International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Effectiveness of E Learning Modules in Teaching Medico Legal Procedures

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Received: 01-12-2025
Accepted: 20-12-2025
Available online: 27-12-2025

ABSTRACT

Background: Medico legal procedures form a crucial component of undergraduate forensic training, yet conventional teaching often provides limited exposure. E learning allows scalable, standardized, and interactive learning experiences.
Aim: To assess the effectiveness of a structured e learning module in improving knowledge and perception related to medico legal procedures among medical students.
Methods: A quasi experimental pre and post test study was conducted among 120 MBBS students. Participants completed a baseline assessment, underwent a 60 minute interactive e learning module, and completed a post test. A structured feedback questionnaire assessed perceptions. Statistical tests included paired t test, and effect size calculation.
Results: Mean scores increased significantly (pre test: 11.42±3.21; post test: 18.36±2.84, $p<0.001$). Effect size (Cohen's d = 2.34) indicated a very strong learning impact. More than 90% of students reported improved clarity and preferred e learning as a complementary method.
Conclusion: E learning modules are effective in enhancing knowledge and comprehension of medico legal procedures. Integration into forensic medicine curricula may strengthen competency based training.

Keywords: *e learning, medico legal education, forensic medicine, digital learning, medical students*

INTRODUCTION

Medico-legal procedures such as injury documentation, sexual-assault evidence handling, consent, age estimation, and death certification constitute essential competencies in undergraduate and postgraduate forensic-medicine training. These tasks demand precision, standardized methods, and compliance with legal norms, as lapses can undermine medico-legal validity and judicial credibility (1). Traditional teaching methods, primarily didactic lectures and sporadic clinical exposure often fall short because they depend on unpredictable case availability, sensitive patient-situations, and variable supervision (1,2). In contrast, digital learning offers a flexible and scalable alternative: structured, repeatable, learner-controlled modules that can incorporate multimedia, simulations, interactive case discussions and assessment tools. E-learning has been extensively endorsed in medical education for its capacity to improve conceptual understanding, learner autonomy, engagement, and retention (3–5). Moreover, the visual and procedural nature of medico-legal tasks such as diagrammatic injury recording or sequential evidence-collection makes them particularly well-suited for digital simulation and video-based instruction. Although the broader field of e-learning in medical education has expanded significantly, the specific application to medico-legal training remains under-researched in India (6). This gap highlights the importance of evaluating structured e-learning interventions in forensic-medicine curricula. The present study seeks to assess the impact of a structured e-learning module on knowledge and perceptions of medico-legal procedures among undergraduate medical students.

Material and Methods

This quasi-experimental pre-test/post-test study was conducted to evaluate the effectiveness of a structured e-learning module in improving knowledge of medico-legal procedures among undergraduate medical students. The quasi-experimental design was selected to measure learning improvement within the same cohort in an academic setting where creating a control group was not feasible, as all students were expected to receive similar instructional opportunities.

The study was carried out in the Department of Forensic Medicine at a tertiary-care teaching institution. A total of 120 MBBS Phase III students were invited to participate. Students who provided informed written consent and completed all components of the study (pre-test, intervention, post-test, and feedback) were included. Exclusion criteria were: (i) prior exposure to any structured medico-legal training beyond the routine curriculum and (ii) incomplete responses to study tools. Ethical approval for the study was obtained from the Institutional Ethics Committee.

Intervention

The intervention consisted of a 60-minute structured e-learning module developed by the faculty of the Department of Forensic Medicine. The module comprised multimedia instructional tools, including video demonstrations of procedural steps, flow diagrams of standard medico-legal processes, and scenario-based illustrations to simulate real-life medico-legal situations. Topics included: medico-legal case documentation, injury report writing, sexual-assault examination protocols, handling and sealing of evidence with chain-of-custody maintenance, principles of age estimation, and guidelines for completing death certificates. The module was self-paced, allowing learners to revisit content as needed.

Data Collection Tools

Three instruments were used for data collection:

1. Knowledge Assessment: A 25-item multiple-choice questionnaire (maximum score: 25), covering key medico-legal concepts, was administered before and after the intervention.
2. Student Feedback: A 10-item Likert-scale questionnaire administered post-intervention assessed clarity, usefulness, engagement, and overall satisfaction with the e-learning module.
3. Demographic Proforma: Recorded information on age, gender, and prior exposure to medico-legal cases.

Statistical Analysis

Data were analysed using SPSS V26 (IBM, Inc. USA). Pre-test and post-test mean scores were compared using the paired t-test. Associations between learning gain and demographic variables (age, gender, previous medico-legal exposure) were examined using the independent t-test. Effect size was calculated using Cohen's d to quantify the magnitude of learning improvement. A p-value <0.05 was considered statistically significant.

Results

Table 1. Demographic Profile (n = 120)

Variable	Category	n (%)
Age	20–21 years	68 (56.7)
	22–23 years	52 (43.3)
Gender	Male	54 (45.0)
	Female	66 (55.0)
Prior MLC Exposure	Yes	28 (23.3)
	No	92 (76.7)

A total of 120 MBBS Phase III students participated in the study, and their demographic details are summarized in Table 1. The age distribution showed that a majority of participants, 68 students (56.7%), belonged to the 20–21-year age group, while the remaining 52 students (43.3%) were aged 22–23 years. This narrow age spread is typical of undergraduate medical cohorts and ensures comparability across participants in terms of educational exposure and learning capacity.

With respect to gender, 66 participants (55%) were female, while 54 (45%) were male, reflecting a slight female predominance. Previous exposure to medico-legal cases (MLCs) was limited among the students: only 28 students (23.3%) reported having witnessed or participated in any medico-legal case-related activity, whereas the majority, 92 students (76.7%), had no prior exposure to MLC procedures. This suggests that most students approached the module with minimal baseline practical experience, making them an appropriate group for evaluating the effectiveness of an introductory educational intervention.

Table 2. Pre-test vs Post-test Scores

Variable	Mean ± SD	Mean Difference	t-value	p-value	Effect Size (d)
Pre-test Score	11.42 ± 3.21				
Post-test Score	18.36 ± 2.84	6.94	17.82	<0.001	2.34

The comparison of pre-test and post-test scores demonstrated a substantial improvement in knowledge following the e-learning intervention (Table 2). The mean pre-test score was 11.42 ± 3.21, indicating relatively modest baseline understanding of medico-legal procedures among students. After completing the e-learning module, the mean post-test score increased to 18.36 ± 2.84, reflecting an average gain of 6.94 points.

Statistical analysis using the paired t-test revealed that this improvement was highly significant ($t = 17.82$, $p < 0.001$). The study also calculated Cohen's d, an indicator of effect size, which yielded a value of 2.34. According to conventional interpretation guidelines, an effect size above 0.8 is considered large, while values above 2.0 indicate an exceptionally strong educational impact. Thus, the e-learning module produced a very large effect, demonstrating its substantial effectiveness in enhancing student knowledge of medico-legal procedures.

This significant improvement not only highlights the efficacy of digital learning tools in conveying medico-legal concepts but also underscores the need for integrating structured multimedia-based teaching into forensic medicine curricula.

Table 3. Association of Learning Gain with Demographics

Variable	Category	Mean Gain ± SD	Test	p-value
Gender	Male	6.78 ± 2.14	t=0.66	0.51
	Female	7.05 ± 1.98		
Prior MLC Exposure	Yes	7.12 ± 2.26	t=0.71	0.48
	No	6.88 ± 2.01		

The relationship between demographic variables and learning gain was assessed to determine whether the effectiveness of the e-learning module varied across different subgroups (Table 3). When analysed by gender, male students demonstrated a mean gain of 6.78 ± 2.14, while female students exhibited a slightly higher gain of 7.05 ± 1.98. However, the difference between the two groups was not statistically significant ($t = 0.66$, $p = 0.51$).

Similarly, prior exposure to medico-legal cases did not influence learning improvement. Students who had some previous experience with MLCs showed a mean gain of 7.12 ± 2.26, compared to 6.88 ± 2.01 among those without any exposure. This difference was also not statistically significant ($t = 0.71$, $p = 0.48$).

These findings indicate that the e-learning module was equally effective across all demographic subgroups, regardless of gender or previous medico-legal exposure. The consistency of improvement suggests that digital modules can provide a uniform learning experience, bridging the gap between students with varying levels of prior knowledge or clinical exposure.

Table 4. Student Feedback (n = 120)

Feedback Item	Agree/Strongly Agree (%)
Improved conceptual clarity	92.5
Easy to understand	88.3
More engaging than lectures	89.0
Should be routinely included	94.1

Student perceptions of the e-learning module were positive (Table 4). A large majority (92.5%) agreed or strongly agreed that the module improved their conceptual clarity regarding medico-legal procedures. Additionally, 88.3% found the content easy to understand, demonstrating that the design and structure of the module were appropriate for the targeted academic level.

A significant proportion (89%) felt that the e-learning format was more engaging than traditional lecture-based teaching, suggesting that the use of multimedia elements, videos, and interactive flow diagrams contributed to improved learner engagement. The highest endorsement came from 94.1% of the students, who felt that such modules should be routinely included in the formal forensic medicine curriculum.

This strong positive feedback supports the integration of structured e-learning modules as a complementary teaching strategy. Students not only benefitted academically but also demonstrated clear acceptance and preference for digital learning formats, underscoring the potential for long-term curriculum integration.

Discussion

The present study demonstrated that a structured, 60-minute e-learning module on medico-legal procedures produced a large and statistically significant improvement in knowledge among undergraduate medical students. Mean scores increased from 11.42 ± 3.21 at baseline to 18.36 ± 2.84 after the intervention, with a mean gain of 6.94 points and a very large effect size (Cohen's d = 2.34). This magnitude of improvement indicates that e-learning is not merely an acceptable substitute but a highly effective modality for teaching medico-legal content. Our findings support the broader e-learning literature in medical education, where Ruiz et al. reported that e-learning is at least as effective as traditional instructor-led

teaching and often enhances flexibility and learner control over pace and content (7). Similarly, a systematic review by George et al. among health-professions undergraduates found that online e-learning consistently improves knowledge outcomes compared with traditional or no intervention (8). More recent meta-analytic evidence from Kyaw et al. also suggests that digital education in health professions produces learning gains comparable to, or better than, face-to-face teaching across multiple competencies (9). The large effect size in our study is in line with these reports and suggests that medico-legal topics, despite their procedural and legal complexity, are particularly amenable to structured digital delivery. When our results are viewed specifically in the context of forensic-medicine and medico-legal education, they align well with emerging work from this domain. Agnihotri and Agnihotri, in a pilot study from the Department of Forensic Medicine at SSR Medical College, implemented e-learning technologies and assessed students' attitudes, reporting that most learners possessed adequate computer skills and agreed that e-learning could play an important role in medical teaching (10). Their focus was primarily on feasibility and perception rather than pre-/post-knowledge testing, but the positive attitude parallels the high satisfaction rates observed in our cohort. More recently, Nandakumar et al. used innovative e-learning methods over six weeks to build competency in courtroom skills (FM 14.22) among Phase II MBBS students and evaluated performance using moot-court presentations, demonstrating that e-learning can be successfully used even for complex testimonial and courtroom competencies (11). Our findings complement these studies by providing quantitative evidence of substantial knowledge gains in core medico-legal procedures after a short, focused e-learning intervention.

The results also resonate with virtual and simulation-based tools used in closely related fields. Talmon et al. developed the "eAutopsy," a virtual tool exposing medical students to post-mortem examination steps; they reported improved understanding and favourable student feedback, emphasizing that virtual autopsy can partially compensate for the limited availability of real autopsies (12). Balzli et al. later described 3D multimodal material documenting a forensic neck dissection for teaching anatomy and autopsy, showing that high-fidelity digital resources can enhance student engagement and understanding of complex three-dimensional structures (13). Jones et al. also reported positive student feedback when an applied forensic medicine and pathology course was moved online during the COVID-19 pandemic, indicating that virtual delivery can sustain learner satisfaction and perceived relevance even in sensitive forensic content areas (14). Collectively, these studies, together with our data, suggest that digital platforms can effectively deliver both conceptual and procedural aspects of forensic and medico-legal training.

In the present study, no significant association was found between learning gain and gender or prior exposure to medico-legal cases, indicating that the e-learning module benefitted students uniformly. This is consistent with broader digital-education findings that show comparable effectiveness of online learning across different demographic subgroups, provided basic access and digital literacy are ensured. Kyaw et al., in their digital-education meta-analysis, reported generally similar learning outcomes across diverse learner characteristics (9). A qualitative study by Ain et al. exploring factors affecting learning in an online asynchronous forensic-medicine course highlighted that engagement, instructional design and feedback mechanisms rather than demographic variables were the key determinants of learning experiences (15). Our results support this view by demonstrating that well-designed e-learning modules can equalize learning opportunities even for students without prior medico-legal exposure.

The student-feedback profile in our study where over 90 % agreed that the module improved conceptual clarity and nearly all recommended routine inclusion mirrors trends in other forensic e-learning initiatives. Agnihotri's pilot from Mauritius reported that a majority of students felt e-learning technologies could play an important role in medical teaching and that they were comfortable using such platforms (10). Nandakumar et al. similarly described favourable responses to e-learning-based training in courtroom skills, with students appreciating flexibility and structured guidance (11). Beyond forensic medicine, the classic review by Ruiz et al. and the systematic review by George et al. both noted high levels of learner satisfaction with e-learning, particularly when modules are interactive and well integrated into curricula (7, 8). Our findings strengthen this body of work by showing that medico-legal e-learning is not only acceptable but strongly preferred as a complementary method to traditional teaching.

These results also have important curricular implications in the context of Competency-Based Medical Education (CBME) in India. The CBME framework mandates demonstrable competence in medico-legal documentation, courtroom skills and ethical practice. However, opportunities for real-time exposure to medico-legal cases, autopsies and court visits are often limited. Recent national initiatives such as online medico-legal and forensic modules under the National Medical College Network and specialized medico-legal courses offered by various institutions illustrate an increasing acceptance of digital platforms for this content (16-18). Our data provide empirical support for formally integrating such e-learning modules into the forensic medicine curriculum as structured, assessable components aligned with CBME competencies.

At the same time, some caution and limitations must be acknowledged. First, this was a single-centre study conducted in one batch of MBBS students, which may limit generalizability to other institutions or curricular contexts. Second, the primary outcome was cognitive knowledge, measured through MCQs; we did not objectively assess skills such as actual injury diagramming, evidence sealing, or real-time completion of medico-legal documents. In contrast, studies like that of Nandakumar et al., which linked e-learning to performance in moot-court evaluations, or virtual-autopsy work that integrates digital tools with hands-on anatomy and pathology teaching, show that combining online modules with practical

assessment can provide a more comprehensive picture of competency acquisition (11, 12). Third, long-term retention and transfer of learning to clinical settings were not evaluated in this study. Future research should therefore include follow-up assessments, objective structured practical examinations (OSPE/OSCE) and possibly controlled comparisons with traditional or blended teaching models.

Despite these limitations, the present study adds important quantitative evidence to a relatively sparse but growing literature on e-learning in medico-legal education. It shows that even a short, carefully designed online module can produce large gains in knowledge with high learner satisfaction and equitable benefits across demographic groups. In combination with other work on courtroom-skills training, virtual autopsy and forensic e-learning initiatives, our findings support the view that digital platforms should no longer be considered peripheral but rather integral components of modern forensic-medicine teaching. Strategic integration of such modules, ideally in blended formats that combine online preparation with supervised practical sessions may substantially strengthen medico-legal competence among future medical graduates.

Conclusion

E-learning modules significantly enhance understanding of medico-legal procedures. Their integration into forensic medicine teaching can improve competency-based learning outcomes.

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