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Effectiveness of Workshop-Based Versus Traditional Practical Modules in Teaching Maitland Mobilization to Physiotherapy Students: A Quasi-experimental Comparative Study

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Manali N. Yadav [1], Sneha Ganu [1], Annamma Varghese [1], Priti Mehendale [2], Dhvani Shah [1], Prachi Sarvaiya [1], Nisha Dhasal [3], Hina Jain [1], Rupali Shevalkar [1]

1. Musculoskeletal Physiotherapy, K J Somaiya College of Physiotherapy, Mumbai, IND 2. Kinesiotherapy, K J Somaiya College of Physiotherapy, Mumbai, IND 3. Physiotherapy, K J Somaiya College of Physiotherapy, Mumbai, IND

Corresponding author: Sneha Ganu, s.ganu@somaiya.edu

Abstract

Introduction

Maitland mobilization is a fundamental manual therapy skill in physiotherapy education, requiring sound psychomotor ability and clinical reasoning. However, limited evidence exists comparing different teaching approaches for imparting these skills at the undergraduate level. This study aimed to compare the effectiveness of traditional practical teaching with a structured workshop-based approach for teaching Maitland mobilization to physiotherapy students.

Methods

Following institutional review board approval, a total of 60 third-year Bachelor of Physiotherapy (BPTh) students (mean age = 20.5 ± 0.5 years) participated after providing informed consent. All students attended a one-hour theoretical lecture on Maitland mobilization and using a crossover design, students were assigned to four experimental groups, workshop-based and traditional practical for upper and lower extremity Maitland mobilization, with interventions reversed across groups to allow within-subject comparison. The workshop module consisted of a single six-hour session incorporating structured demonstrations, hands-on practice, and case-based discussions, whereas the traditional module was conducted over three days with two-hour sessions per day. Performance was evaluated one week post intervention using an Objective Structured Practical Examination (OSPE) assessing affective domain, which included student's attitude, communication, and professional behavior while interacting with the patient and psychomotor domains comprised of hands-on practical skills and correct demonstration of technique, and a multiple-choice questionnaire (MCQ) assessing cognitive knowledge to understand the student's knowledge of the principles, grading, and application of Maitland mobilization. Student perceptions were measured using a structured five-point Likert scale questionnaire. Assessments were conducted by blinded evaluators using standardized OSPE checklists. Data normality was assessed using the Shapiro-Wilk test, and parametric tests were applied accordingly.

Results

Both teaching methods were effective in improving cognitive knowledge, with no significant differences in MCQ scores. However, workshop-based training resulted in significantly higher OSPE scores and learner satisfaction. Students rated workshops higher for clarity, engagement, confidence in skill performance, and overall learning effectiveness ($p < 0.05$), with effect sizes ranging from medium to large (Cohen's $d = 0.68$-0.81). Over 45 (75%) out of 60 students recommended greater inclusion of workshops in the curriculum.

Conclusion

Workshop-based teaching is more effective than traditional practical sessions for Maitland mobilization, particularly in enhancing psychomotor skills, engagement, and learner confidence. Integrating structured workshops into physiotherapy curricula may improve short-term psychomotor and affective performance on standardized assessments; whether this translates to clinical preparedness requires further study.

Categories: Physical Medicine & Rehabilitation, Medical Education, Quality Improvement
Keywords: maitland mobilization, objective structured clinical examination, objective structured practical examination, pedagogical approach, physiotherapy, physiotherapy students, practical modules, workshop-based module

Introduction

Manual therapy is a key part of musculoskeletal physiotherapy, and Maitland mobilization is one of the

most widely used techniques [1]. It has become popular because it is effective in treating joint problems and musculoskeletal pain. This method is based on a systematic approach that combines clinical reasoning with passive joint mobilization, including the spine and peripheral joints [2,3]. Understanding the theory is necessary, and the technique also requires strong psychomotor skills, clinical judgment, and a good sense of touch [4]. The way this technique is taught is very important, as it shapes the competence and confidence of future clinicians.

In traditional physiotherapy programs, students usually observe, copy, and then practice their skills under supervision, which further forms the foundation of clinical training, but some believe they do not provide enough opportunities for feedback or learner independence to develop advanced manual therapy techniques such as Maitland mobilization [5,6]. Additionally, these sessions often lack reflective learning and personalized coaching, which are important for deeply understanding and retaining skills in clinical education [7,8]. Conventional methods are not as good for fostering psychomotor learning, critical thinking, and learner engagement [9-11]. A Cochrane systematic review comparing conferences, lectures, workshops, seminars, symposia, and courses on their effectiveness in medical education showed that interactive teaching methods are more effective than didactic lecture-based teaching. The review also recommends that every effort be made to incorporate interactive learning into standard didactic lessons [12].

Recent pedagogical advances draw attention to the approaches that are of a more structured nature and focus upon the learner, such as workshop-based modules, which are single-day, intensive, structured, hands-on educational interventions designed around active learner participation, guided practice, and immediate feedback [13]. Workshop-based modules are defined as an experiential learning format that emphasizes active engagement, skills practice, reflection, and application of knowledge, and may or may not include the production of tangible outputs [14]. Typically, these workshops are designed using experiential learning principles together with deliberate practice, and they incorporate small-group interactions, peer-assisted learning, scaffolded feedback, and active engagement via skill stations [15]. Literature within health professions education is now emerging, and it does support the idea that such formats are indeed superior [16].

Despite promising findings, there's still a noticeable lack of research that directly compares different teaching methods for Maitland mobilization. This Maitland mobilization technique is found to be beneficial, thereby reducing pain, improving function, and increasing joint mobility in cases like knee osteoarthritis and chronic ankle instability; however, the evidence remains limited with respect to different pedagogical approaches, which will help students learn better [17,18]. This gap is important because if manual therapy skills are not taught properly, it can lead to outcomes that are not ideal, and, in some cases, it might even cause harm to patients. Filling this gap is critical in curriculum design, clinical training, or accreditation to provide evidence to ensure students graduate with solid manual therapy skills. Therefore, the aim of this study is to compare traditional hands-on teaching with a structured workshop approach for teaching Maitland mobilization. The goal is to compare short-term skill performance and learner confidence between the two teaching methods, as measured by a standardized post-intervention assessment. This research is driven by the need to base teaching methods on solid evidence. As the need increases for physiotherapists who are ready to practice and manual therapy techniques become more advanced, education must keep up with new and effective teaching methods to understand students' views.

Materials And Methods

Study design

This study was set up as a quasi-experimental comparative study using a counterbalanced 2 × 2 (teaching method × anatomical region) allocation, rather than a conventional crossover design, since each participant received the two teaching methods for different anatomical regions rather than the same content under both conditions. This allocation balanced "method" against "region" at the group level while holding instructor assignment constant across all arms. Its main goal was to check how effective workshop-based learning is compared to traditional practical learning when teaching Maitland mobilization techniques to third-year Bachelor of Physiotherapy (BPTh) students.

Study setting

The study took place at K J Somaiya College of Physiotherapy in Mumbai, using the college's academic and clinical training resources.

Methods

Participants

The study population comprised third-year BPTh students enrolled at K J Somaiya College of Physiotherapy. A total of 80 students were eligible for participation. The inclusion criteria were students enrolled in the third year of the BPTh program who attended the instructional sessions, completed the Objective Structured Practical Examination (OSPE), were willing to participate, and provided written informed consent. Students who did not provide informed consent, were absent from one or more teaching sessions, did not complete

the OSPE assessment, or withdrew from the study before completion were excluded from the study. As allocation was administrative rather than random, formal allocation concealment procedures were not applicable. Informed consent was obtained from all participants prior to group allocation.

Of the 80 eligible students, 60 fulfilled the inclusion criteria and completed the study (Figure *1*). Twenty students were excluded from the final analysis because they either missed the teaching sessions or did not complete the OSPE assessment. Baseline characteristics of the 20 excluded students were not separately recorded, as data collection procedures for this study did not include follow-up capture of demographic or clinical-exposure data for students who did not complete the assessment; therefore, a formal comparison of completers versus non-completers could not be performed. Educational equity was ensured through a crossover design, allowing all students to receive both teaching modalities for different anatomical regions. This approach prevented unequal learning opportunities and ensured that no group was disadvantaged. The study was conducted for a period of one month, i.e., August 2024. Ethical approval was granted by the Institutional Review Board (IRB) of K J Somaiya College of Physiotherapy (Date: 28th March, 2024).



FIGURE 1: Participant flow diagram.

OSPE: Objective Structured Practical Examination; EG: experimental group.

Instructional Intervention and Group Allocation

Before the practical sessions, all participants attended a one-hour lecture covering the basic principles and clinical use of Maitland mobilization. After the lecture, students were divided into four equal groups, namely, experimental group 1 (EG1), experimental group 2 (EG2), experimental group 3 (EG3), and experimental group 4 (EG4). A total of 40 students were initially allocated equally into two groups (20 students per group) using the lottery method. Following allocation, five students from each group were excluded due to failure to attend all scheduled training sessions and OSPEs. Thus, 30 students (15 in each group) completed the study and were included in the final analysis. Allocation was administrative rather than randomized, consistent with the quasi-experimental design of this study. Four groups were used to enable a counterbalanced allocation in which workshop-based and conventional teaching were alternated between upper and lower limb techniques, ensuring equal exposure to both methods and controlling for limb-specific learning effects. Because each student received only one teaching method per anatomical region, method and region cannot be separated within an individual student's own comparison; however, the

counterbalanced allocation across EG1-EG4 ensured that each teaching method was applied to an equal number of upper- and lower-limb sessions across the sample, allowing method effects to be evaluated independent of region at the group level.

EG1 and EG4 received workshop-based learning for upper-limb techniques and traditional practical learning for lower-limb techniques.

EG2 and EG3 received workshop-based learning for lower-extremity techniques and traditional practical learning for upper-extremity techniques.

This crossover design allowed each participant to act as their own control, enabling a within-subject comparison of the two teaching methods across different anatomical areas.

Workshop-Based Module

The workshop-based module took place in one full-day session with a continuous six hours of training in a structured and interactive format that included demonstrations, hands-on practice, and case-based discussions. The sessions were led by five Maitland mobilization instructors, with three focusing on upper-extremity techniques and two on lower-extremity techniques.

Conventional Practical Module

The conventional practical module was spread over six consecutive days (three days for upper limb and three days for lower limb), with one-hour sessions for each joint region each day. This module followed a traditional format of demonstration and practice, conducted by the same set of instructors. The same five instructors were involved across all groups and teaching modalities to maintain instructional consistency and minimize instructor-related bias.

All five instructors were physiotherapists with formal training and clinical experience in Maitland mobilization and had prior experience in teaching manual therapy techniques at the undergraduate level.

Students were familiarized with the OSPE format prior to assessment through routine internal evaluations conducted as part of the undergraduate curriculum; therefore, no additional practice OSPE was required. The time allocated per station (three minutes) was determined based on standard institutional OSPE protocols, ensuring feasibility while allowing adequate demonstration of the assigned task.

Evaluation Procedure

The evaluation procedure involved an OSPE carried out by three examiners who were not involved in teaching either method to prevent bias. The OSPE checklists were developed based on standard Maitland mobilization teaching objectives and were reviewed by subject experts to ensure content validity and clarity.

OSPE was conducted one week after the completion of both teaching modules to evaluate short-term outcomes in knowledge acquisition, affective, and psychomotor performance.

The cognitive domain was evaluated through a structured multiple-choice questionnaire (MCQ) assessing theoretical understanding of Maitland principles and joint biomechanics. The students were graded based on their correct responses out of 10 marks in total (Table *1*).

Station name	Station objective	Checklist domains	Station score	Total score
Shoulder complex	Affective domain	Introducing yourself	1	10
		Taking oral consent	1	
		Explaining the patient	1	
	Psychomotor domain	Position of patient	2	
		Therapist position	1	
		Treatment plane	2	
		Grade and demonstration of technique	2	
	Affective domain	Introducing yourself	1	
		Taking oral consent	1	

		Explaining the patient	1	
Elbow complex	Psychomotor domain	Position of patient	2	10
		Therapist position	1	
		Treatment plane	2	
		Grade and demonstration of technique	2	
Wrist and hand complex	Affective domain	Introducing yourself	1	10
		Taking oral consent	1	
		Explaining the patient	1	
	Psychomotor domain	Position of patient	2	
		Therapist position	1	
		Treatment plane	2	
		Grade and demonstration of technique	2	
Hip complex	Affective domain	Introducing yourself	1	10
		Taking oral consent	1	
		Explaining the patient	1	
	Psychomotor domain	Position of patient	2	
		Therapist position	1	
		Treatment plane	2	
		Grade and demonstration of technique	2	
Knee complex	Affective domain	Introducing yourself	1	10
		Taking oral consent	1	
		Explaining the patient	1	
	Psychomotor domain	Position of patient	2	
		Therapist position	1	
		Treatment plane	2	
		Grade and demonstration of technique	2	
Ankle and foot complex	Affective domain	Introducing yourself	1	10
		Taking oral consent	1	
		Explaining the patient	1	
	Psychomotor domain	Position of patient	2	
		Therapist position	1	
		Treatment plane	2	
		Grade and demonstration of technique	2	

TABLE 1: The Objective Structured Practical Examination (OSPE) checklist.

The OSPE consisted of the above stations aimed to assess the affective and psychomotor domains.

Each station was assessed by a trained evaluator who was not involved in the lecture or either of the lab sessions. They were also blinded to the student group allocated. Evaluators graded the students' performance using a validated OSPE checklist, which was previously discussed and reviewed with the instructors to ensure standardized assessment.

The checklist included three upper extremity stations, including the shoulder complex, elbow complex, and wrist complex, and three lower extremity stations, including the hip joint, knee complex, and ankle complex.

A total of three minutes was allotted to each student per station, with assessment across the following domains: the cognitive domain was evaluated through a structured MCQ; the affective domain was assessed through evaluator observation of professional behavior, communication skills, and ethical conduct during clinical interaction; the psychomotor domain was evaluated through hands-on demonstration of mobilization techniques, including positioning, hand placement, mobilization grade selection, and safety considerations.

All three domains were scored out of 20 marks (cognitive domain with 10 marks and affective and psychomotor domains together with 10 marks).

Student perception assessment

Following the completion of both instructional modules, all participants were invited to complete three structured, face-validated feedback questionnaires as follows: feedback for the workshop module; feedback for the traditional practical module; feedback to compare the above two modules.

This captured their perceptions, preferences, and satisfaction with the two pedagogical approaches. The quantitative data collected from this feedback used a five-point Likert scale, with 1 indicating strongly disagree and 5 indicating strongly agree. This provided insights into the learners' subjective experiences.

This combination of the feedback survey and OSPE enabled a multidimensional comparison of workshop-based and traditional practical-based teaching methods, focusing on theoretical knowledge, practical skill acquisition, clinical application, and learner satisfaction.

Results

Descriptive statistics (mean and standard deviation) were used to summarize the data obtained from the Likert scale. A Shapiro-Wilk test was used to determine if the data had a normal distribution. The data distributed normally was compared using a paired t-test for within-subject comparisons in the crossover design, and independent t-tests were used to compare mean scores between workshop-based and traditional practical modules and effect sizes were calculated using Cohen's d.

A total of 60 students participated in the study, with 30 students initially attending the upper-limb workshop module and the remaining 30 attending the lower-limb traditional practical-based module; subsequently, each group crossed over, with those who first attended the upper-limb workshop participating in the lower-limb traditional practical-based module and vice versa.

All 60 students attending the theory sessions on Maitland mobilization completed an MCQ to assess their understanding of the Maitland mobilization technique, through which cognitive domains were assessed (Table *2*).

N = 60	Workshop-based module			Traditional practical-based module		
	76%-100%	51%-75%	Below 50%	76 %-100%	51%-75%	Below 50%
Upper extremity (N = 60)	60 (100%)	0	0	56 (93.4%)	4 (6.7%)	0
Lower extremity (N = 60)	60 (100%)	0	0	52 (86.6%)	8 (13.3%)	0

TABLE 2: Cognitive domain score.

The table represents the percentage of students as per the scoring specified.

Table *3* showed overall favorable responses on a three-point rating scale, with the majority of the learners reporting high satisfaction levels across both modules.

Questions		Very satisfied	Satisfied	Neutral
Level of satisfaction (N = 60)	Workshop-based module	21 (35%)	31 (51%)	8 (13.33%)
	Traditional-based module	4 (6.66%)	26 (43.33%)	30 (50%)
	Both equally	0	0	0

TABLE 3: Level of satisfaction.

The table displays the level of satisfaction of participants with the two teaching modules.

Table 4 further elucidates students' perspectives of the workshop module, the traditional practical module, and both modules equally. The statistics indicate that learners appreciated both formats but demonstrated differing levels of preference regarding engagement, clarity of content delivery, and skill applicability. These results offer a thorough grasp of student perspective and satisfaction, which helps to clarify the efficacy and acceptability of the pedagogical approaches used.

Questions (N = 60)	Workshop-based module	Traditional practical-based module	Both equally
Contributed more to the learning experience	66.66%	8.33%	25%
Found more engaging	86.66%	5%	8.33%
Effectiveness in helping to understand subject matter	76.66%	10%	13.33%
Able to apply theoretical model more effectively	61.66%	13.33%	25%
Would prefer more frequently in the curriculum	75%	8.33%	16.66%

TABLE 4: Students' perspectives on the workshop module, the traditional practical module, and both modules equally.

An independent t-test was conducted to determine the differences in the mean test scores of students participating in the workshop module and the traditional practical module. There was a statistically significant difference between all measured statements.

As shown in Table 5, students in the workshop group consistently reported higher mean scores compared to those in the traditional practical group. Perceptions regarding whether “content was effective in meeting learning objectives” showed a mean score of 4.69 (SD = 0.46) in the workshop group versus 2.74 (SD = 0.93) in the traditional group ($t(147) = 16.85$, $p < 0.001$, Cohen’s $d = 0.70$). Similarly, workshop participants rated higher on “activities engaged you in the learning process,” with a mean of 4.29 (SD = 0.59) compared to the traditional practical group with a mean of 2.71 (SD = 0.94), with $t(147) = 14.54$, $p < 0.001$, and Cohen’s $d = 0.69$.

Statements (N = 60)	Groups	Mean	SD	t	Two-sided p significance	95% confidence interval difference		Cohen's D
						Lower	Upper	
Content was effective in meeting learning objectives.	Workshop	4.69	0.46	16.8	<0.001	2.33	3.24	0.70022
	Conventional	2.74	0.93					
Activities have engaged you in the learning process.	Workshop	4.73	0.44	17.4	<0.001	2.424	3.35	0.69842
	Conventional	2.71	0.94					
Instructions provided during the sessions were clear and precise.	Workshop	4.62	0.55	14.1	<0.001	1.928	2.771	0.78672
	Conventional	2.77	1.02					
Content was appropriate for equipping you for skill advancement.	Workshop	4.58	0.64	15.3	<0.001	2.113	2.986	0.7628
	Conventional	2.63	0.9					
I am confident enough in practicing these skills in the future.	Workshop	4.19	0.71	10.7	<0.001	1.396	2.163	0.81473
	Conventional	2.74	0.93					
My concept of Maitland mobilization technique is clear	Workshop	4.3	0.63	12.3	<0.001	1.639	2.439	0.77809

TABLE 5: Comparison of perceived learning outcomes between the workshop module and the traditional practical module.

The instructional clarity dimension also showed a significant difference, with workshop scores (mean = 4.62, SD = 0.55) being higher than traditional practical scores (mean = 2.77, SD = 1.02, t(147) = 14.01, p < 0.001, Cohen's d = 0.78). Likewise, content appropriateness, confidence in practicing skills, and knowledge about Maitland mobilization techniques all demonstrated significant improvements in the workshop group.

Overall, the 95% confidence intervals for mean differences confirm robust differences in favor of the workshop module. Effect sizes (Cohen's d) ranged from 0.68 to 0.81, suggesting medium-to-large effects. These findings indicate that the Maitland workshop module was more effective than the traditional practical module in meeting learning objectives, enhancing engagement, improving instructional clarity, building confidence, and equipping students with advanced mobilization knowledge.

An independent t-test was performed to compare the outcomes of the workshop-based module versus the traditional practical-based module across upper- and lower-limb mobilization modules. The results revealed significant differences favoring the workshop group, as shown in Table *6*.

N = 60	Mean	Std. deviation	95% confidence interval of difference		t	Two-sided p	Effect size
			Lower	Upper			
Lower limb workshop vs. upper limb conventional	4.800	3.17751	3.61350	5.98650	8.274	0.001	3.17751
Upper limb workshop vs. lower limb conventional	5.48333	5.06592	3.59169	7.37498	5.929	0.001	5.06592

TABLE 6: Comparison of upper- and lower-limb Maitland workshop-based module versus traditional practical-based module.

For the lower-limb workshop versus the upper-limb traditional practical-based module, the mean difference was 4.80 (SD = 3.18), with a 95% confidence interval ranging from 3.61 to 5.99. The t-value of 8.27 (p = 0.001) showed a highly significant difference, with an effect size of 3.18, indicating that the workshop-based

module had a very strong impact compared to the traditional practical-based module methods.

When comparing the upper-limb workshop with the lower-limb traditional practical module, the mean difference was 5.48 (standard deviation = 5.07), and the 95% confidence interval ranged from 3.59 to 7.37. The test resulted in a t-value of 5.93 ($p = 0.001$) and an effect size of 5.07, which again shows a medium effect and strong statistical significance, favoring the workshop-based module.

When combined, these results show that the Maitland workshop approach led to much better results than the traditional practical module in both upper- and lower-limb mobilization. The effect sizes were quite large, which means the workshop method is not only statistically significant but also shows clear practical benefits.

Discussion

The present study demonstrated that two pedagogical approaches, employed using a crossover design, showed that the group receiving workshop-based teaching for the upper extremity and traditional training for the lower extremity demonstrated excellence in psychomotor skills, engagement, and learner confidence during workshop modules compared with traditional practical sessions for Maitland mobilization. Conversely, groups exposed to conventional teaching for the upper extremity and workshop-based learning for the lower extremity showed improved outcomes specifically during the workshop exposure. This pattern suggests that the observed benefits were attributable primarily to the instructional strategy rather than limb-specific complexity, supporting the effectiveness of workshop-based modules across different joint regions in Maitland mobilization training. The growing evidence for adult learning principles, combined with the advancement of digital technologies, has greatly influenced the change in medical education during the 21st century. One major change has been the shift from traditional, teacher-focused teaching methods to more learner-centered approaches that focus on applying knowledge, engaging with content, and interacting with others [19].

The results of knowledge-based tests showed that both methods were equally effective in helping students understand concepts and facts, i.e., focusing on their cognitive domain. This supports earlier research that shows traditional, well-organized teaching methods can effectively teach both theoretical and factual knowledge [20,21]. However, the workshop-based approach performed better in areas related to affective and psychomotor domains, where clear differences were found, as workshop-based modules align closely with established neurocognitive and motor learning principles, which not only involve active participation, repetitive hands-on practice, and immediate, scaffolded feedback to facilitate motor skill acquisition by strengthening sensorimotor integration but also promote error-based learning. Small-group interactions and peer-assisted learning enhance attentional engagement and reinforce conceptual understanding through observation and reflection. Context-rich practice using skill stations is intended to approximate clinical environments; however, our study did not assess transfer of learning to real patients or retention beyond one week, and this remains a hypothesis for future research.

In contrast, traditional practical-based modules offer fewer opportunities for deliberate practice and individualized feedback, which may limit the development of fine motor control, tactile discrimination, and psychomotor precision required for advanced manual therapy techniques, as assessed via peer-model OSPE stations. Traditional practical-based modules, due to their design, are not very effective in developing the affective and psychomotor domains. These modules typically involve a teacher-centered approach, where students practice the same skills in a passive setting and watch demonstrations [22]. While this model helps with basic learning, it does not support making decisions in real-life situations, emotional involvement, or deep thinking [23]. Important aspects of the affective domain, such as learning values, improving communication, and applying knowledge in changing situations, are rarely addressed in such environments [24].

Learning in the area of the psychomotor domain is most successful when students actively use their skills, receive timely feedback, and assess their own performance. Conventional practical sessions are less effective at helping students gain long-term skill mastery because they often lack sufficient feedback and a realistic clinical setting [25].

The workshop-based model aligns with constructivist and experiential learning theories by offering a more dynamic, engaging, and interactive learning experience [7,26]. This approach encourages teamwork, problem-solving, reflective discussions, and scenario-based learning, which promote deeper understanding. A similar format can also be used in other areas of physiotherapy requiring skill-based training, such as neurophysiotherapy handling techniques, cardiopulmonary physiotherapy interventions, sports injury management, taping and bracing, electrotherapy applications, and gait training. Integration of other domains of physiotherapy, along with theoretical knowledge, with precise psychomotor execution and clinical decision-making may benefit from this pedagogical model.

This finding agrees with previous research that supports active learning methods in medical education, such as case-based workshops, problem-based learning (PBL), and flipped classrooms [27,28]. These methods

encourage students to build knowledge through inquiry, application, and critical thinking rather than just receiving information. Like flipped classrooms, which mix online learning with in-class activities, the use of workshops in this study included pre-class tasks and post-class reflections, creating a continuous learning process [28].

More research shows that interactive formats are more effective than passive lectures, especially in competency-based training that focuses on skills. A meta-analysis of STEM (science, technology, engineering, and mathematics) disciplines found that active learning consistently improved exam results and reduced the rate of students failing. Interactive teaching methods such as peer-assisted learning and simulation-based workshops have been shown to enhance student confidence, communication, and clinical reasoning in physiotherapy education [29].

Crucially, the traditional practical-based module may not be sufficient to support critical thinking or decision-making in a variety of situations, even though it is useful for demonstrating fundamental skills. Workshops seem to better integrate cognitive and affective domains as well, supporting holistic education in accordance with Miller's pyramid of clinical competence, even though both models address psychomotor domains [30].

The study's findings support the shift in education toward student-centered, interactive pedagogies. Traditional modules are still useful for developing basic procedural skills, but in order to achieve thorough learning in the cognitive, affective, and psychomotor domains, they should be carefully combined with workshops. This is in accordance with competency-based education's objectives, which consider learners to be not only informed but also skilled, sympathetic, and able to apply what they have learned in a variety of clinical settings [31].

Furthermore, our study's results support the trend noted by Mehta and others (2013), which calls on teachers to incorporate learner-driven and technology-enhanced teaching strategies that appeal to today's technologically savvy students [32]. Workshops are a great way to operationalize these contemporary pedagogical expectations, particularly when they are designed with specific goals and competencies in mind. They enable structured facilitator guidance, peer feedback, and customization, all of which enhance learner outcomes.

Additionally, the workshop modules can promote interpersonal and team-building abilities, which are critical proficiencies in the healthcare industry [11].

However, this study has certain limitations. The sample was drawn from a single institution, which may limit generalizability. Long-term retention of skills was not assessed, and outcomes were evaluated only in the short term (one week post-intervention). Additionally, peer models rather than real patients were used during assessment; therefore, findings cannot be generalized to real-patient clinical performance or to sustained skill retention, and should be interpreted strictly as short-term assessment outcomes. Additionally, because method and region were counterbalanced across groups rather than crossed within each subject, the within-subject comparisons in Table *6* conflate teaching method with anatomical region and should be interpreted as exploratory; the primary between-group comparisons (Table *5*), in which region was balanced across method, more directly isolate the effect of teaching method. Also, baseline characteristics of excluded students were not captured, so the possibility of differential attrition bias between completers and non-completers cannot be excluded; future studies should record baseline data for all eligible participants regardless of completion status to permit this comparison.

Although the present study was not powered for subgroup analysis, future research with larger samples could explore potential differences in learning outcomes based on sex or prior clinical exposure. Such analyses may provide further insights into individualized learning needs and instructional optimization.

Conclusions

This study demonstrated that although theoretical knowledge of Maitland mobilization could be effectively taught, in the psychomotor and affective dimensions, the workshop-based module consistently outperformed the traditional approach, even though both workshop-based and traditional practical-based teaching techniques were successful in transmitting theoretical understanding of Maitland mobilization. These conclusions are limited to short-term performance on the study's OSPE and MCQ assessments and to student-reported perceptions one week post-intervention; they should not be interpreted as evidence of improved clinical preparedness, real-patient performance, or long-term skill retention, which were not assessed in this study.

Appendices

Upper limb Maitland mobilization quiz

The Maitland mobilization quiz aims to evaluate students' comprehension and application of Maitland mobilization in clinical practice, shedding light on the cognitive domain. Your participation in this quiz will

help us gauge students' cognitive domain components. Please provide your answers accordingly.

* Indicates a required question

1. Email *

2. Serial No. *

3. Roll No. * In the format of Year/ UG/ Roll No (For example: 2022-23/ UG/ 10)

4. Full name *

5. In Maitland mobilization, what term is used to describe the passive accessory movement within a joint? * 1 point.

● Joint manipulation

● Joint play

● Joint compression

● Joint distraction

6. Which grade of Maitland mobilization involves large-amplitude oscillations that reach the limit of available range of motion? *1 point

● Grade I

● Grade II

● Grade III

● Grade IV

7. Which grade of Maitland mobilization involves small-amplitude oscillations at the beginning of the available range of motion? *1 point

● Grade I

● Grade II

● Grade III

● Grade IV

8. Which of the following is an indication for Maitland mobilization? *1 point

● Acute joint inflammation

● Recent fracture near the joint

● Chronic joint stiffness

● Muscle spasm around the joint

9. Which of the following best describes the goal of Grade 1 and 2 Maitland mobilization? *1 point

● To improve joint stability

● To increase muscle strength

● To reduce pain

● To enhance proprioception

10. What is the loose pack position of the Glenohumeral joint? * 1 point

● Full extension and slight lateral rotation

● Full flexion and slight lateral rotation

● Abducted 55 degrees, horizontally adducted 30 degrees

● Abducted 30 degrees, horizontally adducted 55 degrees

11. Which of the following describes the loose-pack position of the metacarpophalangeal joints (MCP)? * 1 point

● Full extension

● Full flexion

● Slight flexion

● Slight abduction

12. What is the indication for Humeroulnar Distal Glide? * 1 point

● To increase varus

● To increase extension

● To increase flexion

● To increase valgus

13. What is the indication for Sternoclavicular Posterior Glide? * 1 point.

● To increase depression of the clavicle

● To increase protraction

● To increase retraction

● To decrease elevation of the clavicle

14. What is the indication for Glenohumeral Posterior Glide in the resting position? *1 point.

● To increase flexion

● To decrease internal rotation

● To decrease abduction

● To decrease elevation

Lower limb Maitland mobilization quiz

The Maitland mobilization quiz aims to evaluate students' comprehension and application of Maitland mobilization in clinical practice, shedding light on the cognitive domain. Your participation in this quiz will help us gauge students' cognitive domain components. Please provide your answers accordingly.

* Indicates a required question

1. Email *

2. Serial No. *

3. Roll No. * In the format of Year/ UG/ Roll No (For example: 2022-23/ UG/ 10)

4. Full name *

5. What is grade 3? *1 point

● Small-amplitude rhythmic oscillations are performed at the beginning of the range.

● Large-amplitude rhythmic oscillations are performed up to the limit of the available motion and are stressed into the tissue resistance.

● Large-amplitude rhythmic oscillations are performed within the range, not reaching the limit.

● Small-amplitude rhythmic oscillations are performed at the limit of the available motion and stressed into the tissue resistance.

6. When the concave surface is moving on the convex surface, then - *1 point

● Rolling and sliding occur in the same direction

● Rolling occurs in the same direction but sliding occurs in the opposite direction

● Sliding occurs in the same direction but rolling occurs in the opposite direction

● Rolling and sliding occur in the opposite direction

7. Treatment plane lies in- *1 point

● Convex surface

● Concave surface

● Both convex and concave surface

● None of the above

8. What grade will be used for chronic post-traumatic knee stiffness? *1 point

● Grade I

● Grade II

● Grade III

● Grade IV

9. For an acute muscle spasm, which grade will be used? *1 point

● Grade I

● Grade II

● Grade III

● Grade IV

10. Hip posterior glide is given to increase. *1 point

● Flexion, ER

● Extension, IR

● Flexion, IR

● Extension, ER

11. Treatment plane for the tibiofibular joint? *1 point

● Femoral condyle

● Patellar inferior pole

● Tibial plateau

● I don't know

12. Tibiofemoral posterior glide given to? *1 point

● Increase extension

● Increase flexion

● Increase internal rotation

● I don't know

13. To increase dorsiflexion, the glide given is? *1 point

● Anterior

● Posterior

● Medial

● Lateral

14. Subtalar medial glide improves? *1 point

● Dorsiflexion

● Eversion

● Plantar flexion

● Inversion

Feedback for workshop module

* Indicates a required question

1. Email *

2. Roll No. * In the format of Year/ UG/ Roll No (For example: 2022-23/ UG/ 10)

3. Serial No. *

4. Full name *

5. The workshop content was effective in meeting your learning objectives. *

● Strongly Agree

● Agree

● Neutral

● Disagree

● Strongly Disagree

6. The workshop activities have engaged you in the learning process. *

● Strongly Agree

● Agree

● Neutral

● Disagree

● Strongly Disagree

7. The instructions provided during the workshop sessions were clear and precise. *

● Strongly Agree

● Agree

● Neutral

● Disagree

● Strongly Disagree

8. The workshop content was appropriate for equipping you for skill advancement. *

● Strongly Agree

● Agree

● Neutral

● Disagree

● Strongly Disagree

9. I am confident enough in practising these skills in the future. *

● Strongly Agree

● Agree

● Neutral

● Disagree

● Strongly Disagree

10. My concept of the Maitland mobilization technique is clear. *

● Strongly Agree

● Agree

● Neutral

● Disagree

● Strongly Disagree

Feedback for traditional practical module

* Indicates a required question

1. Email *

2. Roll No. * In the format of Year/ UG/ Roll No (For example: 2022-23/ UG/ 10)

3. Serial No. *

4. Full name *

5. The traditional practical module content was effective in meeting your learning objectives. *

● Strongly Agree

● Agree

● Neutral

● Disagree

● Strongly Disagree

6. The traditional practical module activities have engaged you in the learning process. *

● Strongly Agree

● Agree

● Neutral

● Disagree

● Strongly Disagree

7. The instructions provided during the traditional practical module sessions were clear and precise. *

● Strongly Agree

● Agree

● Neutral

● Disagree

● Strongly Disagree

8. The traditional practical module content was appropriate for equipping you for skill advancement. *

● Strongly Agree

● Agree

● Neutral

● Disagree

● Strongly Disagree

Questionnaire to compare workshop module vs. traditional practical module

* Indicates a required question

1. Email *

2. Serial No. *

3. Roll No. * In the format of Year/ UG/ Roll No (For example: 2022-23/ UG/ 10)

4. Full name *

5. On a scale of 1 to 5, how satisfied are you with the traditional practical module? *

- Very dissatisfied
- Dissatisfied
- Neutral
- Satisfied
- Very satisfied

6. On a scale of 1 to 5, how satisfied are you with the workshop module? *

- Very dissatisfied
- Dissatisfied
- Neutral
- Satisfied
- Very satisfied

7. Which module do you feel contributed more to your learning experience? *

- Traditional practical module
- Workshop module
- Both equally
- Neither

9. Which module did you find more engaging? *

- Traditional practical module
- Workshop module
- Both equally
- Neither

10. Which module do you think was more effective in helping you understand the subject matter? *

- Traditional practical module
- Workshop module
- Both equally
- Neither

11. In which module did you feel you were able to apply theoretical knowledge more effectively? *

- Traditional practical module
- Workshop module

• Both equally

• Neither

12. Overall, which module would you prefer to have more frequently in your curriculum? *

• Traditional practical module

• Workshop module

• Both equally

• Neither

13. Would you recommend the conventional practical module or the workshop module to future students? *

• Traditional practical module

• Workshop module

• Both equally

• Neither

14. Do you have any additional comments or suggestions regarding the traditional practical module or the workshop module? *

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Manali N. Yadav, Sneha Ganu, Rupali Shevalkar, Annamma Varghese, Priti Mehendale, Dhvani Shah, Prachi Sarvaiya, Nisha Dhasal, Hina Jain

Acquisition, analysis, or interpretation of data: Manali N. Yadav, Sneha Ganu, Rupali Shevalkar, Annamma Varghese, Priti Mehendale, Dhvani Shah, Prachi Sarvaiya, Nisha Dhasal, Hina Jain

Drafting of the manuscript: Manali N. Yadav, Sneha Ganu, Rupali Shevalkar, Annamma Varghese, Priti Mehendale, Dhvani Shah, Prachi Sarvaiya, Nisha Dhasal, Hina Jain

Critical review of the manuscript for important intellectual content: Manali N. Yadav, Sneha Ganu, Rupali Shevalkar, Annamma Varghese, Priti Mehendale, Dhvani Shah, Prachi Sarvaiya, Nisha Dhasal, Hina Jain

Supervision: Manali N. Yadav, Sneha Ganu, Rupali Shevalkar, Annamma Varghese, Priti Mehendale, Dhvani Shah, Prachi Sarvaiya, Nisha Dhasal, Hina Jain

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