fostered social interaction, collaborative knowledge construction and authentic, context-rich learning experiences. The study concluded that the association between innovative teaching strategies and academic performance was strategy-specific, with structured, socially interactive, learner-centred and practice-oriented approaches demonstrating the strongest relationships. MMUST should strengthen faculty development, skills laboratories, digital infrastructure and the systematic integration of effective innovative strategies across Health Sciences curricula.

Keywords: Academic Performance, Health Professions Education, Innovative Teaching Strategies, Undergraduate Students, Problem-Based Learning, Social Constructivism, Kenya

I. INTRODUCTION

Health professions education plays a fundamental role in preparing competent healthcare professionals capable of delivering safe, evidence-based, and patient-centered care. The rapid evolution of healthcare systems, emerging disease patterns, technological innovations, and increasing patient expectations have created a growing demand for graduates who possess not only strong theoretical knowledge but also critical thinking, clinical reasoning, communication, teamwork, and lifelong learning skills. Consequently, institutions of higher learning are progressively transitioning from traditional teacher-centered approaches toward innovative, learner-centered pedagogies that actively engage students in the learning process and promote the development of professional competencies (Zhang et al., 2022). The best method for providing an in-depth education in the health sciences is thought to be an integrated strategy that incorporates a variety of innovative teaching and learning techniques. Research has shown that a comprehensive strategy

that incorporates PBL, simulations, ICT-based learning and CBE offers students a comprehensive learning experience that equips them with the intricacies of the healthcare industry (Biggs & Tang, 2011).

The use of innovative teaching techniques has been steadily rising in the African setting. PBL's application in Ugandan medical schools found that students' analytical and collaborative abilities significantly improved (Cook *et al.*, 2013). Students in South African health sciences programs are now more ready for clinical placements because of the addition of skills laboratories and simulations (Mothiba *et al.*, 2020). Notwithstanding these developments, issues with faculty preparation and resource constraints continue to exist, which have an impact on the reliability and calibre of these innovative teaching practices (Frambach *et al.*, 2017).

In Kenya, studies have shown that there are major obstacles to the full implementation of approaches like problem-based learning (PBL), ICT-based learning, and community-based education, even if Kenyan universities like MMUST are starting to include them. According to Wambugu *et al.* (2013), the restricted availability of technology and poor simulation labs are two factors impeding the wider use of these tactics. Furthermore, to guarantee that teachers are prepared to apply these cutting-edge techniques successfully, stronger faculty development initiatives are required (Mendenhall & Tangelder, 2016; Amolloh *et al.*, 2018). However, ICT-based learning in the health sciences is still in its early phases of adoption in Kenya. Gikandi (2021) study demonstrated that e-learning can help close the educational gaps, but there are still a lot of obstacles to overcome, like internet connectivity and digital literacy.

PBL is becoming more and more popular as an innovative teaching method throughout the African continent, including Kenya. Despite implementation's logistical hurdles, students expressed satisfaction with PBL's involvement and practical application of information (Katwa *et al.*, 2018). CBE is being added to health sciences curricula in Kenya in order to expose students to real-world health issues. However, Okube *et al.* (2022) noted that major obstacles to the successful use of CBE are logistical in nature, including transportation and coordinating with community health centres. According to a study by Kavinya *et al.* (2023), although simulation-based training is beneficial for students, its efficacy and scalability are constrained by a lack of resources and qualified individuals. While Kenyan universities are working to put these integrated ideas into practice, in order to get the best results, issues with infrastructure, money and faculty preparation must be resolved (Kiguli-Malwadda *et al.*, 2022).

1.1 Statement of the Problem

Health Sciences education is expected to produce graduates who possess strong theoretical knowledge, clinical competence, critical-thinking ability, problem-solving skills and readiness for collaborative professional practice. However, conventional lecturer-centred teaching may not adequately develop these competencies, prompting universities to adopt innovative approaches such as Problem-Based Learning, Case-Based Learning, Simulation-Based Learning, Flipped Classrooms, Peer-Assisted Learning, Interprofessional Education and technology-supported learning. Although international evidence suggests that these strategies can improve theoretical knowledge, practical skills, engagement and student satisfaction, their effectiveness depends on the quality, frequency and context of implementation, and no single strategy has been demonstrated to be universally superior (Zhang *et al.*, 2024). Evidence from African institutions remains limited and geographically uneven, with many studies focusing on students' perceptions or individual teaching strategies rather than objective academic outcomes across multidisciplinary Health Sciences programmes (Ghani *et al.*, 2025).

In Kenya, studies have reported positive attitudes towards e-learning and simulation-based instruction, but unreliable internet connectivity, inadequate simulation facilities, limited digital resources and insufficiently trained instructors continue to constrain implementation (Kabare *et al.*, 2022; Kavinya *et al.*, 2023). At MMUST, several innovative teaching and learning strategies have been introduced within undergraduate Health Sciences programmes; however, limited empirical evidence exists regarding their level of utilisation and whether individual strategies are significantly associated with student academic performance. Without such evidence, curriculum planners and lecturers may be unable to determine which approaches should be strengthened, modified or prioritised when allocating limited educational resources. This study therefore sought to determine the association between innovative teaching and learning strategies and academic performance among undergraduate Health Sciences students at MMUST.

1.2 Research Objectives

To determine the association of innovative –teaching learning strategies on student academic performance in undergraduate Health Sciences at MMUST

1.3 Research Hypotheses

H₀: Innovative teaching learning strategies has no statistically significant association with undergraduate health science student academic performance

II. LITERATURE REVIEW

2.1 Theoretical Review

This study was anchored in Albert Bandura's Social Cognitive Theory (SCT), which explains learning and behaviour as outcomes of the reciprocal interaction among personal cognitive factors, behaviour and the social environment. This interaction, referred to as reciprocal determinism, suggests that students do not acquire knowledge and skills solely through direct instruction; they also learn by observing, imitating and modelling the behaviours of lecturers, clinical instructors and peers. Through observational learning, students evaluate the actions of others and the consequences associated with those actions before adopting similar behaviours. SCT further emphasises self-efficacy, defined as an individual's belief in their ability to organise and perform the actions required to achieve a particular outcome. Students with strong academic and clinical self-efficacy are more likely to participate actively, persist when confronted with difficult learning tasks and apply acquired knowledge and skills effectively (Bandura, 1986, 2001).

SCT was relevant to this study because innovative teaching and learning strategies create social and experiential environments in which students observe, practice, receive feedback and develop confidence in their academic and clinical abilities. Strategies such as Problem-Based Learning, Peer-Assisted Learning, Simulation-Based Learning, Interprofessional Education and collaborative learning enable students to model effective behaviours, learn from peers and instructors, and strengthen their self-regulation and self-efficacy. Similarly, encouragement, constructive feedback, peer support and successful task performance may motivate students to sustain learning behaviours that contribute to improved academic performance. Contemporary applications of SCT in education affirm that self-efficacy, goals, outcome expectations and environmental support influence students' motivation, effort, persistence and achievement (Schunk & DiBenedetto, 2020). The theory therefore provided an appropriate framework for explaining how students' cognitive beliefs, interactions with peers and faculty, and exposure to innovative teaching environments jointly influenced their learning behaviours and academic performance.

2.2 Empirical Review

Innovative teaching and learning strategies have become increasingly important in health professions education because conventional lecture-based approaches may not adequately develop the clinical reasoning, problem-solving, teamwork and practical competencies required in modern healthcare. These strategies include Problem-Based Learning (PBL), Case-Based Learning (CBL), Simulation-Based Learning (SBL), Flipped Classrooms, Peer-Assisted Learning (PAL), Interprofessional Education, Evidence-Based Medicine, Community-Based Education and technology-supported learning. A network meta-analysis involving 80 randomised controlled trials and 6,180 medical students established that innovative approaches generally produced better learning outcomes than lecture-based instruction. CBL was particularly effective in improving theoretical examination scores, PBL enhanced practical performance, and SBL produced high student satisfaction. However, differences among the strategies were relatively small, while variations in their design, duration and assessment methods limited identification of a universally superior approach (Zhang et al., 2024).

Problem-Based Learning, Case-Based Learning, Peer-Assisted Learning and collaborative learning improve academic performance by actively involving students in knowledge construction and application. PBL and CBL expose students to realistic clinical problems that require them to integrate knowledge from different disciplines, identify learning needs and develop evidence-based solutions. The network meta-analysis by Zhang et al. (2024) ranked PBL and CBL among the most effective approaches for improving the quality and effectiveness of medical education. Similarly, evidence from African medical schools indicates that PBL, peer learning and mentorship can strengthen critical thinking, clinical reasoning and self-directed learning (Ghani et al., 2025). Nevertheless, the academic benefits of these approaches depend on well-designed clinical cases, clearly defined learning objectives, trained facilitators and structured feedback. Poorly facilitated group activities may result in unequal participation, dissemination of inaccurate information and excessive cognitive demands, particularly among students with limited prior clinical knowledge.

Simulation-Based Learning and Skills-Based Laboratory Learning provide safe environments in which students can practise clinical procedures, receive immediate feedback and repeat tasks without exposing patients to avoidable risks. A systematic review and meta-analysis of 51 trials involving 4,696 participants found that virtual patient simulations produced knowledge outcomes comparable to traditional teaching but substantially improved clinical and procedural skills (Kononowicz et al., 2019). Similarly, Zhang et al. (2024) identified simulation as one of the most effective strategies for enhancing practical learning and student satisfaction. Despite these benefits, simulation requires adequately equipped laboratories, trained instructors, appropriate scenarios and regular maintenance of equipment. In Kenya, Kavinya et al. (2023) found that simulation-based teaching was not applied uniformly across selected Kenya Medical Training College campuses because of inadequate infrastructure and insufficiently trained instructors. This suggests that the influence of simulation on academic performance may depend on the quality and consistency of its implementation.

Technology-supported strategies, including flipped classrooms, computer-assisted learning, online learning, multimedia instruction and gamification, increase flexibility and allow students to access learning resources beyond the conventional classroom. A meta-analysis of 28 comparative studies found that flipped classrooms produced a significant improvement in learning outcomes compared with traditional instruction, particularly when pre-class materials were reinforced through quizzes and interactive classroom activities (Hew & Lo, 2018). Gamification may similarly improve motivation and engagement by incorporating challenges, feedback and rewards, although its effect depends on alignment with learning objectives rather than entertainment alone (Dichev & Dicheva, 2017). In Kenya, health sciences students generally demonstrated positive knowledge, attitudes and practices towards e-learning, but effective participation was affected by technological and contextual challenges (Kabare et al., 2022). Consequently, access to reliable internet, digital devices, technical support and faculty competence remains essential for these strategies to improve performance.

Within Africa, innovative learning strategies show considerable potential to improve critical thinking, clinical reasoning, self-directed learning and readiness for professional practice. However, available evidence is geographically uneven, dominated by studies from a few countries and frequently based on students' perceptions rather than objective academic or clinical outcomes. Ghani et al. (2025) further observed that much of the African evidence uses cross-sectional designs, making it difficult to determine the long-term effects of innovative teaching approaches. Kenyan studies have mainly examined individual strategies, such as e-learning or simulation, within particular programmes or institutions (Kabare et al., 2022; Kavinya et al., 2023). Limited evidence therefore exists on the combined association of multiple innovative teaching and learning strategies with academic performance across multidisciplinary undergraduate Health Sciences programmes. This contextual and methodological gap justified examining the association between innovative teaching strategies and student academic performance at MMUST.

III. METHODOLOGY

3.1 Research Design

This study employed an institution-based analytical cross-sectional study design to assess the utilization of innovative teaching and learning strategies and their influence on academic performance among undergraduate Health Sciences students at Masinde Muliro University of Science and Technology (MMUST), Kenya. A cross-sectional design was appropriate because it enables assessment of existing educational practices and examination of associations between exposure variables and outcomes at a specific point in time (Setia, 2016).

3.2 Study Area

The study was conducted at Masinde Muliro University of Science and Technology (MMUST), a public university located in Kakamega County, western Kenya. The university offers undergraduate Health Sciences programs through the School of Medicine and other academic units, including Bachelor of Medicine and Bachelor of Surgery (MBChB), Bachelor of Nursing and Midwifery, Bachelor of Science in Clinical Medicine, Bachelor of Science in Public Health, Bachelor of Science in Physiotherapy, Bachelor of Science in Medical Laboratory Science, Bachelor of Science in Nutrition and Dietetics, Bachelor of Science in Medical Education, and Bachelor of Science in Optometry and Vision Sciences. The Health Sciences programs at MMUST are competency-based and integrate multiple teaching approaches, including classroom-based instruction, laboratory practical sessions, clinical skills training, simulation-based learning, hospital rotations, community-based education, and technology-supported learning. The institution is equipped with skills laboratories, simulation facilities, computer laboratories, and electronic learning platforms that support diverse instructional approaches. In addition, the university maintains collaborations with healthcare facilities where students undertake clinical training and community-based learning activities. These characteristics provided an appropriate environment for evaluating innovative teaching practices and their influence on students' academic outcomes.

3.3 Study Population

The study population consisted of undergraduate students enrolled in Health Sciences programs at MMUST during the 2024/2025 academic year. According to university records, approximately 745 undergraduate students were enrolled in eligible Health Sciences programs during the study period. The programs included Medicine, Nursing and Midwifery, Clinical Medicine, Public Health, Physiotherapy, Medical Laboratory Science, Nutrition and Dietetics, Medical Education, and Optometry and Vision Sciences. The present study focused exclusively on undergraduate students because they were the direct recipients of the teaching and learning strategies under investigation and were therefore best positioned to provide information regarding their implementation and perceived influence on academic performance.

3.4 Eligibility Criteria

Students were eligible for inclusion if they were registered undergraduate Health Sciences students at MMUST, were in the second to sixth year of study, had participated in classroom and/or clinical learning activities, and provided informed consent to participate. Students were excluded if they were enrolled in non-health-related programmes, were unavailable during the data collection period, declined participation, or submitted questionnaires with substantial missing information that affected analysis.

3.5 Sampling procedure and Sample Size Determination

3.5.1 Sampling procedure

A stratified random sampling approach was used to ensure representation of students from all undergraduate Health Sciences programs. Students were first categorized into strata according to their respective academic programs. The strata included Medicine, Nursing and Midwifery, Clinical Medicine, Public Health, Physiotherapy, Medical Laboratory Science, Nutrition and Dietetics, Medical Education, and Optometry and Vision Sciences. Proportionate allocation was applied to determine the number of participants selected from each program based on enrolment size. Subsequently, simple random sampling was conducted within each program to select individual participants. This approach enhanced representativeness and reduced potential selection bias by ensuring that students from different academic disciplines were adequately represented.

3.5.2 Sample size determination

The sample size for this study was determined using the Yamane formula (1967) to compute the sample size from the target population of 870. Using the formula, sample is shown in Table 1. Using a 95% confidence level and a 5% margin of error, the estimated sample size was calculated. An allowance was considered for possible non-response and incomplete questionnaires. During the data collection period, 223 fully completed questionnaires were obtained and included in the final analysis.

Table 1

Showing the sampling frame of the study

No	Department	Faculty prop	Faculty n	Student prop	Student n
1	Medical laboratory science	0.184	9	0.114	35
2	Health professional education	0.096	5	0.007	2
3	Nutrition	0.072	4	0.067	20
4	Nursing	0.256	13	0.336	102
5	Clinical medicine	0.032	2	0.107	33
6	Medicine	0.216	11	0.082	25
7	Physiotherapy	0.04	2	0.083	25
8	Public Health	0.048	2	0.106	32
9	Optometry and vision sciences	0.056	3	0.098	30
	Total	1	49	1.000	304

3.5.3 Study Variables

The dependent variable was students' academic performance. Academic performance was assessed using students' reported academic outcomes and performance-related indicators included in the questionnaire. For analysis, performance was categorized into good and poor performance based on predetermined scoring criteria. The main independent variable was utilization of innovative teaching and learning strategies. These strategies included Problem-Based Learning (PBL), Computer-Assisted Learning (CAL), Interprofessional Education (IPE), Community-Based Education (CBE), Simulation-Based Learning (SBL), Skills-Based Laboratory Learning (SKLL), Flipped Classroom (FC), Case-Based Learning (CBL), Gamification, Collaborative Learning, Social Media and Online Learning, Evidence-Based Medicine (EBM), and Peer-Assisted Learning (PAL). Demographic characteristics, including age, gender, program of study, and year of study, were considered explanatory variables that could influence students' perceptions and academic performance.

3.6 Data Collection Instruments and Procedures

Data were collected using a structured self-administered questionnaire developed from the study objectives and reviewed literature on innovative approaches in health professions education. The questionnaire consisted of four sections: demographic characteristics, utilization of innovative teaching strategies, perceived influence of innovative strategies on academic performance, and academic performance indicators. The utilization of innovative teaching strategies was assessed using a five-point Likert scale ranging from 1 = Never to 5 = Always. The assessed strategies included learner-centered approaches such as PBL, PAL, EBM, FC, and collaborative learning, as well as technology-

supported approaches including CAL, online learning, and gamification. Students' perceptions regarding the influence of innovative teaching strategies were evaluated through statements assessing improvement in academic performance, clinical skills development, motivation, knowledge retention, confidence, critical thinking, problem-solving abilities, participation, and effectiveness of digital learning approaches. Responses were rated on a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree. Data collection was conducted after obtaining ethical approval and institutional authorization. Research assistants were trained on study procedures, participant recruitment, administration of questionnaires, and ethical requirements. Eligible students were informed about the study objectives, and those who provided written informed consent completed the questionnaires anonymously.

3.6.1 Validity and Reliability of the Instrument

The validity of the questionnaire was ensured through expert review and pilot testing. Experts in health professions education and research methodology reviewed the instrument to determine whether the items adequately captured the study objectives and represented relevant dimensions of innovative teaching and learning strategies. Construct validity was strengthened by aligning questionnaire items with established educational concepts related to learner-centered, experiential, collaborative, and technology-supported learning approaches. Reliability was assessed during pilot testing using Cronbach's alpha coefficient to determine internal consistency of the questionnaire items. A Cronbach's alpha value of ≥ 0.70 was considered acceptable. Items identified as unclear or reducing reliability were reviewed and modified before the final data collection.

3.7 Data Management and Statistical Analysis

Completed questionnaires were reviewed for completeness, coded, and entered into the Statistical Package for Social Sciences (SPSS) for analysis. Data cleaning procedures were conducted to identify inconsistencies, missing values, and entry errors before analysis. Descriptive statistics including frequencies and percentages were used to summarize demographic characteristics and utilization patterns of innovative teaching strategies. Weighted scores were calculated from Likert-scale responses to determine the overall utilization level of each teaching strategy. Students' perceptions regarding the influence of innovative teaching strategies on academic performance were summarized using frequencies, percentages, and weighted scores. Academic performance was categorized into good and poor performance based on predefined criteria. Inferential analysis was conducted using Chi-square tests to determine associations between innovative teaching strategies and academic performance. Statistical significance was considered at a p-value < 0.05 . Findings were presented using tables, figures, frequencies, percentages, and test statistics.

3.8 Ethical Considerations

Ethical approval was obtained from the relevant Institutional Ethics Review Committee before commencement of the study. Permission to conduct the study was obtained from MMUST administrative authorities. Participation was voluntary, and all participants provided informed consent before completing the questionnaire. Participants were informed about the study objectives, procedures, potential benefits, and their right to withdraw at any stage without consequences. Confidentiality and anonymity were maintained throughout the research process. No personal identifiers were collected, and questionnaires were coded to protect participant privacy. Data were securely stored and accessed only by the research team. The study adhered to ethical principles of autonomy, beneficence, non-maleficence, and justice. Participants were treated fairly and respectfully regardless of their academic programme or demographic characteristics.

IV. FINDINGS & DISCUSSION

4.1 Demographic characteristics of respondents

Table 2 presents the demographic characteristics of the 223 undergraduate health-sciences students who participated in the study. The respondents were drawn from different age groups, genders, academic programmes and years of study. This diversity was important because students' exposure to innovative teaching and learning strategies may vary according to their programme, stage of training and prior learning experiences. However, the demographic results are descriptive and do not, by themselves, demonstrate that age, gender, programme or year of study influenced academic performance. Regarding age, most respondents, 202 (90.6%), were aged 20–24 years, while 15 (6.7%) were below 20 years. Only five (2.2%) were aged 25–29 years, and one (0.4%) was above 30 years. This shows that the study predominantly represented young adults within the conventional undergraduate age range. The finding is comparable to a Kenyan study by Dossajee et al. (2016), which reported that medical students were largely in their early to mid-twenties. The concentration of respondents within a relatively narrow age range may reduce age-related variability in their learning experiences. Nevertheless, the limited representation of mature students means the findings may not adequately capture the experiences of older learners who may have different professional experiences, family responsibilities and approaches to self-directed learning.

In relation to gender, males constituted 117 (52.5%) of the respondents, females accounted for 97 (43.5%), while nine (4.0%) preferred not to disclose their gender. The relatively small difference between male and female representation suggests that the study captured perspectives from both groups. This is useful because some studies have reported possible gender differences in learning preferences, although the evidence remains inconsistent. For example, Hernández-Torrano et al. (2017) found some differences in visual and sequential learning preferences between male and female medical students but cautioned that these preferences did not consistently predict performance. Therefore, the gender distribution strengthened the inclusiveness of the study, but further inferential analysis would be necessary before concluding that gender was associated with students' academic performance or perceptions of innovative teaching strategies.

The respondents were drawn from nine health-sciences programmes, indicating broad multidisciplinary representation. Bachelor of Nursing and Midwifery students formed the largest group, with 54 (24.2%), followed by BSc Clinical Medicine with 31 (13.9%), BSc OPV with 28 (12.6%), BSc Physiotherapy with 24 (10.8%) and BSc Nutritional Sciences with 22 (9.9%). Other respondents were enrolled in MBChB, 19 (8.5%); Medical Laboratory Science, 16 (7.2%); Public Health, 15 (6.7%); and Medical Education, 14 (6.3%). This multidisciplinary composition was particularly appropriate for examining innovative teaching strategies because health-professions education increasingly emphasises interprofessional and collaborative learning. The World Health Organization (2010) recommends that students from different health professions learn with, from and about one another to strengthen teamwork and collaborative practice. Similarly, Reeves et al. (2016) found that interprofessional education generally improves learners' attitudes, collaborative knowledge and teamwork skills. Nevertheless, because nursing students constituted the largest group, the aggregated results may reflect their experiences more strongly than those of programmes with fewer respondents.

Concerning the year of study, nearly half of the respondents, 111 (49.8%), were in the third year, while 50 (22.4%) were in the second year and 46 (20.6%) were in the fourth year. Only 14 (6.3%) were in the fifth year and two (0.9%) were in the sixth year. The dominance of students in the second to fourth years suggests that most respondents had sufficient exposure to university teaching methods and could meaningfully assess innovative strategies such as problem-based, simulation-based, case-based, flipped-classroom and collaborative learning. Research indicates that students' learning needs and experiences may change as they progress from preclinical instruction to advanced clinical training (Liew et al., 2015). The small number of fifth- and sixth-year students, however, means that perspectives arising from extensive clinical exposure were less strongly represented. Consequently, subsequent analyses should consider programme and year of study as possible confounding variables when interpreting the association between innovative teaching strategies and academic performance.

Table 2

Demographic characteristics of respondents (n = 223)

Variable	Category	Frequency (N)	Percent (%)
Age Group (years)	<20	15	6.7
	20–24	202	90.6
	25–29	5	2.2
	>30	1	0.4
Total (Age Group)		223	100
Gender	Male	117	52.5
	Female	97	43.5
	Prefer not to say	9	4
Total (Gender)		223	100
Program of Study	Bachelor of Medicine & Surgery (MBChB)	19	8.5
	BSc. Clinical Medicine	31	13.9
	BSc. Medical Education	14	6.3
	Bachelor of Nursing & Midwifery	54	24.2
	BSc. Public Health	15	6.7
	BSc. Physiotherapy	24	10.8
	BSc. OPV	28	12.6
	BSc. Nutritional Sciences	22	9.9
	BSc. Medical Laboratory Science	16	7.2
Total (Program of Study)		223	100

Year of Study	Second Year	50	22.4
	Third Year	111	49.8
	Fourth Year	46	20.6
	Fifth Year	14	6.3
	Sixth Year	2	0.9
Total (Year of Study)		223	100

4.2 Descriptive analysis of the influence of clinical strategies on students' performance (N = 223)

The findings in Table 3 indicate that students generally held positive perceptions regarding the influence of innovative clinical teaching strategies on their academic and practical performance. Most items recorded weighted scores above 70% of the maximum possible score, suggesting a favorable evaluation of these approaches. The most highly rated statement was that collaboration with peers enhances critical thinking, with 85.7% of students agreeing or strongly agreeing. This suggests that students value opportunities to work together, exchange ideas, and learn from one another, which they perceive as important for developing critical thinking skills. Similarly, “*Pre-class materials are helpful*” and “*Performance is better with innovative strategies*” both attained weighted scores of 874 (78.4%), while “*Simulation-based learning improves skills*”, “*Motivated to learn using innovative strategies*”, and “*Retain knowledge and skills longer with innovative strategies*” each recorded weighted scores of 861 (77.3%). These findings suggest that students recognize the value of preparatory learning materials, simulation activities, and innovative pedagogical approaches in enhancing learning outcomes, motivation, and knowledge retention. Regarding overall academic achievement, 76.2% of respondents agreed or strongly agreed that innovative clinical strategies had improved their overall performance in both classroom and practical settings, yielding a weighted score of 851 (76.4%). Furthermore, 71.3% agreed or strongly agreed that these strategies made them feel more confident in their profession, with a weighted score of 839 (75.2%). The statement “*Innovative strategies enhance problem-solving and critical thinking skills*” achieved a weighted score of 833 (74.8%), with approximately 73.1% of respondents expressing agreement. Likewise, 67.7% of students agreed that innovative strategies encouraged active participation in class, resulting in a weighted score of 814 (73.0%).

Technology-enhanced learning approaches received moderately positive ratings. Interactive online modules improve learning recorded a weighted score of 790 (70.9%), while the use of e-learning or blended learning platforms scored 789 (70.8%). Although these scores indicate favorable perceptions, a notable proportion of students remained neutral, suggesting variability in experiences with digital learning modalities. The lowest-rated items related to the frequency of implementation of certain innovative teaching approaches. Problem-Based Learning (PBL) sessions recorded a weighted score of 730 (65.5%), with 43.9% of respondents remaining neutral. Similarly, Simulation-Based Learning (SBL) activities are regularly part of training achieved the lowest weighted score of 713 (63.9%), with 39.9% reporting neutrality and 18.8% expressing disagreement. These findings imply that while students perceive PBL and SBL as beneficial, their integration into routine training may not be sufficiently consistent or widespread.

Table 3

Influence of clinical strategies on performance of students (N = 223)

Predictor Variable	Strongly Disagree ① (%)	Disagree ② (%)	Neutral ③ (%)	Agree ④ (F%)	Strongly Agree ⑤ (F%)	Weighted Score (F)	Percent of Max
Pre-class materials helpful	3 (1.3)	5 (2.2)	32 (14.3)	99 (44.4)	84 (37.7)	874	78.4
Simulation-based learning improves skills	2 (0.9)	12 (5.4)	33 (14.8)	99 (44.4)	77 (34.5)	861	77.3
Interactive online modules improve learning	7 (3.1)	16 (7.2)	63 (28.3)	82 (36.8)	54 (24.2)	790	70.9
Collaboration with peers enhances critical thinking	3 (1.3)	4 (1.8)	25 (11.2)	97 (43.5)	94 (42.2)	879	79.0
Performance better with innovative strategies	3 (1.3)	13 (5.8)	28 (12.6)	90 (40.4)	89 (39.9)	874	78.4
Motivated to learn using innovative strategies	4 (1.8)	10 (4.5)	32 (14.3)	110 (49.3)	67 (30.0)	861	77.3
Actively participate in class through innovative strategies	4 (1.8)	11 (4.9)	57 (25.6)	97 (43.5)	54 (24.2)	814	73.0
Retain knowledge and skills longer with innovative strategies	4 (1.8)	7 (3.1)	33 (14.8)	105 (47.1)	74 (33.2)	861	77.3
Improved overall performance in class & practical	5 (2.2)	11 (4.9)	37 (16.6)	98 (43.9)	72 (32.3)	851	76.4

Innovative strategies enhance problem-solving & critical thinking	2 (0.9)	11 (4.9)	47 (21.1)	94 (42.2)	69 (30.9)	833	74.8
Feel more confident in profession due to innovative strategies	5 (2.2)	13 (5.8)	46 (20.6)	86 (38.6)	73 (32.7)	839	75.2
Frequently engage in PBL sessions	10 (4.5)	21 (9.4)	98 (43.9)	56 (25.1)	38 (17.0)	730	65.5
SBL activities are regularly part of training	8 (3.6)	34 (15.2)	89 (39.9)	56 (25.1)	35 (15.7)	713	63.9
Often use e-learning or blended learning platforms	11 (4.9)	19 (8.5)	55 (24.7)	64 (28.7)	74 (33.2)	789	70.8

4.3 Student's performance

Further analysis classified performance into good and poor according to clinical assessment pass grade based on 8 items and actual grade obtained by students. Students who agreed and scored on ($\geq 60\%$) or greater than 7 on performance items and those who obtained ($\geq 50\%$) or greater on the actual grades were considered to have good performance or scored ($\leq 60\%$) or less than 8 on performance items and those who scored ($\leq 50\%$) less than 8 was considered to have poor performance. Overall, the visual pattern in Figure 1 shows that the majority of students achieved good academic performance (97.4%), while only a small proportion fell into the poor performance category as shown in Figure 1. This imbalance indicates a positively skewed performance distribution, suggesting that most students were able to meet or exceed the expected academic standards. The relatively low proportion of poor performance cases implies that, in general, the learning environment and teaching strategies may be supporting satisfactory academic achievement. However, the presence of a small group of students with poor performance highlights existing disparities in learning outcomes. This suggests that while the overall system is effective for most students, targeted academic support may still be necessary to address the needs of those who are struggling.

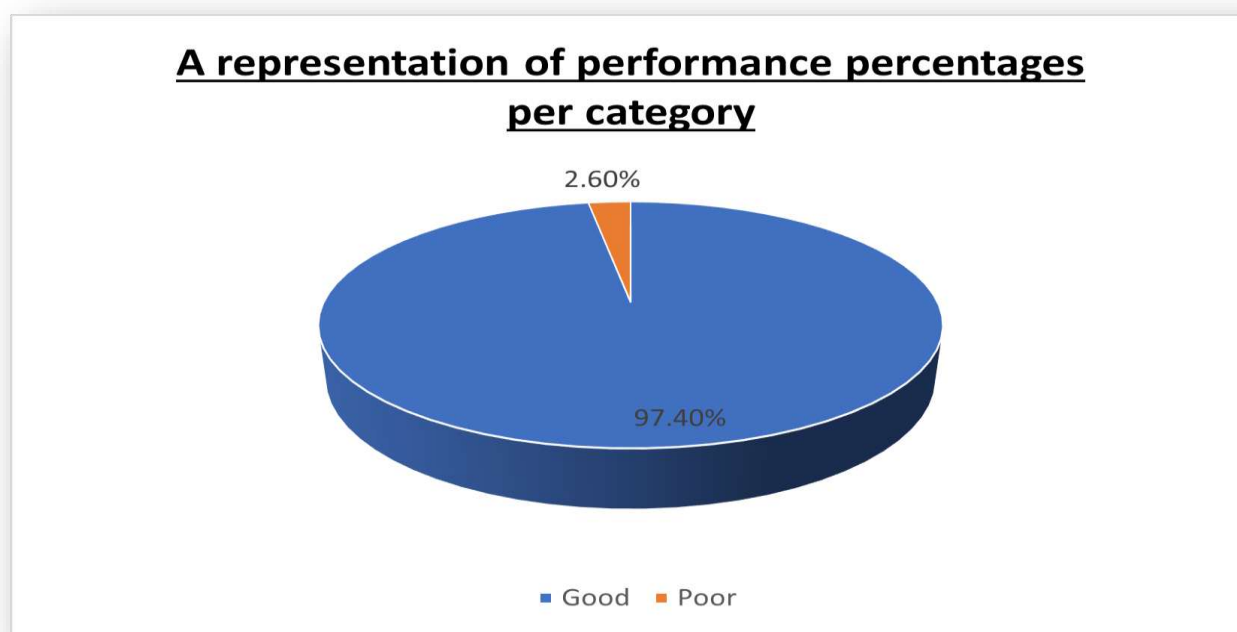


Figure 1
Student's Performance

4.4 Association between Innovative Strategies Used Their Influence and Student Academic Performance in Undergraduate Health Sciences

Table 4 presents the association between innovative teaching and learning strategies and the academic performance of undergraduate Health Sciences students at MMUST. At the 5% significance level, significant associations were found for PBL, IPE, all Skills-Based Laboratory Learning indicators, Flipped Classrooms, CBL, Collaborative Learning, EBM and PAL. However, CAL, CBE, SBL, Gamification and Social Media and Online Learning were not significantly associated with academic performance. The findings therefore indicate that the relationship between innovative teaching strategies and academic performance was strategy-specific rather than uniform. Since the Chi-square test establishes association only, the findings should not be interpreted as demonstrating

that these strategies caused improvements in performance or indicating the direction of the relationships without examining the corresponding cross-tabulations.

Problem-Based Learning demonstrated the strongest associations with academic performance. Teaching based on real clinical conditions was significant, $\chi^2(4) = 49.203$, $p < .001$, as were the promotion of critical-thinking skills, $\chi^2(4) = 50.904$, $p < .001$, and the practice of problem-solving skills, $\chi^2(4) = 60.444$, $p < .001$. The problem-solving component produced the largest Chi-square statistic in the table, suggesting that academic performance differed substantially across its levels of utilization. These findings are consistent with Dolmans et al. (2016), who established that PBL promotes deeper learning, clinical reasoning and long-term knowledge retention. They also support Hmelo-Silver (2004) and Savery (2017), who argued that engagement with authentic problems enables students to integrate theoretical knowledge with clinical practice. Nevertheless, Kirschner et al. (2006) cautioned that PBL may be less effective when learners are given inadequate guidance. The significant results at MMUST therefore underscore the importance of structured clinical problems, competent facilitation and timely feedback.

All three Flipped Classroom indicators were significantly associated with academic performance: active learner responsibility, $\chi^2(4) = 21.711$, $p < .001$; tailoring learning to students' needs, $\chi^2(4) = 24.982$, $p < .001$; and using classroom time to emphasise clinical practice, $\chi^2(4) = 21.818$, $p < .001$. This agrees with Hew and Lo (2018), whose meta-analysis found that flipped classrooms improved examination performance, engagement and higher-order thinking compared with traditional instruction. Betihavas et al. (2016) similarly reported that pre-class preparation created more classroom time for active application of knowledge. The finding may be explained by the opportunity for students to study foundational material before class and use face-to-face sessions for discussion, problem-solving and clinical application. However, O'Flaherty and Phillips (2015) observed that the effectiveness of flipped learning depends on students' motivation, access to learning materials and completion of pre-class activities.

Significant associations were also obtained for CBL, $\chi^2(4) = 14.737$, $p = .005$; Collaborative Learning, $\chi^2(4) = 17.785$, $p = .001$; EBM, $\chi^2(4) = 15.007$, $p = .005$; PAL, $\chi^2(4) = 16.550$, $p = .002$; and IPE, $\chi^2(4) = 10.597$, $p = .031$. The CBL finding supports Thistlethwaite et al. (2012), who established that the use of clinical cases enhances knowledge application, clinical reasoning and learner engagement. The PAL and Collaborative Learning results agree with Topping (2005), Secomb (2008), and Zhang and Maconochie (2022), who found that structured peer interaction promotes active participation, confidence and academic achievement. Similarly, the EBM result is consistent with Greenhalgh et al. (2014), who argued that evidence-based instruction strengthens critical appraisal and clinical decision-making. The significant IPE result supports Reeves et al. (2016), who demonstrated that interprofessional learning develops communication, teamwork and collaborative problem-solving. Collectively, these findings are compatible with Social Cognitive Theory because interaction with peers and instructors provides opportunities for observation, modelling, feedback and development of academic self-efficacy.

Skills-Based Laboratory Learning was significantly associated with academic performance through lecturer instruction, support and clarification, $\chi^2(4) = 11.503$, $p = .021$; observation of learners' performance, $\chi^2(4) = 9.876$, $p = .043$; and encouragement of critical thinking and experiential learning, $\chi^2(4) = 10.940$, $p = .027$. These findings support Cant and Cooper (2017) and Jeffries (2016), who demonstrated that structured practical instruction, repeated practice, observation and feedback help learners connect theoretical knowledge with clinical procedures. The result also reflects the value of direct supervision, through which lecturers can identify errors, provide immediate clarification and guide students towards acceptable performance standards. Skills laboratories may therefore be most educationally valuable when they involve active observation and corrective feedback rather than merely providing access to equipment.

In contrast, CAL, $\chi^2(4) = 3.781$, $p = .436$, and Social Media and Online Learning, $\chi^2(4) = 5.108$, $p = .276$, were not significantly associated with academic performance. Although McCutcheon et al. (2015) and Regmi and Jones (2020) found that digital learning improves flexibility and access to educational resources, the current findings suggest that access to technology alone may not necessarily translate into differences in academic achievement. The absence of significant associations may be related to unreliable internet connectivity, unequal access to digital devices, inadequate faculty preparation or use of online platforms primarily for distributing notes rather than supporting interactive learning. This interpretation agrees with Frehywot et al. (2013) and O'Doherty et al. (2018), who identified infrastructure limitations and differences in digital literacy as major barriers to effective technology-enhanced learning.

CBE, $\chi^2(4) = 4.292$, $p = .368$; SBL demonstration and return demonstration, $\chi^2(4) = 5.528$, $p = .237$; SBL student presentation, $\chi^2(4) = 5.733$, $p = .220$; and Gamification, $\chi^2(4) = 4.943$, $p = .293$, were also not significantly associated with academic performance. These results contrast with literature indicating that simulation strengthens clinical competence and confidence (Cant & Cooper, 2017), CBE promotes understanding of community health and social determinants (Strasser et al., 2015), and gamification enhances motivation and knowledge retention (Dichev & Dicheva, 2017; van Gaalen et al., 2021). The divergence may reflect irregular implementation, limited exposure or insufficient integration of these strategies into assessment. The thesis literature also indicates that simulation and CBE in Kenya are constrained by high equipment costs, inadequate trained personnel, transportation difficulties and weak coordination with community health facilities (Okube et al., 2022; Kavinya et al., 2023). Therefore, non-significance should not be

interpreted as proof that the strategies are educationally ineffective; it may indicate that their implementation was insufficient to produce measurable differences in academic performance.

Table 4

Chi square data analysis of innovative strategies used their influence on student academic performance in undergraduate health sciences

Teaching and learning strategies		χ^2 Value	df	P-value
Problem-Based Learning (PBL)	Teaching is based on real clinical conditions	49.203	4	<0.001
	Promote development of critical thinking skills	50.904	4	<0.001
	Practice problem solving skills	60.444	4	<0.001
Computer Assisted Learning (CAL)	Storing, notes-audio, and visual lessons, assignments, access via internet, provide feedback	3.781	4	0.436
Interprofessional Education (IPE)	Developing skills and allowing students learn in groups	10.597	4	0.031
Community-Based Education (CBE)	Involving learners learn through interaction at the community	4.292	4	0.368
Simulation Based Learning (SBL)	Demonstration and return demonstration	5.528	4	0.237
	Student present what they have learn	5.733	4	0.220
Skills Based Laboratory Learning (SKLL)	Lecturer provide instructions support and clarification	11.503	4	0.021
	Observe learners' performance behavior	9.876	4	0.043
	Encourage critical thinking and experiential learning	10.940	4	0.027
Flipped Classrooms (FC)	Learners are active and responsible for their learning	21.711	4	<0.001
	Learning is tailored to the needs of students	24.982	4	<0.001
	Learning takes a lot of time in class and emphasize on clinical practice	21.818	4	<0.001
Case-Based Learning (CBL)	Learners formulate their own understanding, based research	14.737	4	0.005
Gamification	Stimulates creativity and through games and visual exercises	4.943	4	0.293
Collaborative Learning	Turning teaching experiences into interactive and collaborative experience	17.785	4	0.001
Social Media & Online Learning	Using dynamic multimedia content	5.108	4	0.276
Evidence Based Medicine (EBM)	Student presents what they have learnt	15.007	4	0.005
Peer Assisted Learning (PAL)	Students are active and responsible for their learning	16.550	4	0.002

V. CONCLUSION & RECOMMENDATION

5.1 Conclusion

The study concluded that innovative teaching and learning strategies were positively perceived by undergraduate Health Sciences students at MMUST, with 97.4% attaining good academic performance. Significant associations with academic performance were established for Problem-Based Learning, Interprofessional Education, Skills-Based Laboratory Learning, Flipped Classrooms, Case-Based Learning, Collaborative Learning, Evidence-Based Medicine and Peer-Assisted Learning. However, Computer-Assisted Learning, Community-Based Education, Simulation-Based Learning, Gamification, and Social Media and Online Learning were not significantly associated with performance. The findings therefore indicate that the association between innovative teaching strategies and academic performance was strategy-specific, with structured, learner-centred, collaborative and practice-oriented approaches demonstrating the strongest relationships. Nevertheless, the cross-sectional design and highly unequal performance groups limit causal interpretation; consequently, the findings demonstrate association rather than proof that the strategies directly caused improved academic performance.

5.2 Recommendation

MMUST should systematically integrate Problem-Based Learning, Flipped Classrooms, Case-Based Learning, Peer-Assisted Learning, Interprofessional Education, Evidence-Based Medicine, Collaborative Learning and Skills-Based Laboratory Learning across undergraduate Health Sciences curricula. Lecturers and clinical instructors should receive regular training in clinical-case development, facilitation of group learning, structured observation, constructive feedback and critical-thinking instruction. The University should also strengthen simulation laboratories, internet connectivity, digital learning platforms, community placement arrangements and educational technologies to improve

the implementation of strategies that did not demonstrate significant associations. Students experiencing academic difficulties should be identified early and supported through mentoring, peer tutoring and remedial instruction. Further multicentre and longitudinal research should use objective academic and clinical performance measures, adequately represented performance categories and multivariable analysis to determine the independent and long-term effects of each innovative teaching strategy.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding Declaration

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

- Amolloh, O. P., Lilian, G. K., & Wanjiru, K. G. (2018). Experiential learning, conditional knowledge and professional development at University of Nairobi, Kenya—Focusing on preparedness for teaching practice. *International Education Studies*, 11(7), 125–135. <https://doi.org/10.5539/ies.v11n7p125>
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall.
- Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52, 1–26. <https://doi.org/10.1146/annurev.psych.52.1.1>
- Betihavas, V., Bridgman, H., Kornhaber, R., & Cross, M. (2016). The evidence for “flipping out”: A systematic review of the flipped classroom in nursing education. *Nurse Education Today*, 38, 15–21. <https://doi.org/10.1016/j.nedt.2015.12.015>
- Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university* (4th ed.). Open University Press.
- Cant, R. P., & Cooper, S. J. (2017). The value of simulation-based learning in pre-licensure nurse education: A state-of-the-art review and meta-analysis. *Nurse Education in Practice*, 27, 45–62. <https://doi.org/10.1016/j.nepr.2017.08.012>
- Cook, D. A., Brydges, R., Hamstra, S. J., Zendejas, B., Szostek, J. H., Wang, A. T., Erwin, P. J., & Hatala, R. (2011). Comparative effectiveness of technology-enhanced simulation versus other instructional methods: A systematic review and meta-analysis. *Simulation in Healthcare*, 6(5), 308–320. <https://doi.org/10.1097/SIH.0b013e318222e2b4>
- Dichev, C., & Dicheva, D. (2017). Gamifying education: What is known, what is believed and what remains uncertain: A critical review. *International Journal of Educational Technology in Higher Education*, 14, Article 9. <https://doi.org/10.1186/s41239-017-0042-5>
- Dolmans, D. H. J. M., Loyens, S. M. M., Marcq, H., & Gijbels, D. (2016). Deep and surface learning in problem-based learning: A review of the literature. *Advances in Health Sciences Education*, 21(5), 1087–1112. <https://doi.org/10.1007/s10459-015-9645-6>
- Dossajee, H., Obonyo, N., & Ahmed, S. M. (2016). Career preferences of final year medical students at a medical school in Kenya: A cross-sectional study. *BMC Medical Education*, 16, Article 5.
- Frambach, J. M., Manuel, B. A., Fumo, A. M., Groosjohan, B., van der Vleuten, C. P., & Driessen, E. W. (2017). How innovative and conventional curricula prepare medical students for practice in Sub-Saharan Africa: A comparative study from Mozambique. *Education for Health*, 30(1), 3–10.
- Frehywot, S., Vovides, Y., Talib, Z., Mikhail, N., Ross, H., Wohljen, H., Bedada, S., Korhumel, K., Koumare, A. K., & Scott, J. (2013). E-learning in medical education in resource constrained low- and middle-income countries. *Human Resources for Health*, 11, Article 4. <https://doi.org/10.1186/1478-4491-11-4>
- Ghani, N., Taiebne, M., Farih, M. H., & Nejjari, C. (2025). A mini-review of innovative learning methods in medical education: Insights from African countries. *Discover Education*, 4, Article 140. <https://doi.org/10.1007/s44217-025-00569-5>
- Gikandi, J. W. (2021). Enhancing e-learning through integration of online formative assessment and teaching presence. *International Journal of Online Pedagogy and Course Design*, 11(2), 48–61.
- Greenhalgh, T., Howick, J., & Maskrey, N. (2014). Evidence-based medicine: A movement in crisis? *BMJ*, 348, g3725. <https://doi.org/10.1136/bmj.g3725>
- Hernández-Torrano, D., Ali, S., & Chan, C. K. (2017). First year medical students' learning style preferences and their correlation with performance in different subjects within the medical course. *BMC Medical Education*, 17, Article 131.

- Hew, K. F., & Lo, C. K. (2018). Flipped classroom improves student learning in health professions education: A meta-analysis. *BMC Medical Education*, 18, Article 38. <https://doi.org/10.1186/s12909-018-1144-z>
- Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16, 235–266. <https://doi.org/10.1023/B:EDPR.0000034022.16470.f3>
- Jeffries, P. R. (2016). *The NLN Jeffries simulation theory*. National League for Nursing.
- Kabare, G., Muthuuri, N., Sarna, K., Gwala, F., Amuti, T., Olabu, B., Obimbo, M., & Ogeng'o, J. (2022). Perception and challenges of health science students toward e-learning in a Sub-Saharan African country: A multi-institutional study. *Annals of African Surgery*, 19(1), 16–22. <https://doi.org/10.4314/aas.v19i1.4>
- Katwa, J. K., Obwoye, R. O., Baliddawa, J., Ayiri, L., & Kei, R. (2018). Knowledge and perception of lecturers regarding problem-based learning as an educational approach in College of Health Sciences, Moi University. *IOSR Journal of Research & Method in Education*, 8(1), 26–29.
- Kavinya, M. P., Lugulu, J., & Mosol, P. (2023). Examining the challenges affecting the application of innovative simulation-based teaching and learning among teaching staff in selected Kenya Medical Training College campuses offering medical laboratory sciences in Kenya. *International Journal of Tropical Diseases*, 6, Article 071.
- Kiguli-Malwadde, E., Forster, M., Martin, S., Chilemba, E., Couper, I., Motlhathedi, K., ... Kazembe, A. (2022). Evaluating the impact of a multicountry interprofessional training program to improve HIV knowledge and clinical confidence among healthcare workers in sub-Saharan Africa: A cohort study. *BMJ Open*, 12(7), e060079.
- Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, 41(2), 75–86. https://doi.org/10.1207/s15326985ep4102_1
- Kononowicz, A. A., Woodham, L. A., Edelbring, S., Sathakkarou, N., Davies, D., Saxena, N., Tudor Car, L., Carlstedt-Duke, J., Car, J., & Zary, N. (2019). Virtual patient simulations in health professions education: Systematic review and meta-analysis. *Journal of Medical Internet Research*, 21(7), e14676. <https://doi.org/10.2196/14676>
- Liew, S. C., Sidhu, J., & Barua, A. (2015). The relationship between learning preferences (styles and approaches) and learning outcomes among pre-clinical undergraduate medical students. *BMC Medical Education*, 15, Article 44.
- McCutcheon, K., Lohan, M., Traynor, M., & Martin, D. (2015). A systematic review evaluating the impact of online or blended learning versus face-to-face learning of clinical skills in undergraduate nurse education. *Journal of Advanced Nursing*, 71(2), 255–270.
- Mendenhall, M., & Tangelder, M. (2016). Faculty development for education in emergencies: A university-NGO partnership in Kenya. In *Faculty development in developing countries* (pp. 53–75). Routledge.
- Mothiba, T. M., Bopape, M. A., & Mbombi, M. O. (2020). The emergence of a clinical skills laboratory and its impact on clinical learning: Undergraduate nursing students' perspective in Limpopo Province, South Africa. *African Journal of Health Professions Education*, 12(4), 197–200.
- O'Doherty, D., Dromey, M., Loughheed, J., Hannigan, A., Last, J., & McGrath, D. (2018). Barriers and solutions to online learning in medical education: An integrative review. *BMC Medical Education*, 18, Article 130. <https://doi.org/10.1186/s12909-018-1240-0>
- O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education*, 25, 85–95.
- Okube, O. T., Kimani, S., & Mirie, W. (2022). Community-based lifestyle intervention improves metabolic syndrome and related markers among Kenyan adults. *Journal of Diabetes & Metabolic Disorders*, 21(1), 607–621.
- Reeves, S., Fletcher, S., Barr, H., Birch, I., Boet, S., Davies, N., McFadyen, A., Rivera, J., & Kitto, S. (2016). A BEME systematic review of the effects of interprofessional education: BEME Guide No. 39. *Medical Teacher*, 38(7), 656–668.
- Regmi, K., & Jones, L. (2020). A systematic review of the factors—enablers and barriers—affecting e-learning in health sciences education. *BMC Medical Education*, 20, Article 91. <https://doi.org/10.1186/s12909-020-02007-6>
- Savery, J. R. (2017). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-Based Learning*, 1(1), 9–20.
- Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, 60, Article 101832. <https://doi.org/10.1016/j.cedpsych.2019.101832>
- Secomb, J. (2008). A systematic review of peer teaching and learning in clinical education. *Journal of Clinical Nursing*, 17(6), 703–716.
- Setia, M. S. (2016). Methodology series module 3: Cross-sectional studies. *Indian Journal of Dermatology*, 61(3), 261.
- Strasser, R., Worley, P., Cristobal, F., Marsh, D. C., Berry, S., Strasser, S., & Ellaway, R. (2015). Putting communities in the driver's seat: The realities of community-engaged medical education. *Academic Medicine*, 90(11), 1466–1470.



- Thistlethwaite, J. E., Davies, D., Ekeocha, S., Kidd, J. M., MacDougall, C., Matthews, P., Purkis, J., & Clay, D. (2012). The effectiveness of case-based learning in health professional education: A BEME systematic review: BEME Guide No. 23. *Medical Teacher*, 34(6), e421–e444.
- Topping, K. J. (2005). Trends in peer learning. *Educational Psychology*, 25(6), 631–645.
- van Gaalen, A. E. J., Brouwer, J., Schönrock-Adema, J., Bouwkamp-Timmer, T., Jaarsma, A. D. C., & Georgiadis, J. R. (2021). Gamification of health professions education: A systematic review. *Advances in Health Sciences Education*, 26, 683–711. <https://doi.org/10.1007/s10459-020-10000-3>
- Wambugu, P. W., Changeiywo, J., & Ndiritu, F. G. (2013). Effects of experiential cooperative concept mapping instructional approach on secondary school students' achievement in physics in Nyeri County, Kenya. *Asian Journal of Social Sciences & Humanities*, 2(3), 179–296.
- World Health Organization. (2010). *Framework for action on interprofessional education and collaborative practice*. World Health Organization.
- Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). Harper and Row.
- Zhang, S. L., Ren, S. J., Zhu, D. M., Liu, T. Y., Wang, L., Zhao, J. H., Fan, X. T., & Gong, H. (2024). Which novel teaching strategy is most recommended in medical education? A systematic review and network meta-analysis. *BMC Medical Education*, 24, Article 1342.
- Zhang, Y., & Maconochie, M. (2022). A meta-analysis of peer-assisted learning on examination performance in clinical knowledge and skills education. *BMC Medical Education*, 22, Article 147.