Resilience in Medical Education: Examining the Effects of the COVID-19 Pandemic on Pre-clerkship Curriculum Outcomes and Learner Perceptions at the University of Hawai'i John A. Burns School of Medicine

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Abstract

The transition to virtual learning formats during the COVID-19 pandemic necessitated substantial curricular adjustments to the University of Hawai'i John A. Burns School of Medicine. This study compares student satisfaction and academic performance between the pre-pandemic (up through March 25, 2020) and pandemic (after March 25, 2020) periods. Standard end of course surveys for first year (M1) and second year (M2) courses and exam scores were compared between the pre-pandemic and pandemic groups. The median exam scores for problem-based learning generally increased for M1 and M2 courses during the pandemic, whereas Anatomy scores showed variability with some declining and some remaining stable or inclining. End-course evaluations indicated a significant decrease in student-perceived effectiveness for PBL, Lecture and Anatomy during the initial pandemic period. However, survey ratings for the learning environment improved in later courses, suggesting adaptation over time. Notably, Anatomy exam scores and course ratings improved significantly later in the pandemic which may be attributed to the development of virtual resources and early introduction of in-person sessions. This study provides insight into the dynamic effects of the pandemic on medical education, enhancing understanding of student experiences and academic outcomes during this challenging time. This study underlines adaptations in the curriculum that were effective, highlighting the resilience of the curriculum and students in maintaining quality education during the pandemic.

Keywords

Pandemic; Curriculum changes; Medical students; Medical education; Virtual education

Abbreviations

AY = academic year
AAMC=Association of American Medical Colleges
COVID-19 = coronavirus disease of 2019
IQR= interquartile range
JABSOM = John A. Burns School of Medicine
PBL= problem-based learning
PPE=personal protective equipment
SARS =severe acute respiratory syndrome
UH= University of Hawai'i

Introduction

In March of 2020, the coronavirus disease of 2019 (COVID-19) pandemic significantly changed medical student curriculums across the world. Nationally and internationally, clinical education was abruptly halted as students were removed from clinics and hospitals for varying periods of time due to concern for patient and student safety, and shortages of personal protective equipment (PPE) and COVID-19 tests.[1-4] Pre-clerkship lectures were replaced with virtual lectures and small group learning experiences were attempted to be replaced by online forums.[3] However, online forums had limited interaction between students resulting in reduced collaboration.[3,5] This conversion of in-person to online was particularly impactful at the University of Hawai'i (UH) John A. Burns School of Medicine (JABSOM), due to the format of the curriculum.

The pre-clerkship medical school curriculum at JABSOM is primarily a problem-based learning (PBL) approach where students learn from interacting with each other in small groups. The first 2 years of the curriculum, "pre-clerkship years," consists of problem-based learning cases, lectures, practical labs in anatomy, and clinical skills largely in the classroom setting. In the final 2 years of medical school, the "clinical/clerkship years", the curriculum involves hands-on practice of patient care in clinical environments. From March 2020 to March 2021 even traditionally hands-on experiences such as anatomy lab, clinical skills, and standardized patient exercises were modified into virtual or socially distanced experiences due to pandemic restrictions. Students were removed from clinical rotations due to concerns about PPE shortages, student and patient safety, and complying with the recommendations from the Association of American Medical Colleges (AAMC).[6] This dramatic change to the medical school curriculum was unprecedented at JABSOM.

It is important to investigate the impact that these changes may have had on student satisfaction and knowledge acquisition. Historically, disruptions to medical student education have been shown to affect student performance, as shown in a study where student performance declined after disruptions due to Hurricane Katrina.[7] Singapore drew on past experiences with the severe acute respiratory syndrome (SARS) outbreak in 2003 and leveraged technology during the COVID-19 pandemic to adjust their curriculum which included e-learning platforms, videoconferencing and online resources, and involving students

and residents in crisis relief.[8,9] An international study found that the COVID-19 pandemic negatively impacted medical student education, primarily due to the reduction in face-to-face lectures, conferences, simulations and tutorials.[10]

The purpose of this study was to retrospectively compare both student satisfaction with the restructured pre-clerkship courses pre-pandemic and during the COVID-19 pandemic, as well as the final (summative) scores of pre-clerkship exams including PBL and lecture, and anatomy exams.

Methods

JABSOM's pre-clerkship years encompass the first 2 years. The first year (M1) courses in the fall include health and illness (hereby labeled by class year, month of end-course exams, and year when noted: M1 Sep) & cardiovascular and pulmonary problems (M1 Dec). In the spring, the courses are renal and hematologic problems (M1 Mar) & endocrine and gastrointestinal problems (M1 Jun). The second pre-clerkship year (M2) consists of 2 PBL-based courses: locomotor, neurological and behavioral problems in the fall (M2 Dec), and life cycle in the spring (M2 Mar). Students also take at least 1 summer elective between M1 and M2 years, but the elective was not included in this study. Anatomy is included as part of the courses from the second fall course during M1 year (M1 Dec) through the fall M2 course (M2 Dec). Due to the timing of the courses with the start of the COVID-19 pandemic, the first course affected was the last course in the first year (M1 Jun'20), followed by the next academic year: M1 Sep'20, M1 Dec'20 and M2 Dec'20 in the fall semester and M1 Mar'21 and M2 Mar'21 in the spring semester.

Each course had end-course exams and end-course surveys conducted (Table 1).

This study adapted a standard instrument created and administered by the Office of Medical Education to evaluate the pre-clerkship curriculum. Questions on individual student satisfaction with the learning environment and overall course effectiveness were analyzed. The survey used a 4-point Likert Scale with 1=strongly disagree/very ineffective; 2=somewhat disagree/somewhat ineffective; 3=somewhat agree/somewhat effective; 4=strongly agree/very effective. The surveys were anonymous and distributed at the conclusion of each course to gather comprehensive feedback regarding various aspects of the educational experience.

Percentile exam scores for the pre-clerkship courses were evaluated, including the final combined PBL and Lecture exams for each course, and the anatomy and neuroanatomy exams, when administered. Of note, the PBL and Lecture exams are more weighted to PBL (80%) than Lecture (20%) except for M2 Dec which is split 50/50.

To identify changes in student satisfaction with their pre-clerkship courses between the pre-pandemic and pandemic groups, data from academic years (AY) 2018-2019, 2019-2020 and 2020-2021 were analyzed. For the exam results and survey data, the pre-pandemic group consisted of students enrolled in courses that were completed prior to Hawai'i's governor's "stay at home, work from home" orders that went into effect March 25, 2020[11]. The pandemic group was defined as students who completed their courses after March 25, 2020. This designation allows for a clear distinction between the pre-pandemic and pandemic groups. Survey data was only analyzed for the first pandemic year to assess the immediate effect of the pandemic.

Statistical Analysis

Descriptive statistics were used to summarize exam scores with median and interquartile range (IQR), and survey evaluation results with mean and standard deviation (SD). The Mann-Whitney test was used to compare exam scores between pre-pandemic and pandemic groups. Ordinal logistic regression model was used to compare Likert scale survey results between pre-pandemic and post-COVID start status. All statistical analyses were performed using SAS software version 9.4 (SAS Institute Inc., Cary, NC). A 2-tailed *P*-value <.05 was considered to be statistically significant.

This study was approved by the University of Hawai'i Institutional Review Board as an exempt study (protocol number 2022-0738).

Table 1. Course, Exams and Survey Evaluation Items Analyzed in This Study

Courses	Exams	Survey Evaluation Items
M1 month'year	PBL (PBL and Lecture)	PBL Lecture
	Anatomy (except M1 Sep'20)	Anatomy
M2 month'year	PBL (PBL and Lecture)	PBL Lecture
	Anatomy (only M2 Dec'20)	Anatomy
	Neuroanatomy (only M2 Dec'20)	Neuroanatomy

Results

Student Examination Results

There were significant increases in median scores of the PBL/Lecture exams in the pandemic group when compared to the pre-pandemic group, as well as two other first year courses. In contrast, there was a significant decrease in the median PBL/Lecture exam score between groups for the first post-pandemic second-year course and no change in two other courses. In anatomy, there was a significant decrease in exam scores for pandemic vs pre-pandemic groups for first year courses, but a significant increase for the second year course. (Figure 1)

Student Survey Results

Excluding neuroanatomy, student-perceived effectiveness of the anatomy component of the course on the pre-clerkship end-course survey had a similar pattern to exam performance with a decrease in M1 courses and increase in the M2 course. In contrast to the anatomy component, student-perceived effectiveness of the PBL component of the course, which composed the majority of the exam content, did not change or decreased in the first 3 courses early in the pandemic (M1 Jun'20, M1 Sep'20, M1 Dec'20), while their exam scores increased. (Figure 1 and 2)

For the broader survey items about the whole course and learning environment, there were significant rating decreases in multiple survey items for the pandemic group in the first 4 courses after the start of the pandemic. This decrease was particularly notable for the survey item "Effectiveness of the overall course experience". The M1/M2 Mar'21 courses, which started almost 9 months after the start of the pandemic, had either no significant changes or had significant rating increases compared to pre-pandemic, with the most notable being, "The learning environment was supportive" which had significant rating increases for both courses. (Figure 3)

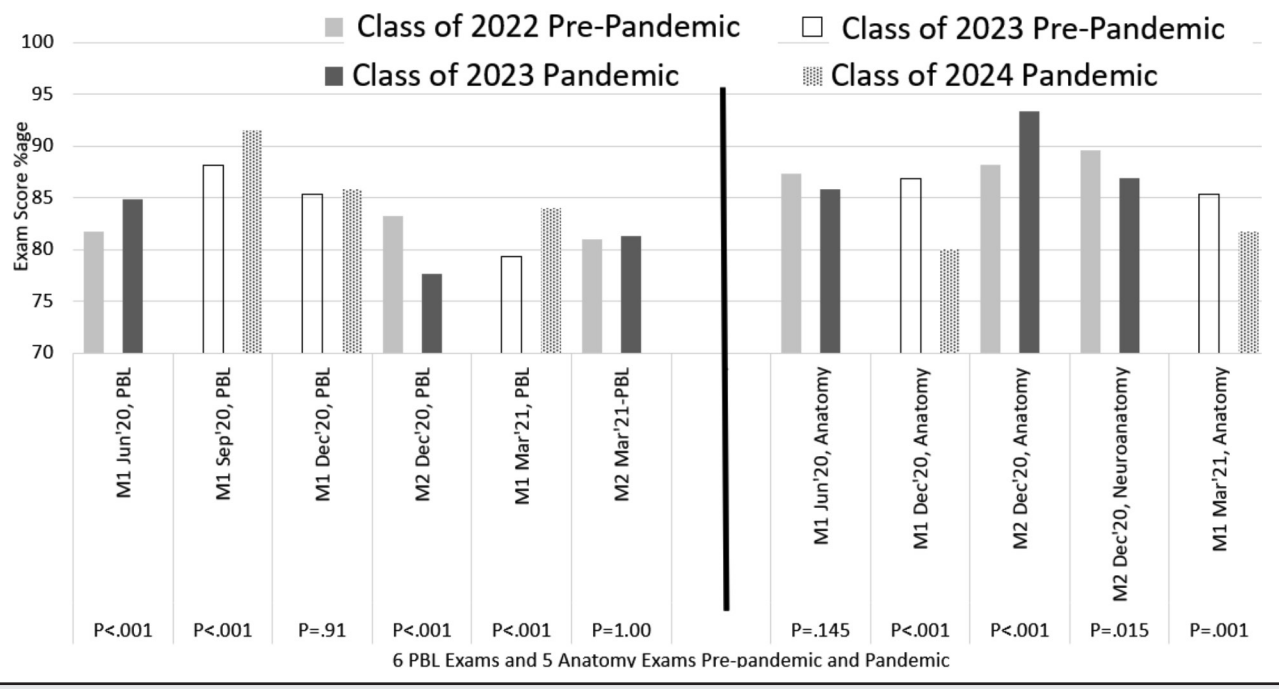

Figure 1. Median of Pre-pandemic and Pandemic Cohort Exam Scores Placed in Order of Pandemic Timeline

Problem Based Learning (PBL) refers to PBL and Lecture exam. M1 refers to first year medical student courses, M2 refers to second year medical student courses. Mann-Whitney test was used for statistical analysis. PBL exams are to the left of the black vertical line. Anatomy exams are to the right of the vertical line. Each pairing represents a separate course.

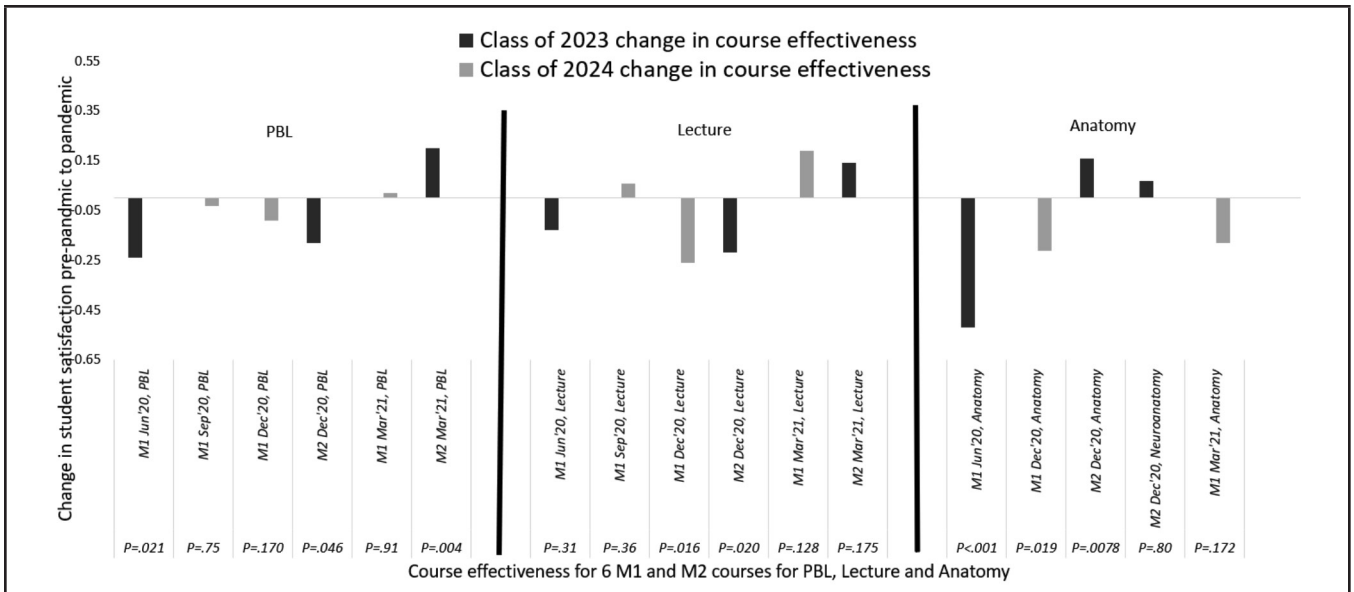

Figure 2. Pre-clerkship End-course Evaluation Change in Student-perceived Effectiveness of PBL, Lecture and Anatomy Experiences Pre-pandemic vs Pandemic, Placed in Order of Pandemic Timeline

M1 refers to first year medical student courses, M2 refers to second year medical student courses. Ordinal logistic regression model was used for statistical analysis. Vertical bars are used to separate overall effectiveness of 3 items: Problem Based Learning (PBL), Lecture and Anatomy.

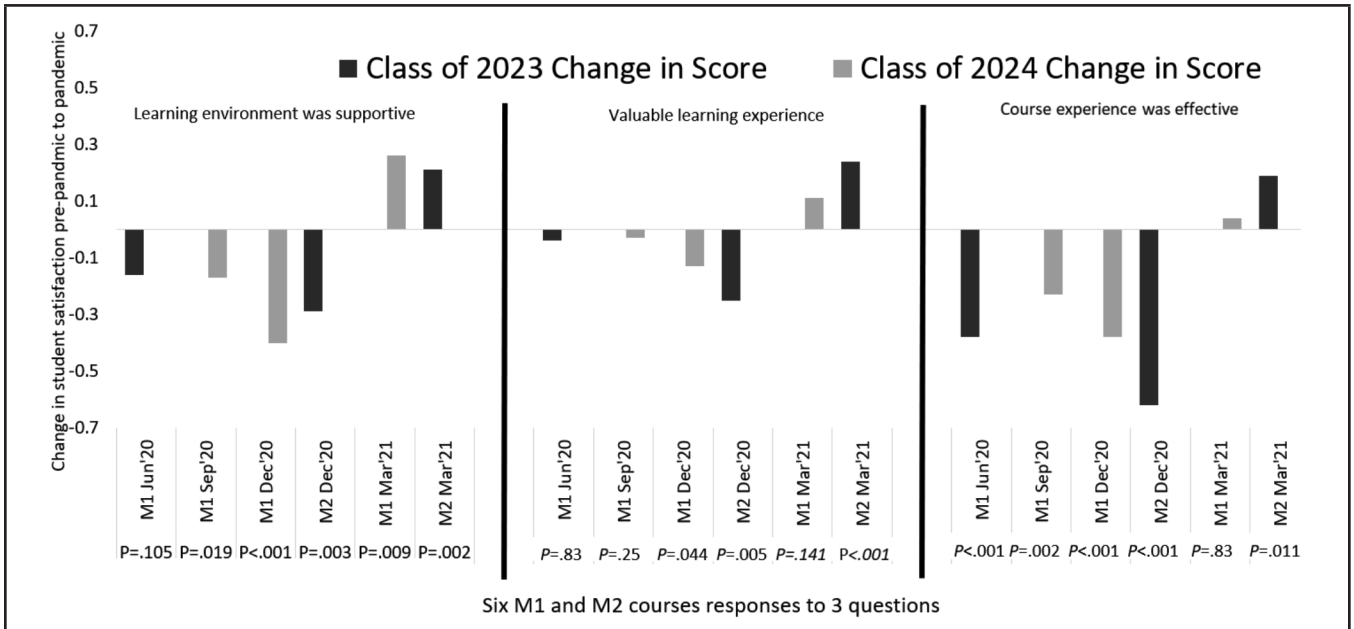

Figure 3. Pre-clerkship End-course Evaluation Ratings Change Pre-pandemic vs Pandemic, Placed in Order of Pandemic Timeline

M1 refers to first year medical student course, M2 refers to second year medical student course. Ordinal logistic regression model was used for statistical analysis. Vertical bars are used to separate the 3-course evaluation questions for the 6 courses.

Discussion

Changes that occurred during the COVID-19 pandemic included moving classes to virtual formats and canceling in-person activities. Nationally, learners appeared to gravitate toward online learning, and virtual lectures or recordings were fairly well received.[5] However, collaboration was reduced due to limited interaction between students in online forums.[3,5] These can have effects on student well-being and life satisfaction which could lead to increased burnout.[12] At JABSOM, the transition to virtual learning overall led to a decline in student's perceived effectiveness of the course in the first 4 pre-clerkship courses that occurred after the start of the pandemic, affecting the Class of 2023 and 2024. In particular, the Class of 2023, who had a "normal" pre-pandemic medical school experience for the first 3 quarters of their first year of medical school, rated their first 2 courses after the start of the pandemic (M1 Jun'20 and M2 Dec '20) lower for survey items such as the effectiveness of the overall course experience, presence of a supportive learning environment, and effectiveness of the overall anatomy experience (M1 Jun'20 only).

Anatomy in particular, can be difficult to teach in a virtual format.[1,4,14] The initial first-year course that post-dated the start of the pandemic (M1 Jun'20) had anatomy sessions that were converted to completely virtual and had the lowest ratings for "anatomy lab". Thus, anatomy was deemed a priority for early transition and returned to socially distanced in-person instruction (October 2020) before other concurrent PBL and Lecture sessions (January 2021). For the class of 2023, their second course after the start of the pandemic (M2 Dec'20) started in August, several months into the pandemic. This time frame allowed the anatomy department to develop virtual anatomy resources, and students had access to freely available educational tools. These changes likely contributed to the improved anatomy exam scores and ratings.

The statistically significant changes in exam performance and survey ratings contrasts with a previous study that showed no statistical difference in examination scores and satisfaction with the learning experience, but that study compared only the first basic science course for first year students,[13] as opposed to this study comparing all courses over multiple academic years. In this study, the end-course survey ratings increased significantly for "learning environment was supportive" in courses which ended 12 months after the pandemic restrictions were put into place, and thus the last courses analyzed as the pandemic group. This suggests that students were able to adjust to the new learning environment implemented during the COVID-19 restrictions. The gradual phased transition back to in-person may have contributed to the students feeling supported in the pandemic learning environment.

Interestingly, the pandemic cohort excelled in first-year final exams. This could be due to the Class of 2023 being familiar with first year medical school exam expectations from the first 3 courses prior to the pandemic, the Class of 2024 having some experience with pandemic-related social changes prior to starting medical school or less pandemic related stress in the students overall. Without reassurance from their upperclassmen about exam expectations, and additional time due to the postponement of in-person clinical skills on physical exam, the Class of 2024 may have adopted a more intensive study schedule resulting in better exam scores. Additionally, students may prefer virtual lectures and online small group learning may be conducive to their learning style.[4,5] This was also promoted through many free or discounted medical education resources provided by multiple organizations during the early pandemic.[15] However, the exam performance did not extend to the beginning of the second year. This could be due to the increase in course length, content and complexity of this particular course, and the different weighting of PBL (50%) and Lecture (50%) content. Indeed, the student ratings of both PBL and Lecture effectiveness were significantly decreased for M2 Dec'20. Another factor could be the absence of in-person study groups for collaborative learning.

Advantageously, a curricular addition that started in AY 2020-2021, right after the start of the pandemic, was the introduction of the learning communities program. The learning communities foster the building of connections between peers within JABSOM and the larger community. Walters et al recommended that learning communities are an important initiative to support student learning during the pandemic.[1] Such communities were shown to be important for mental well-being, resiliency, and mentorship, and JABSOM learning communities structure and activities are similar to those published by Zheng et al.[16] Although the JABSOM learning community launch was planned before the pandemic, it fortunately provided crucial connections for students when social distancing measures had been implemented. The learning communities might have contributed to the rise in some of the satisfaction scores for the learning environment in the pandemic cohort, even though students faced additional restrictions in their learning environment such as social distancing and virtual learning.

Conclusion

The transition of pre-clerkship courses to virtual formats due to the COVID-19 pandemic overall led to a general increase in exam scores during most courses, except the first exam of 2nd year which is a more difficult course with different grading weights. Additionally, scores in anatomy courses also declined, likely reflecting the challenges of mastering anatomy in a virtual environment. However, the exception was the 2nd year anatomy course, where more innovative resources were developed during the pandemic, resulting in higher scores than pre-pandemic. Initial shifts to virtual formats also decreased satisfaction with key components of the courses, including PBL and anatomy. However, this study also highlights the process of resiliency and recovery, as ratings progressively improved as

adaptations to the virtual format and resumption of in-person activities took place. Significantly improved satisfaction scores were observed in the final courses analyzed in this study in the pandemic group. Importantly, this study reveals that negative objective and subjective measures associated with COVID-19 pandemic curriculum changes lasted less than a year. More long-term effects such as residency preparedness and specialty choice will be monitored.

A pivotal lesson learned from this experience is the resilience and adaptability of JABSOM's medical education in the face of unprecedented challenges. The progressive improvement in satisfaction scores following adjustments to virtual formats and the resumption of in-person activities underscores the importance of flexibility and ongoing adaptation. Moving forward, these insights can inform the development of contingency plans for future disruptions, ensuring that medical education remains responsive and effective under varying circumstances. Finally, the transient nature of the observed negative impacts highlights the capacity for the medical education community to navigate and overcome challenges, allowing for more informed decision-making and strategic planning in the post-pandemic era.

Conflict of Interest

None of the authors identify a conflict of interest.

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