# Original Article

# Comparing Academic and Teaching Assessment Outcomes in Online vs. In-Person Dental Education During and After COVID-19

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## Abstract:

**Objective:** This study aimed to compare the academic performance and teaching evaluations of second-year dental students at Prince of Songkla University in a foundational course between two teaching formats: online learning during the Coronavirus Disease-19 (COVID-19) pandemic (2020-2021) and classroom-based learning after the pandemic (2022-2024).

**Material and Methods:** This retrospective study analyzed data from 50 students per academic year during online teaching (2020–2021) and in-person teaching (2022–2024). The online period consisted of one cohort (n=40), while the in-person period included three consecutive cohorts (approximately 40 students per cohort, n≈120). Quantitative data on academic scores and teaching evaluations were compared using descriptive statistics and independent t-tests (p-value<0.05, 95% CI). Qualitative data from open-ended feedback were anonymized, categorized, and thematically coded through a collaborative review by the research team.

**Results:** No significant differences were found in academic performance between online (mean±S.D.=78.4±6.2) and in-person teaching (79.1±5.8; $t$(98)=0.53, p-value=0.60). Teaching evaluations were consistently high across both formats, with nearly identical scores for Oral Biology I (4.88 vs. 4.89), Oral Biology II (4.75 vs. 4.80), and Dental Morphology (4.80 vs. 4.90). Thematic analysis of qualitative feedback revealed similar positive perceptions regarding clarity of instruction and accessibility of resources.

**Conclusion:** Both online and classroom-based teaching methods demonstrated similar effectiveness in delivering foundational dental education. These results underscore the adaptability of higher education systems and support the development of blended learning approaches. Such models can enhance educational resilience and respond effectively to future disruptions while accommodating diverse student needs.

**Keywords:** COVID-19, dental students, online teaching

## Introduction

Since the emergence of the Coronavirus Disease–19 (COVID–19) pandemic in Thailand in 2020, the country has experienced rapid increases in infection rates and mortality[1]. In response, significant adjustments were made to daily life, particularly in the education sector. Higher education institutions, including faculties of dentistry, were forced to suspend in–person teaching and shift toward online learning platforms. This change posed unique challenges, particularly for dental programs, which heavily rely on hands–on training and face–to–face instruction[2].

Dental education in Thailand aims to produce graduates with sound knowledge, appropriate skills, and professional attitudes. To maintain learning standards during the pandemic, universities adopted various online teaching innovations, such as Zoom, Google Classroom, LINE, and Facebook, to support student understanding of theoretical content and practical applications in dentistry[2,3]. Foundational courses, such as dental anatomy and oral biology, play a critical role in bridging preclinical knowledge with clinical application, linking core content in medicine, public health, and biomedical sciences[2].

Traditionally, most dental schools in Thailand deliver instruction in classroom settings using active learning strategies, including problem–based learning and student–centered activities[4]. However, during the COVID–19 outbreak, students were unable to attend on–site classes, and faculty members had to teach remotely to comply with public health protocols, including physical distancing and work–from–home policies. This unprecedented disruption necessitated the development of fully online instruction models, including online demonstrations, virtual labs, and remote discussion–based activities[5].

Some research indicates that online formats can achieve comparable academic outcomes and student satisfaction to traditional teaching, particularly in didactic courses[6,7]. Others highlight challenges related to practical skill acquisition, clinical training, and reduced interaction[8,9]. Recent systematic reviews further suggest that while online learning is feasible and well–accepted, blended or hybrid approaches may optimize both cognitive and psychomotor skill development[10].

In the academic years 2020–2021, the Ministry of Higher Education, Science, Research and Innovation in Thailand officially mandated that all universities implement online learning or consider modifying course schedules and assessments in accordance with the evolving situation[11]. This shift had profound implications for professional programs such as dentistry, which require both theoretical knowledge and extensive clinical training. In response, dental schools adopted synchronous and asynchronous online teaching through Zoom, Microsoft Teams, and Google Meet, as well as independent study methods involving case–based discussions, virtual simulations, and self–directed learning.

The National Education Plan of Thailand (2017–2036) emphasizes the importance of accessible, high–quality lifelong learning aligned with the philosophy of sufficiency economy and global challenges of the 21st century. In compliance with the standards set by the Dental Council of Thailand and the Dental Licensure Examination Center, dental education must ensure students achieve competency before clinical practice. Thus, instruction must integrate foundational biomedical sciences with the applied clinical skills relevant to patient care.

Although global studies have demonstrated that online dental education can achieve outcomes comparable to traditional formats, most evidence originates from Western or high–income countries, where digital infrastructure and learning resources are more advanced. In Thailand, while dental schools rapidly adopted online teaching during the COVID–19 pandemic, limited empirical data exist evaluating its effectiveness compared with subsequent in–person teaching. Moreover, cultural and institutional differences, such as patterns of student engagement, access to reliable

internet, and teaching practices, may influence the success of online learning in this context. Therefore, assessing both academic performance and student satisfaction in Thai dental education is essential to determine whether the international findings are applicable locally. This study addresses this gap by directly comparing online and in-person teaching in core preclinical dental courses, providing evidence to inform future curriculum planning and potential integration of blended learning approaches in Thailand.

Dental students' learning is shaped by multiple factors, including the quality of instruction, the learning environment, motivation, and readiness for e-learning[8,9]. Within higher education, a distinction is often made between *learning outcomes*, which specify the intended competencies students should acquire, and *educational outcomes*, which reflect measurable indicators such as course grades, examination results, and student evaluations[12,13]. In the present study, educational outcomes were chosen because they are routinely collected, objective, and comparable across academic years, thus enabling a robust retrospective analysis while preserving student anonymity. This approach provides a practical and reliable means to assess the effectiveness of different teaching modalities in dental education[6,10].

However, some studies indicate that the effectiveness of online learning is contingent on the student's level of engagement and the learning environment. Without adequate motivation or a collaborative classroom atmosphere, students may underperform or fail to meet learning outcomes, especially in courses that require active participation and hands-on practice[14]. Few studies in Thailand have compared online and in-person teaching outcomes in foundational dental courses.

This study aimed to compare the academic performance and teaching evaluations of second-year dental students at Prince of Songkla University in a foundational course between two teaching formats: online learning during the COVID-19 pandemic (2020-2021) and classroom-based learning after the pandemic (2022-2024).

## Material and Methods

This retrospective study employed both quantitative and qualitative approaches using data from second-year dental students enrolled in the Faculty of Dentistry, Prince of Songkla University. Data were extracted by academic support staff of the Division of Oral Biology and Occlusion, with all personal identifiers removed prior to analysis. Ethical no. EC 6604-025 was approved by the Faculty of Dentistry, Prince of Songkla University.

The study covered two academic periods: 2020-2021, during which teaching was fully online due to the COVID-19 pandemic, and 2022-2024, when classroom-based instruction was reinstated. The 2020-2021 period consisted of one cohort (n=40), while the 2022-2024 period included three consecutive cohorts (approximately 40 students per cohort, n≈120).

The focus was on three foundational courses under the responsibility of the Division:

1. Oral biology I: Development of Facial and Cranial Structures (3 credits).

2. Oral biology II: Health and Disease of the Teeth and Periodontium (3 credits).

3. Dental anatomy: Morphology of the Teeth (2 credits).

These foundational courses are compulsory for second-year dental students and provide essential knowledge to prepare for subsequent preclinical and clinical training. Only second-year dental students were included in this study because the selected courses—Oral Biology I, Oral Biology II, and Dental Anatomy—are part of the preclinical curriculum delivered exclusively in the second year. These courses provide foundational knowledge essential for subsequent preclinical and clinical training, making Year 2 students the most appropriate population for

evaluating the impact of online versus in–person teaching modalities. First–year students were not included as their curriculum focuses on foundational courses rather than core preclinical dental content.

Apart from the mode of delivery, the core teaching content for all three courses remained largely consistent between online (2020–2021) and in–person (2022–2024) periods. Minor updates were made to include recent literature and examples relevant to current clinical practice, but learning objectives, assessments, and credit hours were unchanged. The same teaching staff were responsible for delivering the courses across both periods, ensuring consistency in instructional approach. No significant differences in student sociodemographic characteristics (age, gender distribution) were observed between cohorts. Prior to online teaching, all faculty and students received training on the digital platforms and tools used, including video conferencing, learning management system functions, and access to recorded lectures, to ensure effective participation in online learning. The same faculty members were responsible for course delivery across both online and in–person periods. No significant differences in sociodemographic characteristics (age, gender) were observed between cohorts. All faculty and students received training on the digital platforms used for online instruction, including video conferencing, learning management systems, and access to recorded lectures.

Formative assessments, including quizzes, assignments, and class participation, were implemented consistently across both online (2020–2021) and in–person (2022–2024) cohorts. Quizzes and assignments followed the same schedule, content coverage, and grading criteria, regardless of delivery mode. Participation was evaluated based on engagement in synchronous sessions or in–class discussions, with comparable expectations for both online and classroom settings. This approach ensured that all cohorts experienced equivalent formative assessment opportunities, allowing fair comparison of academic performance and learning outcomes.

### Data collection instruments

Quantitative data included academic performance (course grades) for the three targeted courses across the specified academic years. Additionally, teaching evaluation scores were obtained from the PSU Teacher Evaluation System, a standardized evaluation system managed by the Education and Innovation Learning Academy at Prince of Songkla University. Two types of evaluations were analyzed:

- Overall course satisfaction
- Teaching quality and learning environment

Each item in the evaluation was rated on a 4–point Likert scale:

1 : Needs Improvement,
2 : Satisfactory,
3 : Very Satisfactory,
4 : Excellent,

which was later converted into a 5–point average scale for comparison.

Each item in the teaching evaluation was originally rated on a 4–point Likert scale (1=Needs Improvement, 2=Satisfactory, 3=Very Satisfactory, 4=Excellent). For ease of interpretation and comparison across cohorts, scores were converted to a 5–point scale using a proportional transformation.

### Data analysis

Academic scores and teaching evaluation results were analyzed to compare online and in–person teaching formats. Independent t–tests (normality of the distribution) were conducted to compare group means, with significance set at p–value<0.05. In addition to $p$–values, effect sizes (Cohen's d) and 95% confidence intervals for mean differences were calculated to quantify the magnitude and precision of observed differences between groups.

For qualitative analysis, students' open-ended feedback from the course satisfaction surveys was categorized and analyzed thematically. The research team collaboratively reviewed the content and identified key themes. No personal student identifiers were included, and all data were anonymized. The researchers did not have access to the names of individual students as all evaluation data were extracted directly from the university's secure system.

## Results

During the 2020–2021 online period, courses were delivered using a combination of synchronous and asynchronous methods. Synchronous sessions included live lectures and discussion via video conferencing platforms, while asynchronous materials comprised recorded lectures, reading materials, and self-directed exercises. In addition, digital simulations and virtual demonstrations were used to support practical skill understanding.

Classroom-based teaching (2022–2024) returned to traditional face-to-face lectures, hands-on laboratory sessions, and small-group tutorials, while some online resources (recorded lectures and readings) were retained. No significant differences were found in academic performance between online (mean±S.D.=78.4±6.2) and in-person teaching (79.1±5.8; $t$ (98)=0.53, p-value=0.60). A comparison of academic performance between students enrolled in online learning (academic year 2020–2021) and those taught in traditional classroom settings (academic years 2022–2024) revealed no statistically significant differences across the three evaluated courses: Oral Biology I, Oral Biology II, and Dental Anatomy (Tables 1–3). The mean grades in each course were comparable between the two teaching modalities.

Further investigation through in-depth interviews by staff members revealed that one student exhibited low engagement during the online learning period and failed to submit course assignments. As a result, the student was required to repeat the second year of study in the following academic year due to unsatisfactory academic performance.

Teaching evaluations completed by students in both classroom-based (2022–2024) and online (2020–2021) cohorts showed no statistically significant differences in overall satisfaction scores for any of the three courses, as shown in Table 4. Students rated aspects such as the learning environment, instructional methods, and instructor effectiveness similarly across both delivery formats. The online teaching period (2020–2021) was limited to a single academic year, as this corresponded to the peak of the COVID-19 pandemic, when all classes were required

**Table 1** Distribution of grades for oral biology I by teaching format

| Grade | Score range (points) | Academic year 2020–2021 (n=45) | Academic year 2022–2024 (n=44) |
|---|---|---|---|
| A | ≥80.00 | 4 (8.9%) | 6 (13.6%) |
| B+ | 75.00–79.99 | 13 (28.9%) | 11 (25.0%) |
| B | 70.00–74.99 | 22 (48.9%) | 13 (29.5%) |
| C+ | 65.00–69.99 | 6 (13.3%) | 11 (25.0%) |
| C | 60.00–64.99 | 0 (0%) | 2 (4.5%) |
| D+ | 55.00–59.99 | 0 (0%) | 0 (0%) |
| D | 50.00–54.99 | 0 (0%) | 1 (2.3%) |
| E | <50.00 | 0 (0%) | 0 (0%) |
| **Total students** | — | 45 (100%) | 44 (100%) |

to shift to remote delivery. Once restrictions were lifted, classroom-based teaching was resumed and maintained across the subsequent two academic years (2022–2024). Therefore, the online modality is represented by one cohort (n=40), while the classroom modality encompasses three consecutive cohorts (n≈120). Including multiple classroom cohorts allowed for a more stable comparison and minimized the influence of year-to-year variation in student performance.

Analysis of the open-ended responses from the post-course satisfaction questionnaires (Table 5) indicated a mix of positive and negative feedback in both formats. However, no clear relationship was observed between students' qualitative feedback and their academic performance. That is, the tone or content of students' comments – whether favorable or critical – did not correspond with higher or lower course grades.

**Table 2**  Distribution of grades for oral biology II by teaching format

| Grade | Score range (points) | Academic year 2020–2021 (n=45) | Academic year 2022–2024 (n=44) |
|---|---|---|---|
| A | ≥80 | 5 (11.1%) | 8 (18.2%) |
| B+ | 75.00–79.99 | 6 (13.3%) | 14 (31.8%) |
| B | 70.00–74.99 | 22 (48.9%) | 15 (34.1%) |
| C+ | 65.00–69.99 | 11 (24.4%) | 5 (11.4%) |
| C | 60.00–64.99 | 1 (2.2%) | 1 (2.3%) |
| D+ | 55.00–59.99 | 0 (0%) | 0 (0%) |
| D | 50.00–54.99 | 0 (0%) | 1 (2.3%) |
| E | <50 | 0 (0%) | 0 (0%) |
| **Total students** | — | 45 (100%) | 44 (100%) |

**Table 3**  Distribution of grades for tooth morphology by teaching format

| Grade | Score range (points) | Academic year 2020–2021 (n=45) | Academic year 2022–2024 (n=44) |
|---|---|---|---|
| A | ≥80 | 6 (13.3%) | 3 (6.8%) |
| B+ | 75.00–79.99 | 17 (37.8%) | 14 (31.8%) |
| B | 70.00–74.99 | 17 (37.8%) | 19 (43.2%) |
| C+ | 65.00–69.99 | 5 (11.1%) | 7 (15.9%) |
| C | 60.00–64.99 | 0 (0%) | 0 (0%) |
| D+ | 55.00–59.99 | 0 (0%) | 1 (2.3%) |
| D | 50.00–54.99 | 0 (0%) | 0 (0%) |
| E | <50 | 0 (0%) | 0 (0%) |
| **Total students** | — | 45 (100%) | 44 (100%) |

**Table 4** The teacher evaluation of dental students who enrolled in Oral biology 1, Oral biology 2 and tooth morphology

| Course | Academic year 2020–2021 | Academic year 2022–2024 |
|---|---|---|
| Oral biology I | 4.88±0.15 | 4.89±0.12 |
| Oral biology II | 4.75±0.20 | 4.80±0.18 |
| Dental morphology | 4.80±0.18 | 4.90±0.10 |

**Table 5** The comment from dental student's questionnaire in academic 2021–2024

| Code | Theme | Frequency (n, %) | Representative quote |
|---|---|---|---|
| 1 | Course content | 5 (20) | "Online learning felt like onsite classes with opportunities for interaction and questions." (Student with B+ grades)<br>"The content was difficult. Studying consecutively in morning and afternoon sessions throughout the week was challenging." (Student with C+ grades) |
| 2 | Motivation and engagement | 10 (40) | "The instructor frequently asked questions during class, used effective teaching techniques, and held non-graded quizzes which helped me prepare and understand the material." (Student with A grades)<br>"The instructor was very approachable, creating a relaxed and enjoyable learning atmosphere that made the material easy to understand." (Student with A grades) |
| 3 | Care and support | 10 (40) | "Initially, I struggled to adjust and couldn't keep up with the pace due to lack of adequate equipment. However, the instructor was understanding and provided recorded videos that we could watch during designated times." (Student with A grades)<br>"I contracted COVID-19, but the instructor maintained contact and provided videos for review." (Student with B grades) |

## Discussion

The findings of this study indicate that there was no statistically significant difference in academic performance between dental students enrolled in online courses during the academic years 2020–2021 and those who studied in a traditional classroom setting during 2022–2024. These results align with previous research suggesting that student performance is not determined solely by the mode of delivery – online or in-person – but rather by the design of the instructional approach and the level of student engagement it fosters[2].

The foundational dental science courses evaluated in this study – Oral Biology I, Oral Biology II, and Dental Anatomy – are critical components of the preclinical curriculum. Oral Biology I and II cover the developmental biology of the craniofacial region, the structural anatomy of the teeth and related oral and facial tissues, as well as the pathophysiology of common oral diseases, such as dental caries, periodontitis, and pulpitis. Dental Anatomy, meanwhile, focuses on the morphology and physiology of all 52 teeth and their relationships with surrounding oral structures. These courses serve as the academic foundation for subsequent clinical training, underscoring the importance of maintaining instructional quality regardless of delivery mode, even amid public health disruptions. This observation is consistent with findings from Kang et al. (2015)[15], which

emphasized that curriculum continuity must be preserved under any circumstances, including pandemics.

An exceptional case emerged in the academic year 2021, where one student received a grade of "D" in all three courses. Upon follow-up, it was revealed that the student demonstrated poor engagement with online learning and failed to submit the required assignments. Moreover, this student and their family were affected by COVID-19 and faced financial hardship, which likely contributed to their academic difficulties and eventual repetition of the second year. This case highlights the influence of personal, health-related, and environmental factors on academic outcomes, beyond the scope of course delivery formats.

Student evaluations of teaching for all three courses yielded comparable satisfaction levels between the online and in-person formats. Many comments from students were constructive and positive, reflecting an appreciation for instructional methods that were clear, supportive, and actionable. These findings are supported by Schönwetter et al. (2006)[16], who noted that effective feedback, demonstrations, and teacher-student rapport contribute to positive learning experiences. Similarly, Stormon et al. (2019)[17] emphasized that empathy, accessibility, and practical examples can foster behavioral change and deeper engagement among students.

Although most students performed consistently across both online and in-person cohorts, a single outlier in the online cohort received lower grades ("D" level). This case likely reflects individual factors such as personal study habits, engagement, or challenges with digital tools, rather than shortcomings in the online teaching modality itself. Previous studies have noted that occasional low-performing students may appear more prominently in online courses due to variable self-regulation and digital readiness[8,9]. Importantly, this outlier did not significantly affect group averages or statistical comparisons, and the overall findings support that online learning can achieve academic outcomes comparable to traditional classroom teaching. Monitoring and providing additional support for students at risk in online settings is recommended to ensure equitable learning outcomes.

This study found no statistically significant differences in academic performance or student evaluations between online (2020–2021) and in-person (2022–2024) teaching formats for second-year preclinical dental courses. While the primary outcome suggests comparable effectiveness, several limitations should be considered. The sample size was relatively small, and data were collected from a single institution, limiting generalizability. Instructor-related variation, unmeasured student characteristics, and potential evaluation bias (e.g., students giving positive ratings regardless of learning outcomes) could also have influenced results. Baseline data on student preparedness prior to each teaching modality were not available, making it difficult to conclusively determine whether the learning method itself affected outcomes.

Despite these limitations, the findings support the feasibility of integrating online components into dental education. Post-pandemic studies increasingly report that blended learning models, combining asynchronous online resources with face-to-face instruction, enhance flexibility, engagement, and accessibility while maintaining academic performance[18,19]. Representative student feedback in this study highlighted the benefits of interactive online tools, timely access to recorded lectures, and supportive instructor engagement, which align with the emerging evidence from the blended learning literature.

Based on these insights, several recommendations can be made for future teaching practices. Institutions may consider adopting blended models for preclinical courses, investing in digital infrastructure, and providing training for faculty in online pedagogy. Further research is warranted to

explore long-term learning outcomes, the impact of blended approaches across multiple institutions, and strategies to support students with varying digital readiness. Future studies could also include baseline assessments and control for additional confounding factors to better isolate the effect of teaching modality.

Nonetheless, a strength of this study is its integration of both academic performance data and student evaluation feedback. This dual approach enables the data-driven refinement of teaching strategies and supports the development of educational innovations that foster self-directed and lifelong learning.

## Conclusion

The present study demonstrated that there were no statistically significant differences in students' academic performance between in-person and online learning formats across three core dental subjects: Oral Biology I, Oral Biology II, and Dental Morphology. Although one student who consistently underperformed in all subjects during the 2021 academic year required grade repetition, this appeared to be an isolated case associated with a lack of engagement in online learning. Furthermore, student evaluations of teaching showed no significant difference between the two instructional modalities. While open-ended feedback from students revealed both positive and negative comments regarding course delivery, no clear correlation was found between students' feedback and their academic performance. These findings suggest that, overall, the transition between online and in-person instruction did not adversely affect academic outcomes in the context of these foundational dental courses.

## Conflict of interest

No conflict of interest.

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