

The Effect of Time Lapse Between Online Lectures and Clinical Practice on Medical Students' Performance in an Orthopedics Hybrid Course

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Introduction: The integration of technology in medical education has led to the adoption of hybrid teaching methods, combining online lectures with traditional face-to-face clinical practice. While this approach offers flexibility and safety, it raises questions about the impact of potential time lapses between theoretical learning and hands-on experience. This study aimed to investigate the effect of the time interval between online lectures and on-site clinical practice on medical students' performance in orthopedic rotation.

Methods: A retrospective study was conducted on 116 fifth-year medical students who completed their orthopedic rotation during the 2021/2022 academic year. Students underwent a one-week online course followed by three weeks of on-site clinical practice, with varying time lapses (0–38 weeks) between these periods. Performance was assessed through examinations including key features test (KF), multiple-choice questions (MCQ), multiple-essay questions (MEQ), objective structured clinical examination (OSCE), and long case examination. Spearman's rank correlation was used to analyze the relationship between time lapse and examination scores.

Results: The analysis revealed a significant negative correlation between the time lapse duration and KF scores ($p < 0.05$). However, no significant associations were found between time lapse and scores in MCQ, MEQ, OSCE, or long case examinations ($p > 0.05$).

Conclusion: This study demonstrates that the time lapse between online lectures and clinical rotation in orthopedic education significantly impacts students' performance in key features tests. However, other examination scores remained unaffected. These findings highlight the need for careful scheduling and potential interventions to mitigate the effects of extended time lapses on specific aspects of medical knowledge retention and application in orthopedic education.

Keywords: online lectures, clinical practice, medical students, orthopedics hybrid course

Introduction

A hybrid teaching approach that integrates Internet-based elements with face-to-face instruction has become increasingly popular in education.¹ Typically, online components replace less interactive elements like lectures, while in-person sessions emphasize active, skill-based learning.^{2–4} This model allows students to customize their learning environment, access content remotely and reduce travel.⁵ However, drawbacks include reduced attention and limited peer and instructor interaction, which are vital for effective learning.⁶

Healthcare education, particularly the medical curriculum, combines of theoretical and skill learning, which requires hands-on experience and interaction with patients. However, during a pandemic, policies aim to decrease infection by minimizing physical contact and implementing social distancing measures.⁷ Therefore, online education was adopted. However, we believe that fully online courses may not be considered suitable for training medical students due to the limitations in replicating hands-on clinical experience, developing interpersonal skills, and facilitating team-based learning. Our institute considered shifting some components of medical student education, such as lectures, from onsite to online. Nevertheless, skill training and classes that requiring interaction with patients continue onsite.

Students' knowledge retention declines significantly over time after course completion.⁸ Consequently, ideal learning conditions for medical students would combine lecture and skill-based learning.⁹ However, due to limited resources and unique circumstances, such as the pandemic period, the gap between lecture and skill practice may widen beyond the usual range.

Although hybrid learning has been explored in medical education, little is known about how the timing between online instruction and clinical rotation affects student outcomes in specific specialties like orthopedics. Given the procedural and decision-making demands of orthopedic training, this gap is important. This study addresses it by evaluating how varying time lapses between online lectures and on-site clinical training influence medical students' performance in an orthopedic hybrid course.

Methods

This was a retrospective study. The database for the undergraduate medical education unit was searched to obtain information on fifth-year medical students who rotated in the orthopedic department in the 2021/2022 academic year. Students who did not undergo the examination in the academic year and those who missed their academic year schedules were excluded.

Fifth-year medical students in the 2021/2022 academic year in this faculty had two learning periods due to the COVID-19 pandemic. The first three-month period was online, in which students were divided into 12 rotations by the education team. The rotations included internal medicine, surgery, obstetrics-gynecology, pediatrics, and family medicine for two weeks each, and orthopedics and emergency medicine for one week each. The rest of the academic year (9 months) was onsite learning.

The medical students who studied orthopedics started with a one-week online course in the first period and continued with three weeks of on-site clinical practice training in the operating theaters, outpatient clinic, and inpatient clinic for three weeks. However, there were differences in the time lapse between the first period, which was an online course, and the second period in clinical practice for each student (0–38 weeks).

The Internet-based course consisted of 16 lectures encompassing an extensive assortment of subjects. Medical instructors were available for live online interactions during lectures and interactive sessions. The curriculum covered a diverse range of topics, including case studies associated with conditions affecting the spine, upper limbs, and lower limbs. Moreover, students were taught how to interpret traumatic films during these sessions.

The on-site clinical practice component of the course provided students with essential hands-on experience, such as attending outpatient and inpatient clinics, assisting in the operating room, and acquiring practical orthopedic skills such as casting, splinting, and traction. Through these clinical activities, students had the opportunity to apply the theoretical knowledge gained from online lectures in a real-world setting and develop clinical skills under the guidance of experienced medical professionals. However, due to the rotation schedule, no students had a time lapse between 10 and 20 weeks, resulting in a gap in the distribution.

To assess student performance, examination scores were collected during the final week of the on-site clinical practice. The assessments included five formats: key feature (KF) test, multiple-choice questions (MCQ), multiple essay questions (MEQ), objective structured clinical examination (OSCE), and long case examination. The KF test focuses on clinical decision-making and typically consists of short-answer questions embedded within clinical case scenarios. These questions are context-rich and require students to identify critical steps and synthesize key information to reach appropriate clinical decisions. The MCQ format assesses factual recall, while the MEQ requires structured written responses that test clinical reasoning. The OSCE evaluates hands-on clinical skills through task-based stations, and the long case examination assesses students' ability to perform complete patient evaluations, including history taking, physical examination, and case presentation.

This study was approved by the Ethics Committee and Institutional Review Board of the Faculty of Medicine, Prince of Songkla University. As this was a retrospective study using anonymized data, the requirement for informed consent was waived. Faculty members provided permission to extract information from the database.

Statistical analyses were performed using R version 4.2.3 (R Foundation, Vienna, Austria). Spearman's rank correlation was employed to assess the correlation between the time lapse between online lectures and onsite clinical practice with baseline grade point average (GPA) and MCQ, MEQ, OSCE, and long case examination scores.

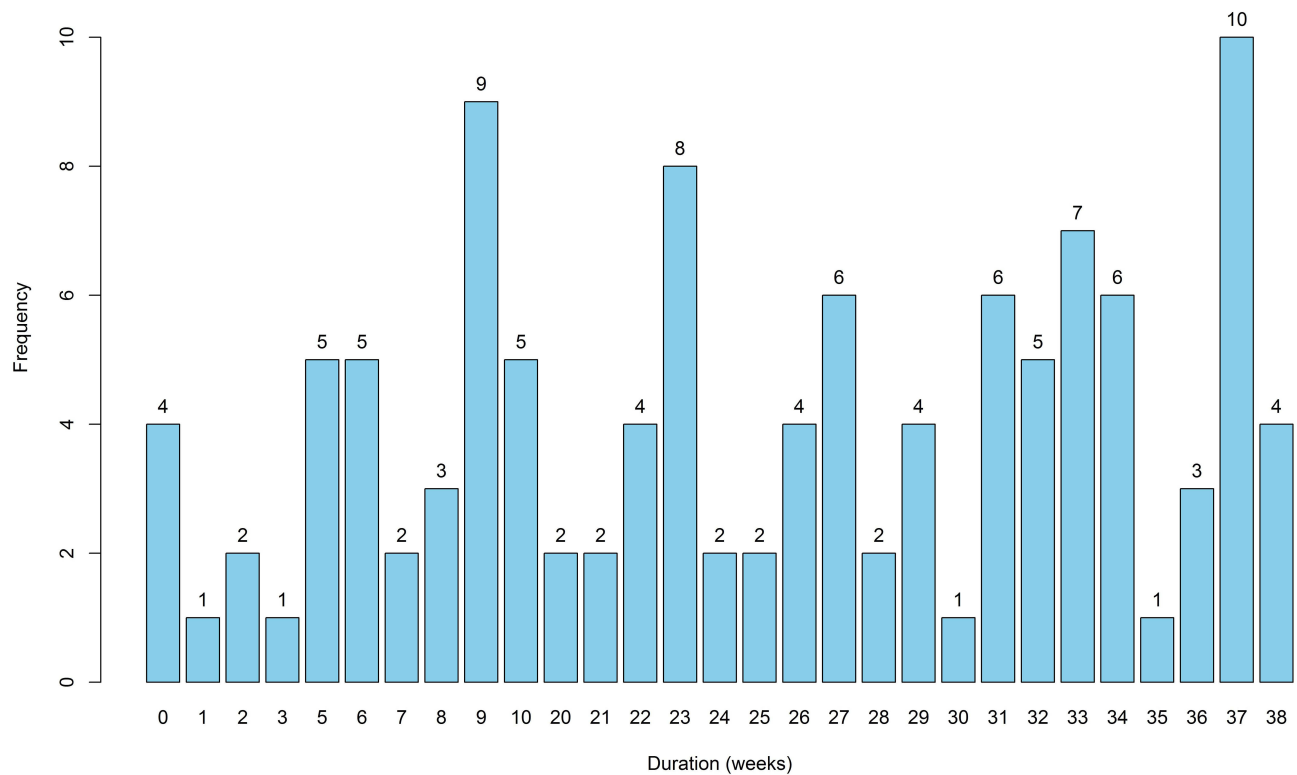


Figure 1 The distribution of time lapse of the online course and on-site clinical practice.

Results

This study included 116 students (63 female and 53 male). The average GPA of the participants was 3.24 ± 0.33 . The time lapse between the online course and on-site clinical practice ranged from 0 to 38 weeks, as illustrated in [Figure 1](#)

The analysis revealed no significant association between baseline GPA and time-lapse distribution (Spearman's $\rho = -0.023$, $p = 0.798$). The examination scores are shown in [Table 1](#).

A significant negative correlation was found between the time-lapse duration and KF scores (Spearman's $\rho = -0.2$, $p < 0.05$; [Figure 2](#)). However, the time lapse between online and on-site clinical practice was not associated with MCQ, MEQ, OSCE and long case examination scores (Spearman's $\rho = 0.1, 0.06, 0.05$ and 0.05 , respectively; $p > 0.05$).

Discussion

This study investigated the effect of time lapse between online lectures and clinical practice on medical students' performance in a hybrid orthopedic course. Our findings showed that time-lapse duration negatively impacted performance in KF test, while no significant association was found with other examination formats.

This result aligns with findings from Brown et al, who analyzed ASCP certification data from over 10,000 Medical Laboratory Scientist (MLS) and Medical Laboratory Technician (MLT) examinees.¹⁰ They found that delaying the exam

Table 1 Examination Scores

	Score (0–100)
Key features test (KF)	64.14 ± 8.94
Multiple choice question (MCQ)	67.97 ± 8.44
Multiple essay question (MEQ)	69.99 ± 6.02
Objective structured clinical examination (OSCE)	74.64 ± 5.74
Long case examination	79.79 ± 12.01

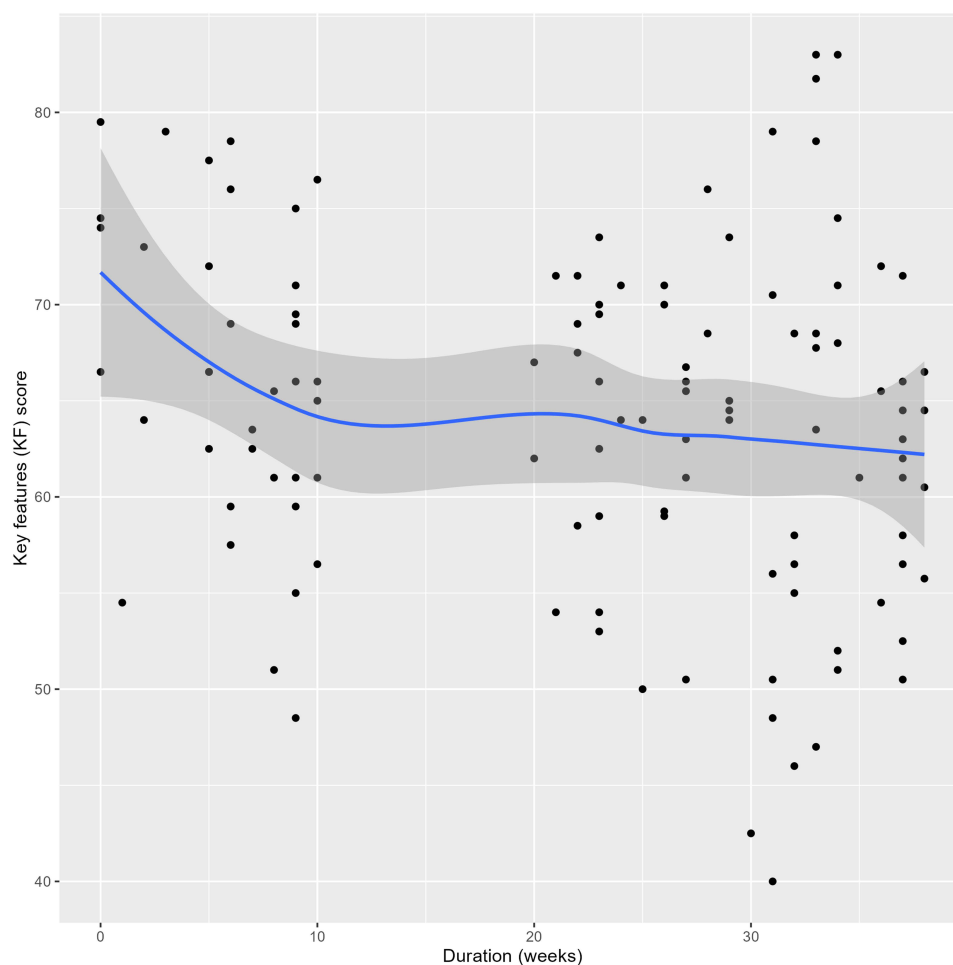


Figure 2 Duration of time lapse and KF scores.

beyond three months after program completion significantly reduced pass rates and scaled scores, suggesting that early assessment helps preserve applied knowledge. Similarly, Morgan et al reported that institutions with shorter average delays before CPA exam sittings had consistently higher pass rates. Delay alone accounted for 5.7% of variance across 605 US universities and still explained 3.6% after adjusting for factors like program quality.¹¹ The study proposed that delays may lead to diminished recall and reduced exam readiness especially for complex material.

In our context, this negative effect of time lapse was observed only for the KF test. We hypothesize that this is because the KF examination requires the integration of core knowledge from online lectures and higher-order thinking skills to make clinically relevant decisions.¹² Therefore, longer intervals between online lectures and examinations indicate a higher possibility of students forgetting knowledge from the lecture, leading to a negative impact on KF scores. To mitigate this, institutions may consider brief refresher sessions or blended review modules before clinical rotations.

However, the time interval between online lectures and clinical practice was not associated with MCQ, MEQ, OSCE, or long case examination scores. In terms of MEQ, OSCE, and long case examination scores did not differ from our expectations, as most of the knowledge and skills required for these examinations were acquired during the clinical practice period. However, the results regarding the MCQ scores were unexpected. We expected the results to be the same as those of the KF test. This could be because the KF test requires students to use higher-order thinking skills and integrate their knowledge to solve clinical problems, which may make them more susceptible to the effects of time lapse between learning and testing.^{12,13} Conversely, the MCQ test may primarily assess the recall of factual knowledge,^{14,15} which may be less affected by time lapse.

In addition, the contents of the KF and MCQ tests may have varied in ways that influenced the results. Further research is necessary to explore these possibilities and gain a better understanding of the relationship between time lapse and performance in different types of assessments.

Although this study provides valuable insights into the relationship between time lapse and examination scores among fifth-year medical students in an orthopedic department, it had several limitations. First, the retrospective nature of this study means that there may have been potential confounding variables not accounted for in the analysis, such as variations in teaching quality and differences in individual learning styles. Second, this study was limited to one academic year at a single medical school, which may limit the generalizability of the findings to other settings and populations. In addition, this study collected only examination scores and did not assess other factors that may have influenced student performance, such as motivation or stress levels. Furthermore, the absence of students within the 10–20-week time range between online lectures and on-site clinical practice can be attributed to the rotation arrangement set by the education team. As part of their curriculum, students were required to rotate to other wards, which resulted in a gap where they were not assigned to the orthopedic department during that specific time frame. This limitation restricts our ability to fully evaluate the impact of this particular time lapse on examination scores in the orthopedics course. Finally, this study had a small sample size, primarily due to the limited number of students during the COVID-19 pandemic. This may have contributed to insufficient statistical power. Thus, non-significant findings should be interpreted carefully. A larger sample size would be necessary to detect true correlations.

Conclusion

This study revealed a significant impact of time lapse on the scores of the key features test, highlighting the importance of enhanced coordination between online lectures and clinical practice. However, no significant association was observed between time lapse and the scores of other examinations. These findings emphasize the significance of strategic planning in medical education, particularly in times of challenges and disruptions.

Data Sharing Statement

The datasets generated during this current study are available from the corresponding author upon reasonable request.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee and Institutional Review Board of the Faculty of Medicine, Prince of Songkla University. As this was a retrospective study using anonymized data, the requirement for informed consent was waived.

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Disclosure

The authors declare that they have no competing interests in this work.

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