Journal of Medical Education Development
e-ISSN: 2980-7670
https://edujournal.zums.ac.ir
Volume 19, Issue 3
July 2026
Pages: 75–87

Original Article

Online versus in-person clinical immersion for undergraduate medical students: a retrospective cohort study of satisfaction outcomes

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Article info

Article history:
Received 2 Oct. 2025
Revised 20 Oct. 2025
Accepted 20 Jun. 2026
Published 1 Jul. 2026

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How to cite this article:
Thiangphak E, Buhachat R, Saeaib N, Suttisang B. Online versus in-person clinical immersion for undergraduate medical students: a retrospective cohort study of satisfaction outcomes. *J Med Edu Dev*. 2026;19(3):75-87.

Abstract

Background & Objective: Clinical immersion provides medical students with early exposure to professional roles, healthcare systems, and interpersonal skills. Disruptions to conventional placements—whether from public health measures, resource limitations, or curriculum reform—have accelerated the adoption of online delivery. While digital formats offer flexibility and standardization, questions remain about whether core learning objectives can be adequately achieved. This study compared medical student satisfaction with online versus in-person clinical immersion models.

Materials & Methods: This retrospective comparative cohort study included second-year medical students from two academic years. The 2019 cohort (n = 179) completed a two-week community hospital placement (conventional group), whereas the 2021 cohort (n = 138) undertook a standardized online version (online group). Satisfaction was assessed across domains of learning objectives and course activities using a faculty-developed questionnaire. Demographic characteristics were compared, and between-group differences were evaluated using appropriate statistical tests.

Results: Both groups were demographically similar except for domicile, with more metropolitan students in the online group ($p = 0.012$). The online group reported significantly higher satisfaction in describing physicians' work lives in community hospitals ($p = 0.006$), understanding the health service system ($p = 0.003$), explaining biopsychosocial-spiritual factors ($p = 0.003$), and developing interpersonal skills ($p = 0.009$). Overall satisfaction with learning objectives was greater in the online group ($p = 0.004$). For course activities, online students rated lectures ($p = 0.004$), the electronic logbook system ($p = 0.020$), activity benefits ($p < 0.001$), overall community hospital experience ($p = 0.002$), and curricular alignment ($p = 0.008$) more favorably.

Conclusion: The adapted online immersion achieved higher satisfaction across several domains, demonstrating its potential as a structured and engaging model. However, in-person placements offer irreplaceable experiential depth. Hybrid approaches may provide a sustainable balance between digital innovation and authentic clinical exposure.

Keywords: education, medical, undergraduate; students, medical; personal satisfaction; computer-assisted instruction; clinical clerkship; education, distance

Introduction

Medical education has historically relied on structured, in-person teaching and clinical exposure to prepare students for professional practice. Early clinical immersion programs have traditionally been viewed as essential for helping students understand physicians' roles, observe patient care, and comprehend health system functioning. These experiences, situated within real clinical environments, provide technical knowledge alongside opportunities for cultivating professional identity, interpersonal skills, and contextual awareness. However, the stability of these conventional learning arrangements has been increasingly challenged by

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[DOI: 10.66224/edcj.19.3.75]

various disruptions that demand educational adaptation.

Health professions education has undergone multiple waves of change in recent decades. The expansion of medical knowledge, rapid technological advances, and shifting healthcare demands have prompted schools to continually update their curricula. Globalization and increasing student diversity have further complicated educational experiences. In some settings, resource constraints combined with rising student numbers have strained traditional apprenticeship models. These forces have driven medical schools to explore new instructional methods, assessment formats, and learning environments. The COVID-19 pandemic provided a particularly striking example of such disruption [1, 2], substantially accelerating the adoption of online delivery. While the immediate impact was acute, the pandemic also accelerated pre-existing conversations about the sustainability of conventional methods and the potential of digital innovation in medical education [3]. Universities rapidly adopted online teaching platforms, digital assessments, and virtual simulations to maintain instructional continuity. Clinical immersion courses, which traditionally sent students to community hospitals, were restructured to minimize risks while preserving learning objectives. Beyond the pandemic, advances in educational technology, including learning management systems, virtual reality, and artificial intelligence, have steadily transformed expectations for how students learn [4].

The growing emphasis on competency-based education requires not only knowledge acquisition but also demonstrated skills in communication, teamwork, and systems-based practice—competencies difficult to achieve through conventional lectures or brief placements alone. Meanwhile, new generations of students bring strong digital skills, expectations for flexibility, and varied learning preferences. For many, online and blended formats feel efficient and natural; for others, the absence of face-to-face interaction can reduce engagement and sense of connection [5]. While online clinical immersion offers potential benefits, its effectiveness compared with conventional placements remains uncertain [6]. In response, many medical schools are redesigning curricula to integrate traditional and innovative approaches, aiming to preserve the authenticity of clinical exposure while leveraging the scalability and accessibility of digital delivery. Yet important questions remain about how students adapt to changing formats and how such adaptations influence learning outcomes. Clinical immersion provides an ideal context for examining these issues, as it serves as an early gateway for students to experience healthcare systems, physician-patient interactions, and interprofessional teamwork. Understanding how students perceive and navigate transitions between in-person and adapted formats is therefore essential. Numerous studies compare online and in-person instruction in didactic courses [5, 7—9], but fewer have examined these modalities in early clinical immersion—a unique experience focused on context, reflection, and professional socialization rather than content acquisition. Clinical immersion exposes students to healthcare systems, physician roles, and interprofessional teamwork, elements traditionally assumed to depend on physical presence. Understanding how students interpret and adapt to an online version of this experience reveals which immersion components are sensitive to modality and which can be supported through digital platforms. Accordingly, this study compared the satisfaction of second-year medical students with clinical immersion delivered in two models: conventional in-person placements and a standardized online program. We also investigated demographic and contextual factors that may influence perceptions. By addressing these questions, the study aims to provide evidence on how adaptation in medical education affects student experiences and to inform the development of hybrid models that combine the irreplaceable value of direct clinical exposure with the strengths of digital innovation.

Materials & Methods

Design and setting(s)

This retrospective comparative cohort study conducted at a university faculty of medicine in southern Thailand. The retrospective data retrieval and analysis were performed between 1 January 2024 and 31 October 2024. The study compared two cohorts of second-year medical students enrolled in the Clinical Immersion course: the 2019 cohort (4—22 March 2019), which undertook conventional in-person community hospital placements, and the 2021 cohort (6—24 December 2021), which completed a modified online version due to the COVID-19 pandemic. Within this period, students completed a two-week clinical immersion experience, with additional time allocated for orientation, preparatory activities, and course wrap-up sessions. Archived course evaluation data had originally been collected at the completion of the Clinical Immersion course on 22 March 2019 and 24 December 2021, respectively. No additional data were collected after

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course completion. The study design and reporting follow principles for observational studies as outlined in the STROBE statement for cohort studies. The course aims to expose students to the working life of physicians in community hospitals, with an emphasis on interpersonal and professional skills rather than direct patient care knowledge.

Participants and sampling

All second-year medical students enrolled in the Clinical Immersion course in 2019 and 2021 were included using a census sampling approach. Students from 2019 were classified as the conventional group and those from 2021 as the online group. No random sampling was performed and no formal sample size calculation was required; the study size was determined by the total number of students enrolled during the study period. Although no a priori sample size calculation was performed due to the census-based design, post hoc power considerations suggest that the available sample size was adequate for comparative analysis. **Figure 1** illustrates the participant flow diagram. With all students in both the conventional and online groups, the study had sufficient power (>80%) to detect small-to-moderate effect sizes ($r \approx 0.20–0.30$) in satisfaction outcomes using non-parametric tests at a two-sided α level of 0.05, consistent with recommendations for educational research [10]. The Clinical Immersion course is designed to introduce second-year medical students to community-based healthcare and foundational aspects of early clinical professional development. The course aims to provide students with opportunities to experience and describe the working life, professional roles, and daily realities of physicians practicing in community hospitals, while exploring the operational context and healthcare delivery systems within these settings, including patient care processes and interprofessional collaboration. Students are encouraged to understand how physical, psychological, social, and spiritual factors contribute to illness and to apply a holistic biopsychosocial-spiritual perspective to patient care. In addition, the course enables students to recognize how their experiences in community hospitals align with the core competencies of the Doctor of Medicine curriculum.

Through observation and participation, students are expected to appreciate appropriate attitudes and interactions among physicians, healthcare personnel, patients, and family members, with particular emphasis on communication and professionalism. The course also seeks to foster interpersonal and social skills necessary for living and working effectively with others, including respect for others, adaptability to different environments, and responsible teamwork. These learning objectives formed the basis of both the conventional and online formats of the course and guided the structure of learning activities.

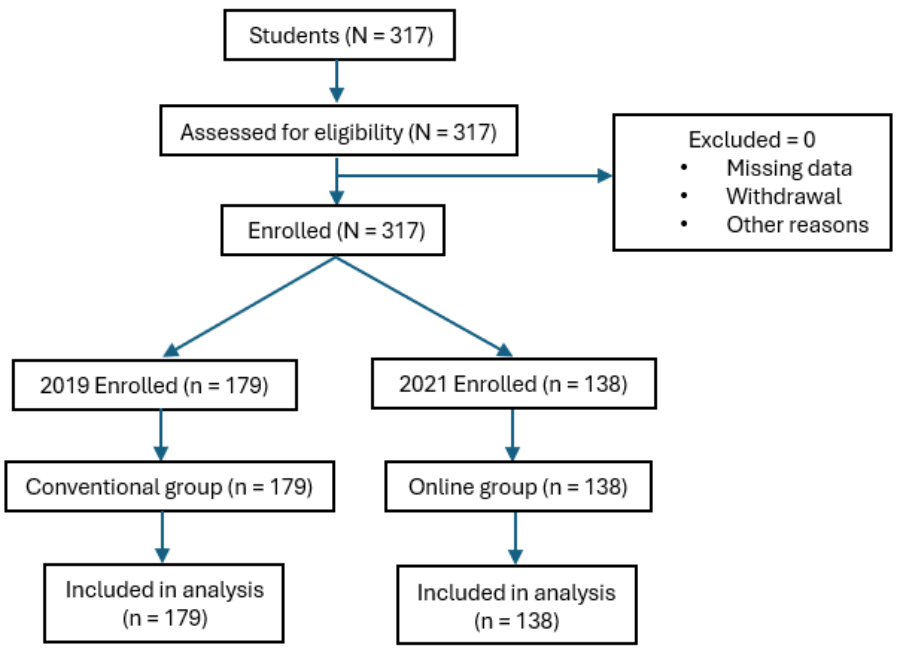


Figure 1. Participant flow diagram illustrating the enrollment, exclusions, and final analytical sample for the conventional group (n = 179) and the online group (n = 138).

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[DOI: 10.66224/edcj.19.3.75]

The conventional clinical immersion model implemented in 2019 consisted of a full-time community hospital placement in which students were assigned to a single community hospital for the duration of the immersion experience. The course was conducted over an 18-day period and included a two-week clinical placement, with additional time allocated for orientation and course wrap-up activities. Community hospitals from several provinces participated in the program, providing students with exposure to diverse healthcare settings. During the placement, students shadowed physicians in outpatient clinics, inpatient wards, and emergency departments. They observed patient-physician interactions, communication strategies, and multidisciplinary workflows. When opportunities were available, students also participated in community-based health activities, such as home visits and health promotion clinics. Throughout the immersion, students completed daily reflective tasks focusing on professional roles, interprofessional collaboration, hospital systems, and care processes. Structured assignments included documenting observed patient encounters, interviewing healthcare personnel, mapping hospital services and workflows, maintaining reflective logbooks, and submitting a final summary report.

University faculty members conducted at least one on-site visit to each placement site. During these visits, faculty supervised hospital preceptors, clarified the intended learning objectives, and sought to maintain consistency in the educational experience across participating community hospitals. Faculty reviewed students' assigned tasks and reflective logbooks and provided formative verbal feedback to promote reflective learning and professional development. The primary outcome of this study was students' satisfaction with the learning experience, assessed using a structured satisfaction questionnaire administered at the end of the course. However, these evaluations were conducted without a standardized checklist. In addition to the satisfaction survey, university faculty conducted on-site observations using structured forms to provide formative feedback on student engagement, professionalism, and interactions with healthcare staff, while hospital preceptors evaluated students' professionalism, participation, and teamwork within the clinical environment. However, these faculty and preceptor evaluations were intended for educational purposes only and were not analyzed as objective outcome measures in this study because they were not implemented using a uniform scoring rubric or standardized grading system across all evaluators. The online clinical immersion model implemented in 2021 was developed in response to institutional restrictions that precluded in-person community hospital placements during the COVID-19 pandemic. The course was delivered through the university's learning management system in combination with synchronous sessions conducted via Zoom. Although direct clinical exposure was not feasible, the curriculum was intentionally designed to replicate the core components of community-based immersion through a series of structured virtual learning activities. The online curriculum incorporated synchronous lectures focusing on community hospital systems, professional identity formation, patient communication, and interprofessional collaboration. Annotated demonstration videos were used to illustrate communication strategies and patient interviewing techniques. Faculty facilitated case-based discussions using anonymized cases derived from community hospital practice to promote clinical reasoning and understanding of real-world healthcare delivery. Virtual tours and structured presentations of community hospital workflows were conducted with practicing community physicians to familiarize students with the community healthcare environment. In addition, community hospital physicians developed scenario-based activities that simulated experiences commonly encountered in outpatient clinics, inpatient wards, emergency departments, and primary care units. Students also completed reflective assignments aligned with the stated learning objectives throughout the course. Faculty members delivered all synchronous online sessions, facilitated discussions, monitored student participation, and provided structured feedback on reflective assignments. To ensure consistency across student groups, standardized teaching materials, learning activities, and session outlines were used throughout the online program. To promote interpersonal skill development and reflective learning, students participated in guided role-playing activities in which they practiced structured communication tasks with peers. Each role-play session was followed by faculty-led debriefings to reinforce key communication principles and encourage reflective discussion. Students also engaged in small-group reflective exercises focused on doctor-patient relationships and participated actively in facilitated discussions. In addition, they completed an electronic logbook documenting their understanding of professional roles, healthcare system organization, and the biopsychosocial dimensions of illness. Reflection

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papers and group assignments summarizing insights into community-based medical practice were submitted at the conclusion of the course. Assessment included completion of an online satisfaction questionnaire identical in structure and content to that used in the conventional format. Faculty members evaluated student participation during synchronous sessions, reviewed electronic logbooks, and provided structured written feedback on reflective assignments. Faculty assessed student participation, professionalism, communication, teamwork, and reflection based on direct observation (conventional cohort) or online participation and e-logbook submissions (online cohort). These evaluations were intended solely for formative educational purposes. While these evaluations aligned with shared objectives, no standardized checklist, scoring rubric, or numerical grading system was used uniformly. Thus, faculty evaluations were not included as objective outcome measures.

Tools/Instruments

Student satisfaction was assessed using a questionnaire developed by the faculty. The satisfaction questionnaire is a faculty-developed tool used annually to evaluate clinical immersion [11]. Content validity was established through expert review by two senior medical educators. Formal construct validation procedures, such as exploratory or confirmatory factor analysis, were not performed because the instrument was designed as a course-specific evaluative tool rather than a fully standardized psychometric scale. Accordingly, results are interpreted as indicators of perceived learning experience and satisfaction rather than latent educational constructs. The instrument comprised two components. The first component assessed students' perceived achievement of the six course objectives, including understanding the roles and responsibilities of physicians in community hospitals, recognizing healthcare systems and service processes, applying a biopsychosocial-spiritual perspective to patient care, appreciating the alignment between community experiences and the Doctor of Medicine curriculum, observing professional communication and interactions, and developing interpersonal and social skills. The second component evaluated students' satisfaction with learning activities and the appropriateness of the community hospital setting through 12 domains: orientation, lecture on medicine and the community, logbook writing process, counsellor meetings, orientation by the Provincial Public Health Office, e-logbook system, e-group reports, overall benefit of activities, overall community hospital experience, overall benefit of the course, perceived motivation to become a doctor in a community hospital after completing the course, and the appropriateness and consistency of the course with the curriculum. Each item was rated on a five-point Likert scale (5 = very high clarity/satisfaction, 1 = needs improvement). The questionnaire has been routinely used in course evaluations and reviewed by faculty experts to ensure content validity. For the present study, internal consistency reliability was assessed using Cronbach's alpha, calculated from the study dataset. The overall questionnaire demonstrated good internal consistency (Cronbach's $\alpha = 0.88$). Reliability coefficients for the two subdomains were also acceptable; achievement of course objectives (six domains): Cronbach's $\alpha = 0.92$, satisfaction with learning activities and appropriateness of the community hospital setting (twelve domains): Cronbach's $\alpha = 0.86$.

Data collection methods

In 2019 (conventional group), students completed a two-week placement in community hospitals. Objectives included experiencing the health service system, recognizing doctor-patient interactions, and developing teamwork skills with physicians and hospital staff. Faculty members conducted site visits to evaluate learning. In 2021 (online group), due to COVID-19 restrictions, the course was modified to reduce in-person exposure. Students participated in a shortened program supported by structured online learning modules, with faculty conducting remote assessments via virtual platforms. The online adaptation was delivered over the same two-week academic period as the conventional course; however, because students were not placed in community hospitals, the daily workload was reduced. Online sessions were scheduled for approximately 3–4 hours per day, whereas the in-person format required full-day engagement in hospital activities, including morning rounds, outpatient clinics, and community outreach. In both formats, faculty conducted formative evaluations based on students' reflections, participation in discussions, and adherence to course expectations. All students completed the standardized satisfaction questionnaire at the end of the course. The university's secure online evaluation system administered an anonymous satisfaction questionnaire.

Completion was mandatory for both conventional and online cohorts. Students completed the questionnaire

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immediately after the course and submitted their responses about an hour later. Since the evaluation was built into the course workflow and was required to finalize academic records, the response rate was 100%, with no missing data. Faculty oversight ensured consistent application of objectives and evaluations across both groups. All questionnaires were complete; no missing data occurred.

Data analysis

All statistical analyses were performed using R software (R Core Team, 2022. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria). Continuous variables were summarized as mean ± standard deviation (SD) if normally distributed, or as median with interquartile range (IQR) if non-normally distributed. Categorical variables were expressed as frequency and percentage. Normality of continuous variables was assessed using the Shapiro-Wilk test and Q-Q plots. Between-group comparisons were performed using chi-square or Fisher's exact tests for categorical variables and independent t-tests or Mann-Whitney U tests for continuous variables, as appropriate. Comparisons of satisfactory scores between the conventional and online groups were conducted using the Mann-Whitney U test. For all statistically significant Mann-Whitney U test results, effect size (r) was calculated. No subgroup or interaction analyses were prespecified. A p-value < 0.05 was considered statistically significant.

Results

A total of 317 students were included: 179 in the conventional group (2019) and 138 in the online group (2021) (**Table 1**). Median age was 20 years in both groups (p = 0.484).

Admission pathways, including those based on academic merit with rural service commitment and the national entrance system open to all regions, did not differ significantly between groups. Most students in both cohorts were Buddhist. However, domicile background showed a significant difference between groups. The online group had a greater proportion of students from metropolitan areas (58% vs. 43%), while the conventional group included more students from provincial regions (57% vs. 42%) (p = 0.012). For this analysis, "metropolitan" referred to urbanized provinces, while "provincial" referred to other regions.

Table 1. Baseline characteristics of second year medical students between the conventional group and the online group

Variables	Conventional group (n = 179)	Online group (n = 138)	P-value
Age (years)			0.484
Median (IQR)	20 (20, 20)	20 (19, 20)	
Student's background, n (%)			0.283
Rural doctor	74 (41.3%)	48 (34.8%)	
Consortium of Medical Schools' doctor	105 (58.7%)	90 (65.2%)	
Religion, n (%)			0.635
Buddhism	162 (90.5%)	120 (87.0%)	
Christian	3 (1.7%)	3 (2.2%)	
Muslims	14 (7.8%)	15 (10.9%)	
Domicile, n (%)			0.012
Provincial	102 (57.0%)	58 (42.0%)	
Metropolitan	77 (43.0%)	80 (58.0%)	

Note: Independent t-test was used to compare the median age between groups. Chi-square test was employed to compare the distribution of students' backgrounds, religions, and domiciles between groups.
Abbreviations: n, number of participants; IQR, interquartile range; P, probability value.

Tables 2 and **3** summarize satisfaction with learning objectives and course activities. Effect sizes for significant differences ranged from r = 0.13 to r = 0.18, indicating small to small-medium effects across domains. The online group reported significantly higher scores for describing the lives of doctors in community hospitals (p = 0.006), experiencing the health service system (p = 0.003), explaining physical, mental, social, and spiritual factors of illness (p = 0.003), and skills for living with others appropriately (p = 0.009). Although the medians for the first two domains were identical between groups (5 [IQR 4–5]), the online group achieved higher mean scores (4.7 vs. 4.4 and 4.7 vs. 4.5, respectively), reflecting fewer low-end ratings. No significant differences were observed in recognizing the congruence of the Doctor of Medicine program with medical competency or in explaining physician-patient interactions. Overall, the total score for learning objectives was significantly higher in the online group (p = 0.004). For course activities, the total activity score was slightly higher in the online group, though not statistically significant (p = 0.084). No significant

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differences were observed between the conventional and online groups in satisfaction with orientation (p = 0.381), counsellor meetings (p = 0.638), orientation provided by the Provincial Public Health Office (p = 0.270), logbook writing process (p = 0.262), e-group reports (p = 0.097), the overall benefit of the course (p = 0.088), or the perceived need to become a doctor in a community hospital after completing the course (p = 0.566). The online group reported significantly higher satisfaction with the lecture on medicine and the community (p = 0.004), the overall benefit of activities (p < 0.001), the overall community hospital experience (p = 0.002), and curricular appropriateness and consistency (p = 0.008). Although the medians for the lecture on medicine and the community were the same in both groups (4 [IQR 3–5]), the online group achieved a higher mean score (4.1 vs. 3.9), indicating fewer lower ratings. For the e-logbook system domain, the conventional group demonstrated a slightly higher mean score than the online group (4.2 vs. 4.0), and this difference reached statistical significance (p = 0.02). However, the effect size was small (r = 0.13), suggesting limited practical significance.

Table 2. Satisfactory scores of learning objectives between the conventional group and the online group

Domain	Conventional group (n = 179)	Online group (n = 138)	P-value (r)
1. Able to describe the lives of doctors in community hospitals			0.006 (0.15)
Median (IQR)	5 (4, 5)	5 (4, 5)	
Mean (SD)	4.4 (0.7)	4.7 (0.5)	
2. Experience the health service system of community hospitals			0.003 (0.17)
Median (IQR)	5 (4, 5)	5 (4, 5)	
Mean (SD)	4.5 (0.7)	4.7 (0.5)	
3. Able to explain physical, mental, social and spiritual factors of illness			0.003 (0.17)
Median (IQR)	4 (4, 5)	5 (4, 5)	
Mean (SD)	4.3 (0.7)	4.5 (0.6)	
4. Recognizing the congruence of doctor of medicine program to the medical competency			0.081
Median (IQR)	4 (4, 5)	5 (4, 5)	
Mean (SD)	4.4 (0.8)	4.5 (0.6)	
5. Able to explain attitudes and interactions between physicians towards patients and their relatives			0.134
Median (IQR)	5 (4, 5)	5 (4, 5)	
Mean (SD)	4.5 (0.7)	4.6 (0.6)	
6. A skill to live with others appropriately			0.009 (0.15)
Median (IQR)	4 (4, 5)	5 (4, 5)	
Mean (SD)	4.4 (0.7)	4.6 (0.6)	
Overall score from median (IQR)	4.0 (4, 5)	4.7 (4.3, 5)	0.004 (0.16)
Overall score from mean (SD)	4.4 (0.6)	4.6 (0.5)	

Note: Mann-Whitney U test was used to compare the medians of satisfactory scores between the conventional and online groups. P values were calculated from the median and reported with the correlation coefficient (r) for all significant comparisons.
Abbreviations: n, number of participants; SD, standard deviation; IQR, interquartile range; P, probability value; r, correlation coefficien

Discussion

The rapid shift to online education during the pandemic represented an unprecedented disruption to conventional clinical immersion, raising concerns that student learning quality might be compromised. Online formats, once considered supplementary, suddenly replaced in-person placements, threatening the experiential foundation of early medical training. This study retrospectively compared satisfactory scores of second-year medical students in a conventional in-person model (2019) and a pandemic-driven online model (2021). Despite initial uncertainty, both formats achieved high satisfaction levels, and the online cohort consistently rated higher across most domains. These findings suggest that, while the change was abrupt and untested, a structured online format can successfully deliver core elements of clinical immersion and even enhance perceived learning in several areas.

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Table 3. Satisfactory scores of course activities in the community hospital between the conventional group and the online group

Domain	Conventional group (n = 179)	Online group (n = 138)	P-value (r)
1. Orientation			0.381
Median (IQR)	4 (3, 5)	4 (4, 5)	
Mean (SD)	4.0 (0.9)	4.1 (0.8)	
2. Lecture on medicine and the community			0.004 (0.16)
Median (IQR)	4 (3, 5)	4 (4, 5)	
Mean (SD)	3.9 (1.0)	4.1 (0.8)	
3. Logbook writing process			0.262
Median (IQR)	4 (3, 5)	4 (3, 5)	
Mean (SD)	3.9 (1.0)	3.8 (1.0)	
4. Counsellor meeting			0.638
Median (IQR)	4 (3, 5)	4 (4, 5)	
Mean (SD)	4.1 (0.9)	4.2 (0.8)	
5. Orientation of Provincial Public Health Office			0.270
Median (IQR)	4 (3, 5)	4 (4, 5)	
Mean (SD)	4.0 (0.9)	4.1 (0.9)	
6. E-logbook system			0.020 (0.13)
Median (IQR)	4 (4, 5)	4 (3, 5)	
Mean (SD)	4.2 (0.9)	4.0 (0.9)	
7. E-group report			0.097
Median (IQR)	4 (3, 5)	4 (4, 5)	
Mean (SD)	3.9 (0.9)	4.1 (0.8)	
8. The overall benefit of activities			< 0.001 (0.18)
Median (IQR)	4 (3, 5)	5 (4, 5)	
Mean (SD)	3.9 (0.9)	4.6 (0.6)	
9. The overall communities hospital			0.002 (0.17)
Median (IQR)	4 (4, 5)	5 (4, 5)	
Mean (SD)	4.3 (0.7)	4.6 (0.7)	
10. The overall benefit of course			0.088
Median (IQR)	4 (4, 5)	5 (4, 5)	
Mean (SD)	4.3 (0.7)	4.5 (0.6)	
11. The need to be a doctor in the hospital after completing the course			0.566
Median (IQR)	4 (4, 5)	5 (4, 5)	
Mean (SD)	4.3 (0.8)	4.3 (0.8)	
12. Courses are appropriate and consistent with the curriculum			0.008 (0.15)
Median (IQR)	4 (4, 5)	5 (4, 5)	
Mean (SD)	4.3 (0.8)	4.5 (0.6)	
Overall score from median (IQR)	4.1 (3.6, 4.8)	4.2 (4.0, 4.7)	0.084
Overall score from mean (SD)	4.1 (0.7)	4.2 (0.6)	

Note: Mann-Whitney U test was used to compare the satisfactory scores between the conventional and online groups. P values were calculated from the median and reported with the correlation coefficient (r) for all significant comparisons.
Abbreviations: n, number of participants; SD, standard deviation; IQR, interquartile range; P, probability value; r, correlation coefficient; E, electronic.
Figures

The median age of participants was 20 years in both groups, reflecting the stable age distribution of second-year medical students in Thailand. Given the similar stage of training, developmental differences are unlikely to explain outcome differences. Admission pathways through the Rural Doctor Program and Consortium of Medical Schools were also comparable, consistent with stable national selection policies, suggesting that differences in satisfaction were driven by instructional modality rather than demographic variation [12].

The religious composition was also comparable, with both groups predominantly Buddhist, indicating a limited influence of cultural or religious factors. Religion is not typically a primary determinant of medical education, but shared cultural and value systems may shape student perceptions of community engagement and professional roles. However, domicile differed significantly: the online group included more metropolitan students, while the conventional group had more provincial students ($p = 0.012$). This imbalance may reflect natural year-to-year variation in the medical school selection process in Thailand, where recruitment policies aim to balance regional representation but cannot entirely eliminate fluctuations. Metropolitan students generally have greater familiarity with digital technologies, better internet access, and more comfort with structured online communication [8], which may have facilitated adaptation to the online course. Conversely, provincial students, with closer ties to rural healthcare contexts, may benefit more from direct in-person immersion.

The online cohort reported higher satisfaction in describing doctors' roles in community hospitals,

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understanding the health service system, explaining biopsychosocial-spiritual factors, and interpersonal skills. These advantages likely stemmed from standardized content, structured reflective activities, and clearer mapping of health system functions, which provided more consistent learning than the site-dependent variability of the conventional placement [13, 14]. Near-ceiling scores for physician-patient interaction and competency congruence across both groups explain the absence of significant differences in these domains. Self-reported interpersonal skill improvements may also reflect social desirability bias [15], particularly in the online group.

Activities such as orientation, logbook writing process, and counselor meetings showed no significant group differences, suggesting that checklists and structured mentorship ensured consistent outcomes. In contrast, lectures scored higher in the online cohort, likely due to flexible access to recorded and interactive resources. The e-logbook system, which referred to the electronic platform used for documentation and submission, was rated more favorably by the conventional group, possibly due to fewer technical issues and smoother integration with in-person activities. As the absolute difference between groups was small and the effect size was minimal ($r = 0.13$), this finding should be interpreted cautiously, as it may reflect subtle distributional differences rather than a practically meaningful educational advantage. Group reporting trended toward higher online satisfaction, reflecting collaborative completion and peer feedback. Overall benefit of activities and perceptions of the community hospital setting favored the online cohort, indicating that structured guidance and digital materials enhanced system-level understanding [16]. However, such resources cannot fully substitute for direct clinical exposure, which remains central to experiential learning [17]. Career intentions to work in community hospitals did not differ, underscoring that short-term course modality may have limited influence on long-term professional goals.

Although several domains exhibit identical medians and IQRs between groups, the Mann-Whitney U test detected statistically significant differences in the distribution of ranks. This indicates subtle shifts in the score distributions that are not captured by the medians. Means and standard deviations are therefore provided as complementary descriptive statistics. Effect sizes ranged from 0.13 to 0.18, indicating small to small-medium effects, consistent with subtle but measurable differences in satisfaction. This is expected for Likert-scale educational outcomes, where variations reflect tendencies rather than substantial shifts.

The online format afforded flexibility, reduced logistical burdens, and expanded access to supplementary resources, consistent with literature suggesting that well-structured digital courses enhance satisfaction, engagement, and autonomy [18]. Online systems may also reduce hierarchical barriers, allowing more accessible communication between students and faculty. Nevertheless, higher satisfaction does not equate to superior educational outcomes. In-person immersion uniquely enables observation of patient care, interprofessional collaboration, and exposure to authentic clinical challenges, which cannot be replicated virtually. The domicile imbalance should also be considered, as metropolitan students may have been predisposed to prefer online modalities. Moreover, the unprecedented context of emergency adaptation may have influenced perceptions, with online delivery perceived as a timely and efficient alternative during disruption.

The finding that students reported higher satisfaction in an online format compared to a traditional course that involved experiential, community-based immersion may seem counterintuitive. Several learning theories offer explanations.

From cognitive load theory, online instruction reduces extraneous cognitive load by presenting information in structured modules as opposed to the unpredictable real-world situations. Early-stage learners often experience cognitive overload in clinical environments, hindering knowledge integration [19]. Online modules allow controlled pacing and repeated exposure that support comprehension. The reduced workload in the online version may have influenced satisfaction ratings independently of instructional modality. A shorter daily contact schedule, absence of clinical duties, and increased flexibility may have contributed to greater comfort and perceived manageability of the course. This factor must be considered when interpreting differences between the two formats.

Self-determination theory (SDT) also provides insight. Well-designed online learning may enhance students' sense of autonomy, competence, and relatedness (interaction in psychologically safe online environments). When these SDT needs are met, learners are more motivated and more satisfied [20].

Furthermore, online learning environments can create greater psychological safety, as virtual platforms can

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reduce usual pressures and variability across clinical sites. Students may feel freer to ask questions, participate in discussions, and express uncertainty in online discussions than in busy or unfamiliar clinical settings [21]. The standardized structure of the online immersion model may also have minimized disparities across training sites, thereby elevating the lower portion of satisfaction distributions.

Finally, online platforms can support structured reflection, an essential component of early professional identity formation. Research suggests that reflective activities may be more deeply engaged online due to reduced distractions and clearer task guidance [22]. These factors likely contributed to higher ratings in domains such as understanding physician roles, health system structure, and biopsychosocial-spiritual perspectives.

This study has several limitations. First, it compared cohorts from different years, raising the possibility of cohort effects unrelated to instructional modality. Although baseline demographics were largely comparable, the greater proportion of metropolitan students in the online group may have influenced results in favor of digital learning. Second, satisfaction outcomes were self-reported and may have been influenced by social desirability, potentially inflating ratings in domains such as interpersonal skills. Although the questionnaire underwent expert review to ensure relevance and clarity, it was developed for routine course evaluation rather than as a fully standardized psychometric instrument. In addition, item-level data from earlier cohorts were unavailable, limiting comprehensive validation (e.g., factor analysis) and preventing complete reliability testing across all cohorts. Therefore, the instrument should be interpreted as a structured satisfaction measure aligned with course objectives, not as a formally validated scale. Third, outcomes were limited to short-term satisfaction; long-term measures such as clinical competence, professional identity formation, or career outcomes were not assessed. Fourth, no sample size calculation was performed, as all eligible students were included, and the retrospective design limited control of unmeasured confounders. Fifth, subtle variations in course delivery, faculty engagement, and digital readiness may have contributed to differences despite standardized questionnaires. Sixth, the evaluations were designed to provide feedback rather than serve as a basis for grading. Consequently, no objective performance scores were collected or incorporated into the analysis. This implies that the study primarily examines learners' perceptions rather than direct assessments of competence across various formats. Finally, a limitation of this study is that it relied exclusively on self-reported satisfaction, without measuring objective learning outcomes such as knowledge retention, communication skills, systems-based understanding, or observed professional behaviors. Satisfaction reflects students' perceptions of clarity, structure, and engagement, but it does not necessarily correlate with actual development of competence. The higher ratings observed in the online format should therefore be interpreted as indicators of perceived learning quality rather than evidence of superior educational effectiveness. Without performance-based or behavioral assessments, it remains unknown whether students in the online cohort achieved equivalent or better mastery of course objectives compared with those who completed in-person immersion. These factors suggest that the observed statistical differences should be interpreted cautiously.

Selection bias was minimized by including all second-year medical students enrolled in the clinical immersion course each academic year. Allocation to the conventional (2019) or online (2021) format was determined by academic year rather than by participant choice, reducing self-selection effects. To control for information bias, all students completed the same standardized satisfaction questionnaire under comparable conditions at course completion, which reduced the likelihood of non-response or reporting bias. A statistically significant difference was observed in the distribution of students' domiciles between cohorts. Metropolitan students may have been more familiar with digital tools, which could have influenced satisfaction with the online format. This was acknowledged as an uncontrolled confounder that may have contributed to differences in satisfactory scores.

Internal validity was supported by consistent course objectives across years, the same assessment tools and consistent faculty oversight. External validity was concerned with other undergraduate medical curricula that incorporate early clinical immersion. The variations in institutional culture, technological infrastructure and community hospital contexts may limit broader applicability.

This study offers novel insights into how specific experiential learning objectives, such as understanding physician roles, appreciating health service systems, and articulating biopsychosocial-spiritual perspectives, can be effectively supported through well-designed online

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structures. At the same time, the results reinforce which components, such as authentic patient interaction and situated learning, still rely on in-person exposure. This contributes to a better understanding of modality-sensitive and modality-flexible elements of clinical immersion. Thus, beyond just measuring satisfaction, this study helps us understand how experiential medical education can change in response to curricular redesign and emerging learning needs.

A key limitation is that the two cohorts experienced markedly different societal contexts. The 2019 cohort completed the course under routine academic conditions, whereas the 2021 cohort learned during a period of widespread disruption, uncertainty, and adaptation. Students in 2021 may have valued the flexibility, safety, and continuity afforded by the online format and thus reported higher satisfaction independent of the intrinsic educational quality. Appreciation for institutional support or reduced logistical burdens (e.g., travel, living away from home) may also have contributed to elevated satisfaction. These contextual influences cannot be entirely separated from the delivery format and may partially explain the observed differences between groups.

The findings may be generalisable to medical schools in Thailand and low- and middle-income contexts where community hospital immersion and online modalities are integrated into curricula. However, applicability to other settings may vary depending on health system structures, digital infrastructure, and cultural factors. The results are most relevant for institutions considering hybrid approaches that preserve experiential, community-based learning while leveraging the flexibility and standardization of digital platforms [23]. However, online materials may occasionally contain inappropriate content. The ease of accessing and sharing digital resources raises concerns regarding copyright violations and plagiarism [24]. Furthermore, the rapid expansion of online information makes it impossible to comprehensively cover all relevant topics within the limited time available in a course. Future work should incorporate objective outcome measures, including knowledge tests, the mini-clinical evaluation exercise, assessments of reflective ability, and evaluation of teamwork or communication skills, to determine whether differences in satisfaction are associated with meaningful improvements in competence. Longitudinal follow-up helps clarify whether early online immersion shapes later clinical performance, adaptability, or the formation of professional identity. Such evidence would allow educators to make stronger claims about the effectiveness of online and hybrid immersion models beyond perceived learning quality.

Conclusion

This study demonstrates that medical students can adapt to different clinical immersion formats, with the online model achieving high satisfaction across multiple domains. Although digital delivery offers structured, standardized, and accessible learning experiences, it does not fully replicate the authenticity and contextual richness of in-person community placements. Nevertheless, the findings indicate that key educational objectives related to professional awareness and understanding of healthcare systems were perceived as meaningful in both formats.

Because this study evaluated satisfaction rather than objective measures of competence, conclusions regarding comparative educational effectiveness should be interpreted cautiously. Future research should investigate whether blended or hybrid models can combine the complementary strengths of online and in-person approaches and assess their impact on measurable outcomes such as knowledge acquisition, clinical skills development, and professional identity formation.

Ethical considerations

The study was approved by the Institutional Ethics Committee of the Faculty of Medicine, Prince of Songkla University (IRB No. 65-207-12-1). The satisfaction questionnaire was administered as part of the routine course evaluation. Students were informed that while completing the evaluation was mandatory for academic quality assurance, participating in the research using anonymized data was entirely voluntary. They were assured that refusing to participate in the study would not result in any academic penalty or affect their course standing. All methods were conducted in accordance with the relevant guidelines and regulations as outlined in the Declaration of Helsinki.

Artificial intelligence utilization for article writing

ChatGPT (OpenAI) was used for language refinement under author supervision, and Grammarly® was applied for grammar correction. The authors take full responsibility for the integrity and originality of the work.

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[DOI: 10.66224/edcj.19.3.75]

Acknowledgment
The authors gratefully acknowledge the support of the Faculty of Medicine, Prince of Songkla University, Thailand.

Conflict of interest statement
The authors declare no conflict of interest.

Author contributions
The contributions of the authors are as follows. TE was responsible for conceptualization, funding acquisition, methodology, project administration, resources, software, supervision, validation, visualization, and writing review and editing. BR contributed to conceptualization, data curation, formal analysis, investigation, methodology, project administration, supervision, validation, visualization, writing original draft preparation, and writing review and editing. SN participated in conceptualization, formal analysis, methodology, supervision, and writing review and editing. SB was involved in conceptualization, supervision, and writing review and editing.

Funding
This research received no external funding.

Data availability statement
Data are owned by the University and cannot be shared publicly. Researchers seeking access may contact the corresponding author, subject to approval by the institutional ethics committee.

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