Synthesis Across Disciplines: Creating Integrated Clinical Vignettes for Pre-clerkship Medical Training

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ABSTRACT

INTRODUCTION: Case-based learning strategies have been shown to enhance student engagement, promote active learning, and improve problem-solving ability by simulating clinical scenarios. However, few interventions focus specifically on integration within basic science domains, and even fewer have been student-led and implemented longitudinally throughout a pre-clerkship curriculum. This study evaluates the impact of a student-led initiative that incorporated interdisciplinary clinical vignettes into first-year medical coursework at a large allopathic medical school in the United States.

METHODS: Vignettes were designed to align with curricular themes across anatomy, histology, and pathology for each of the 13 curricular blocks. First-year medical students completed post-intervention surveys measuring confidence in applying course material, integration between concepts, and perceived relevance of the vignettes.

RESULTS: Across all blocks of vignettes, the majority of respondents agreed that the vignettes allowed them to think about lecture material in a new way (98%; 57% strongly agree, 41% somewhat agree), felt relevant to current material (95%; 73% strongly agree, 22% somewhat agree), and related the concepts from their anatomy, pathology, and histology courses (94%; 69% strongly agree, 25% somewhat agree). The analysis of our survey data confirms that students' confidence in exam material increased after the use of the clinical vignettes. This was statistically significant for every discipline and across the vast majority of blocks.

CONCLUSIONS: Integrated vignettes fostered interdisciplinary learning and improved confidence in applying pre-clerkship knowledge across disciplines. This low-resource, peer-led model may serve as an adaptable tool to support early clinical reasoning and integrative learning across foundational science curricula.

KEYWORDS: Medical education; clinical vignettes; interdisciplinary learning; curriculum integration; pre-clerkship training

INTRODUCTION

The pre-clerkship curriculum is the foundation of the medical student's career as a future physician. It introduces them to the basic sciences such that, as students transition into the clinical sciences during their third and fourth years, they are well-equipped with the knowledge that will be applied to their future patients. The medical profession necessitates that this foundation be simultaneously wide and deep. It must extend to include a variety of topics across several specialties, from histology to anatomy to microbiology. While this compartmentalization supports subject-specific depth, it frequently lacks the contextual integration that mirrors the complexity of clinical practice. As a result, students may struggle to synthesize across disciplines, a skill crucial for transitioning into the clinical years and beyond.

The ability to connect structure with function and textbook learning with clinical decision-making is not inherently intuitive and must be deliberately cultivated. Yet, current pedagogical strategies often emphasize knowledge acquisition over integration, leaving a critical educational gap in helping students bridge theory to practice during pre-clerkship training.[1] This gap can contribute to lower confidence, diminished retention, and difficulty applying basic science knowledge in clinical reasoning tasks.[2,3]

Case-based and vignette-driven learning strategies have been shown to enhance student engagement, promote active learning, and improve problem-solving ability by simulating real-world scenarios.[4,5] A meta-analysis of eight studies indicates that case-based approaches lead to greater physician competency years after graduation.[6,7] Furthermore, curricular models that intentionally integrate content across disciplines lead to stronger learner satisfaction, improved diagnostic accuracy, and greater preparedness for medical content encountered in the clerkship phase.[8,9] However, few interventions focus specifically on integration within basic science domains, and even fewer have been student-led and implemented longitudinally throughout a pre-clerkship curriculum.

In this study, we sought to address this unmet need by developing and distributing a series of integrated clinical vignette sets designed to promote cross-disciplinary synthesis between anatomy, histology, and pathology. These vignettes were crafted by both upperclassmen and first-year medical students for eight blocks of a first-year medical school curriculum and provided in advance of each block's summative exam. Each vignette combined radiologic and gross anatomical images, microscopic pathology, and clinical narratives to encourage students to apply knowledge in a cohesive and contextualized format.

We hypothesized that this intervention would improve students' perceived confidence across disciplines and enhance their ability to view pre-clerkship content in novel, clinically relevant ways. Specifically, we investigated whether integrated vignettes (1) increased students' confidence in their understanding of core disciplines; (2) encouraged novel approaches to the material; and (3) supported perceived relevance to the curriculum. This paper presents a quantitative and qualitative evaluation of that initiative, with the goal of informing future strategies for meaningful integration in medical education.

METHODS

A set of clinical vignette scenarios (3–4 per block) was designed for each of the 13 blocks of the first-year curriculum at a large allopathic medical school in the United States. Content integrated content and images (slides, radiology images, cadaver images) to synthesize content across key themes in anatomy, histology, and pathology. For example, a case pertaining to a child with lung disease may incorporate chest X-rays (anatomy), microscope slides of alveoli (histology), and gross images of the diseased lung (pathology). The student must then incorporate the relevant information from each visual modality as it relates to the clinical picture and questions asked in the vignettes.

Vignettes were reviewed by professors of the relevant specialty to ensure accuracy. Each block of the curriculum lasted approximately three weeks and culminated in a non-cumulative multiple-choice exam. Every block, the new slide deck was distributed to the 144 first-year students via the class email listserv one week before their exam. Students completed 13 blocks of their curriculum by the end of their first year. Vignettes were provided for 8 of their 13 blocks (Scientific Foundations of Medicine [SFM] Exams 1–4, Brain Sciences Exams 1–3, and Supporting Structures). These exams comprised the portions of the curriculum which included at least two of the three core courses (anatomy, pathology, histology) the vignettes sought to integrate. Similarly, the 8 blocks spanned both the students' SFM and Organ Systems (Brain Sciences and Supporting Structures) phase of the pre-clerkship medical school curriculum. Individual feedback from respondents was taken into consideration to make each block resource more applicable to the lecture or anatomy lab material. After each open-ended question posed to learners, there was an in-depth explanation of the correct answer and link to the relevant lecture for their reference.

At the end of the deck, there was a link to an anonymous Qualtrics survey for students to complete. This post-intervention survey asked students to retrospectively rank their confidence pre-intervention and then post-intervention. The survey was approved by our institution's IRB prior to dissemination. Student participation in the survey was voluntary and asked students to rank their confidence on a Likert scale (0–100) in material before and after the practice set, as well as evaluate their attitudes toward the practice material. There was one open-response question for students to provide additional thoughts or bring errors in the resource to the attention of the researchers.

After each block, statistics regarding students' attitudes toward the resource were compiled and compared to the previous blocks. Statistical analyses, including one-way T tests and ANOVA tests, were performed to determine if there was a difference in students' survey responses pre- and post-intervention. After the last block, aggregated data was analyzed to determine the overall efficacy of the intervention.

RESULTS

In total, the survey received 188 responses, of which 161 responses (85%) evaluated our key study objectives: presentation of material in a new way, relevance to current material, and concept integration. Across all categories, the majority of respondents agreed that the vignettes allowed them to think about lecture material in a new way (98%; 57% strongly agree, 41% somewhat agree), felt relevant to current material (95%; 73% strongly agree, 22% somewhat agree), and related the concepts from their anatomy, pathology, and histology courses (94%; 69% strongly agree, 25% somewhat agree) [**Figure 1**]. When comparing the three study objectives between the SFM and Organ Systems Portion, differences were noted in terms of thinking about material in a new way. While respondents agreed the vignettes made them think about material in a new way (98% and 97%, respectively), 63% of respondents during SFM strongly agreed the resource allowed them to encounter the material in a

Figure 1. Student responses regarding the extent to which the clinical vignettes: (1) presented material in a new way, (2) were relevant to current coursework, and (3) facilitated integration of concepts across disciplines.

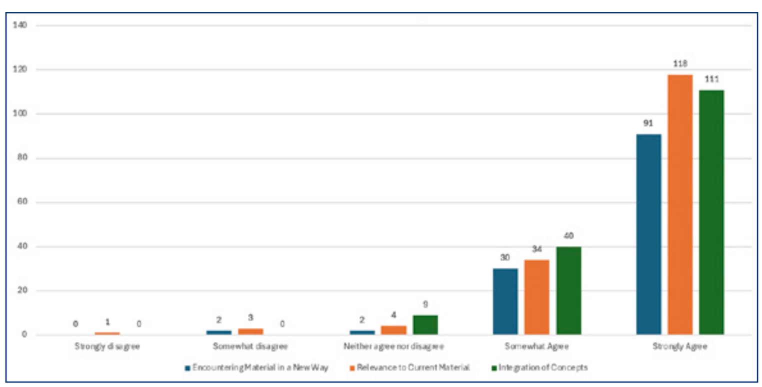


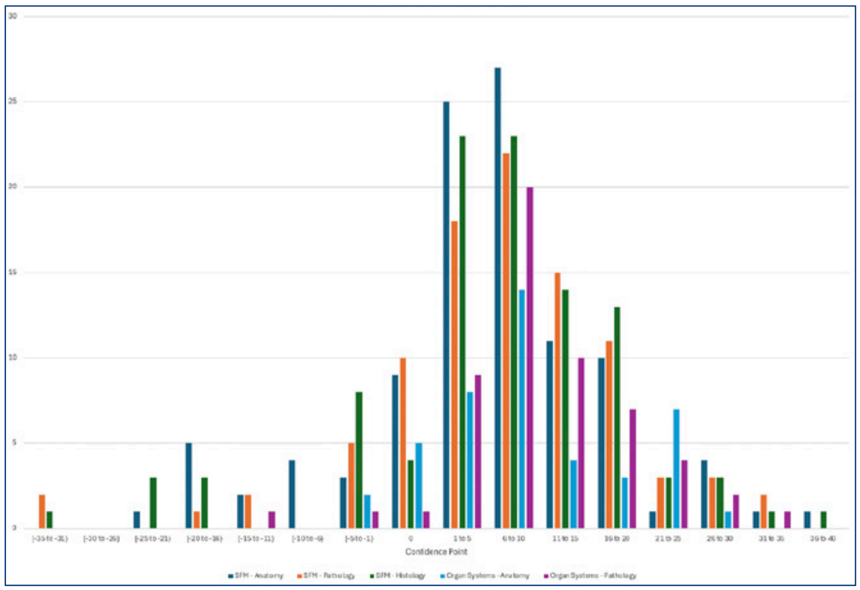
Table 1. Mean change in confidence scores with corresponding 95% confidence intervals, stratified by course (Anatomy, Pathology, and Histology) and curricular phase (Scientific Foundations of Medicine [SFM], Organ Systems, Brain Sciences, and Supporting Structures).

Exam	Responses	Anatomy	Pathology/Physiology	Histology
Total	176	7.43 (95% CI 5.78–9.07)*	8.05 (95% CI 6.27–9.83)*	6.26 (95% CI 3.78–8.74)*
SFM	105	6.21 (95% CI 4.19–8.35)*	6.56 (95% CI 4.40–8.84)*	6.26 (95% CI 3.78–8.74)*
Organ Systems	71	10.20 (95% CI 8.07–12.73)*	11.70 (95% CI 9.62–13.77)*	N/A
Brain Sciences	60	10.03 (95% CI 7.42–12.63)*	11.27 (95% CI 9.21–13.32)*	N/A
Supporting Structures	11	11.57 (95% CI 5.95–17.20)*	14.71 (95% CI 6.84–22.59)*	N/A

new way compared to 47% of respondents during Organ Systems. This finding was reversed when rating relevance of material, with 67% of respondents strongly agreeing that the material was relevant during SFM; whereas during Organ Systems, 87% of respondents strongly agreed the material was relevant. Interestingly, respondents noted the integration of concepts remained similar between the two phases of the curriculum.

Respondents were asked to rank their confidence from 1–100 in their ability to perform well on the exam for the three courses integrated into the clinical vignettes (Anatomy, Pathology/Physiology, And Histology). Overall, confidence increased significantly across all three domains: Anatomy (mean increase = 7.43; 95% CI: 5.78–9.07), Pathology/Physiology (mean increase = 8.05; 95% CI: 6.27–9.83), and Histology (mean increase = 6.26; 95% CI: 3.78–8.74) [**Table 1**]

Figure 2. Distribution of respondents grouped by 5-point intervals of change in confidence, presented across all combinations of exam domains (SFM and Organ Systems) and individual courses (Anatomy and Pathology). Histology is excluded because it is only taught during SFM. *Denotes statistical significance at P < .0001.



When stratified by curriculum phase, significant increases in confidence were observed in Anatomy and Pathology across all phases. Within the SFM phase, confidence increased in Anatomy by 6.21 points (95% CI: 4.19–8.35), in Pathology by 6.56 points (95% CI: 4.40–8.84), and in Histology by 6.26 points (95% CI: 3.78–8.74). In the Organ Systems phase, confidence increased in Anatomy by 10.20 points (95% CI: 8.07–12.73) and in Pathology by 11.70 points (95% CI: 9.62–13.77). Within the Brain Sciences subunit, increases were similarly observed in Anatomy (10.03; 95% CI: 7.42–12.63) and Pathology (11.27; 95% CI: 9.21–13.32). Finally, in the Supporting Structures subunit, the greatest increases were noted: 11.57 points in Anatomy (95% CI: 5.95–17.20) and 14.71 points in Pathology (95% CI: 6.84–22.59). All reported changes were statistically significant when comparing pre- to post-vignette confidence (P <0.0001).

To assess the distribution of confidence changes and compare vignette efficacy across curriculum phases, we stratified responses from the SFM and Organ Systems blocks and binned confidence change scores into 5-point intervals (ranging from –35 to 40). Among the 104 SFM Anatomy respondents, 76.9% reported an increase in confidence, with 50.0% noting a gain of 1–10 points. Similarly, of the 94 SFM Pathology respondents, 78.7% reported increased confidence, with 42.5% falling within the 1–10 point range.

In the Organ Systems phase, 84.1% of the 44 Anatomy respondents experienced a confidence increase, with 50.0% reporting gains of 1–10 points. Confidence improvements were even more pronounced in Organ Systems Pathology: among 56 respondents, 94.6% reported increased confidence, and 51.8% reported a gain of 1–10 points [**Figure 2**].

Student confidence prior to resource use impacts the degree of confidence change respondents report. To further investigate how baseline confidence influenced the effectiveness of the vignettes, we stratified respondents based on their pre-vignette confidence levels (<60, 60–80, and >80). Furthermore, we categorized the degree of confidence level change into 5 groups—substantial decrease, modest decrease, no change, modest increase, and substantial increase. These are defined as follows: substantial is a gain or loss of 10 or more confidence points, modest is a gain or loss of 1 to 10 points, and no change is 0 confidence point change. The majority of respondents with low initial confidence in both Anatomy and Pathology experienced either a modest or substantial increase in confidence, with 62.1% and 54.5%, respectively, reporting a modest increase and an additional 25.0% and 30.3% reporting a substantial increase [**Figure 3**]. In contrast, respondents with high baseline confidence were more likely to report no change or only a modest improvement. For example, 45.2% of students with high confidence in Anatomy and 41.4% in Pathology reported only a modest increase, while 34.3% and 37.9%, respectively, experienced no change [**Figure 3**].

To investigate how baseline confidence influenced the effectiveness of the vignettes, we stratified respondents across both total and course-specific domains. Respondents with lower initial confidence (<60) demonstrated the greatest mean increase in total confidence (13.71; 95% CI: 11.24–16.18), followed by those in the 60–80 range (8.24; 95% CI: 6.85–9.63). Respondents who began with high confidence (>80) reported minimal changes (0.99; 95% CI: –0.79 to 2.77). The differences between all groups was significant (>60 v. 60-80, p<0.0001; >60 v. 80+, p<<0.0001, (60–80 v. 80+, p<0.0001).

This trend held across both Anatomy, Pathology, and Histology. In Anatomy, students with initial confidence <60 showed a mean increase of 15.16 points (95% CI: 11.28–19.04), compared to 7.06 (95% CI: 4.26–9.86) and 2.70 (95% CI: 0.96–4.44) for those in the 60–80 and >80 groups, respectively. Similarly, in Pathology/Physiology, students with confidence <60 experienced a mean increase of 11.03 (95% CI: 7.16–14.90), while those with confidence between 60–80 improved by 9.52 points (95% CI: 7.62–11.42), and those above 80 saw a smaller gain of 2.17 points (95% CI: 0.37–3.97). In Histology, students with confidence <60 experienced an average increase of 14 (95% CI: 8.79–19.21), while those with confidence between 60–80 improved by 8 points (95% CI: 4.95–11.05), and those above 80 saw a decrease of 1.59 points (95% CI: –5.88–2.7) [**Table 2**]. When comparing confidence changes between pre-exam confidence groups within the same curriculum segment (e.g., Anatomy <60 vs. Anatomy 60–80), the only comparison that did not reach statistical significance was between the Pathology groups with baseline confidence >60 and 60–80 (p = 0.23). Additionally, one-way ANOVA's revealed that there was not a statistically significant difference in confidence interval change between each course at each initial confidence interval (Anatomy: $F(2, 86) = 0.51$, $p = 0.60$; Pathology: $F(2, 190) = 1.13$, $p = 0.32$; Histology: $F(2, 113) = 0.1.87$, $p = 0.16$).

Figure 3. Distribution of students within each pre-vignette confidence group who experienced a substantial decrease, modest decrease, no change, modest increase, or substantial increase in confidence following vignette exposure, stratified by course.

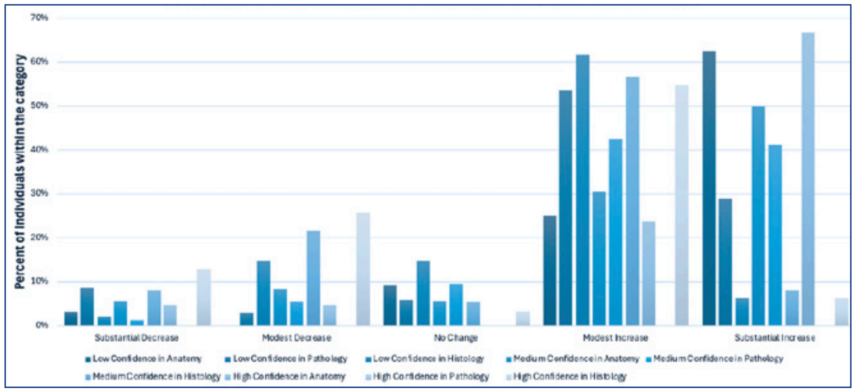


Table 2. Mean change in confidence with 95% confidence intervals, stratified by pre-vignette confidence levels (low, moderate, high) for each course (Anatomy, Pathology, and Histology), with sub-analyses conducted within each course.

Category	Number of Survey Responses	Mean Confidence Change
Total Confidence: <60	89	13.71 (95% CI 11.24–16.18)
Total Confidence: 60–80	193	8.24 (95% CI 6.85–9.63)
Total Confidence: >80	116	0.99 (95% CI –0.79–2.77)
Anatomy Confidence: <60	32	15.16 (95% CI 11.28–19.04)
Anatomy Confidence: 60–80	69	7.06 (95% CI 4.26–9.86)
Anatomy Confidence: >80	47	2.7 (95% CI 0.96–4.44)
Pathology/Physiology Confidence: <60	36	11.03 (95% CI 7.16–14.90)
Pathology/Physiology Confidence: –80	73	9.52 (95% CI 7.62–11.42)
Pathology/Physiology Confidence: >80	37	1.05 (95% CI -2.48–4.58)
Histology Confidence: <60	21	14 (95% CI 8.79–19.21)
Histology Confidence: 60–80	51	8 (95% CI 4.95–11.05)
Histology Confidence: >80	31	–1.59 (95% CI -5.88–2.7)

DISCUSSION

The analysis of our survey data confirms that students' confidence in exam material increased after the use of the clinical vignettes. This was statistically significant for every discipline and across the vast majority of blocks. They were most helpful in aiding students in view material in a new way when covering topics from the SFM course. We postulate that this is due to the granular, memorization-heavy nature of SFM content, which can be difficult to contextualize through traditional study methods. Previous literature has shown that clinical vignettes improve student engagement,[10-12] confidence,[13] and knowledge retention by promoting contextualized learning and clinical reasoning.[6,8] Presenting basic science material in a narrative or patient-based format may make abstract or foundational content more digestible and memorable.

Conversely, material felt more relevant for students during the organ systems blocks. This may reflect improved vignette writing skills over time as the authors gained experience, but also aligns with the observation that clinical relevance becomes more salient as students transition to more advanced systems-based content.[7] The authors intend to perform additional analysis after the next academic year to evaluate if the revisions that were made to the vignettes impact this metric. The utility of the vignettes in integrating topics remained stable across the blocks. This may be due to the intentional focus on horizontal and vertical integration during vignette design, a strategy supported by educational research as key to improving curricular coherence and clinical application of knowledge.[14,15]

Importantly, students who rated their baseline confidence as low showed greater improvement in confidence after completing the vignettes. This could be partially explained by a statistical ceiling effect (i.e., students who began with high confidence had less room to improve), but it may also suggest that the vignettes serve as an especially valuable learning tool for students struggling to master the material. Given the pass/fail nature of the pre-clerkship curriculum, this is particularly significant. Supporting students with lower confidence in the material helps ensure the entire cohort's success and promotes equity in academic performance.

There are several other limitations that should be considered. The main limitation being that there is only one survey that students fill out retrospectively. This asks them to estimate their confidence level before they did the vignettes and after, which can lead to recall bias and prevent accurate results. The authors intentionally designed the study in this way to prevent excessive burden on students as they use these materials to prepare for their exams—a common consideration in educational research where time constraints can reduce participation.[16] The authors aimed to remove the barrier of a pre-test so that students would be more inclined to use the vignettes without the burden of excessive evaluation. It should also be noted that responding to the survey was encouraged but not required or incentivized, which may have led to response bias in those who felt strongly enough to take the survey. With that being said, the response rate included a large proportion of students in the cohort, and thus leads the authors to believe that this was not a source of significant bias.

A future initiative of this project will be to track individual student responses across blocks and disciplines. This was omitted from the initial study for ease of completion by students (e.g., not having to remember and input a unique identifying code to ensure anonymity). Another extension of this project will be to see how students' responses correlated with their actual exam performance. Other medical education studies have successfully used anonymized tracking tools to correlate student perceptions with academic outcomes.[16,17] Since the majority of the authors are current students, the team decided that this would not be appropriate, in order to respect the privacy of their fellow students.

Despite these limitations, this project offers evidence that integration across disciplines encourages students to interact with pre-clerkship curriculum material in a way that increases confidence and allows students to think critically about material in a new way. This project will continue to support students in their pre-clerkship phase and provide a roadmap for curricular innovation at other institutions.

CONCLUSION

The findings of this study add to the growing body of evidence that clinical vignettes are a powerful tool for promoting integration across disciplines and enhancing student confidence. This intervention encourages students to engage with pre-clerkship material in a more active and applied way, fostering the development of critical thinking skills. Our approach serves as a model for curricular innovation both within our institution and beyond.

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Disclosures

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