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ORIGINAL ARTICLE

Can peer feedback substitute for faculty feedback in predoctoral dental education?

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Abstract

Purpose/objectives: The ability to give and receive feedback is a key skill to develop during predoctoral dental education, and the use of peer feedback specifically offers distinct benefits including a different understanding of material due to peers' proximity of knowledge development and assisting with overburdened instructors. However, it is unclear if peer feedback offers similar quality to instructor feedback.

Methods: Dental students in two different graduation years provided quantitative and qualitative peer feedback on a case-based oral and maxillofacial pathology simulation. The data from these exercises were aggregated and analyzed to compare the quality of qualitative feedback to course examination scores. Student perceptions of peer feedback were also recorded.

Results: The mean quality of feedback was not correlated with course examination scores, though the number of times students gave high-quality feedback and received high-quality feedback was correlated with course examination scores. Student feedback overall had a lower quality than instructor feedback, though there was no significant difference between instructor feedback quality and the maximum student feedback quality received. Student perceptions of the utility of feedback were positive.

Conclusion: While instructor feedback is more reliable and consistent, our findings suggest that in most instances, at least one peer in moderate-sized groups is able to approximate the quality of instructor feedback on case-based assignments.

KEYWORDS

assessment, cognition, curriculum development/evaluation, educational measurement, educational methodology, peer feedback, rubric, small group evaluation, teaching methods, undergraduate dental

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1 | INTRODUCTION

The provision of feedback and the successful incorporation of received feedback are key skills for healthcare practitioners; the Commission on Dental Accreditation's Accreditation Standards for Dental Education Programs[1] includes a requirement for peer feedback (Standard 2-11). Implementations of peer feedback can be motivated by intrinsic benefits to students as well as other more extrinsic benefits. Intrinsic benefits include cognitive congruence (i.e., students who are at a similar skill level can understand and explain concepts in a more familiar way compared to an expert) as well as goal-oriented information processing.[2] A major extrinsic benefit is that peer feedback can also serve as an alternative or supplement to expert feedback (i.e., to reduce institutional expenses and faculty burden[3,4]).

In describing qualities of successful feedback, some authors suggest that feedback should contain some aspect of "problem diagnosis" and "solution suggestion."[5] That is, feedback must be sufficiently detailed to describe a potential issue identified by the reviewer as well as offer an alternative resolution to the issue. A subsequent publication further condensed this definition to "general" (problem detection), "specific" (problem diagnosis), and "constructive" (solution suggestion with or without problem diagnosis).

Peer feedback can also be used in simulation-based learning (SBL). SBL is a mechanism to provide students practice on a variety of clinical cases that learners may not be guaranteed access to or in cases where the risk to the patient can be minimized by providing a simulation; a meta-analysis found that SBL in medicine provided superior outcomes compared to traditional clinical education.[6] In dental diagnostic sciences, including oral and maxillofacial pathology, the successful diagnosis of uncommon diseases (which students would not likely have direct experience with in limited dental education clinical settings) is essential for disease management and optimal patient outcomes.

Prior investigations of peer feedback have revolved around various issues, including its comparison to experts or individuals of terminal competence (e.g., instructors), its acceptance by students,[7,8] and its ability to improve the knowledge and/or skills of the feedback givers and receivers.[3,9] However, most of these have occurred in the context of objective structured clinical examinations,[3,10,11] where the scientific comparison between expert and peer feedback uses a quantitative rubric rather than the provision of qualitative/open-ended feedback. While quantitative feedback can be helpful, in some contexts, qualitative feedback can offer more flexibility in addressing suboptimal performance as well as insight into the thought process of the feedback giver. In published literature, the distinction between benefits for the feedback *giver* and the feedback *receiver* is also not frequently made.

The aim of this study was to evaluate the use of peer feedback in a simulation-based diagnostic sciences course and to address the following questions: (1) to what degree does peer feedback approximate instructor feedback in the diagnostic sciences, and (2) does high-quality peer feedback confers a benefit to course performance for feedback givers and/or for feedback receivers?

2 | METHODS

This study was exempted from IRB review (University of Michigan, HUM00213063). The context for the study is a case-based didactic oral and maxillofacial pathology course in diagnostic sciences at the University of Michigan School of Dentistry given in the fall semester of the third year. The students integrate and apply material learned in various courses, including basic and advanced oral and maxillofacial pathology, neoplasia, basic and advanced radiology, oral medicine, and pharmacology, to actual patient cases. Student enrollment was 127 in 2020 and 129 in 2021. In both cohorts, students were divided semi-randomly into groups of six to eight students per group (some attributes were balanced between each group, such as those with prior experience in dentistry). For the 8 weeks prior to the midterm examination, students were given a weekly assignment that described one to three patients with ongoing hard- or soft-tissue disease processes affecting the head and neck region, including the oral cavity. The students' assignment was structured similarly to the Queen's Simulation Assessment Tool[12]: students described lesions ("examination"), used that description to generate a list of differential diagnoses annotated with supportive/non-supportive features for each diagnosis ("diagnostic reasoning"), described the treatment they would provide ("treatment plan"), and provided the resources they used for the assignment ("resource utilization"). Assignments were completed individually and students were informed that collaborative work would constitute a violation of the academic honor code. A rubric (Figure 1) was created for each of these domains to guide peer feedback. Each group decided who would undergo peer review of their assignment for that week, with each student having peers review their assignment at least once throughout the course. The review was anonymous to the reviewee but not to the course faculty. Each student provided six to seven reviews for a total of eight homework assignments; each student had a homework assignment reviewed by all members of their group.

Category	Level I	Level II	Level III
Examination (NB: if the examination details provided or the clinical photographs are not clear, please indicate so. Please state your assumptions: ulcerated areas…)	Key physical examination findings are missing or incorrect.	Most key positive findings are present but are poorly documented (for example: size, location, color, etc is missing) or report is missing pertinent negatives	All key information is present, concise and well-organized with little irrelevant information.
Diagnostic Reasoning (NB: Please pay particular attention to alignment between exam findings and diagnosis. Do not penalize twice: if a person's clinical findings were not accurate, if the diagnostic reasoning is in alignment with the incorrect observation, that is OK—alignment.)	The differential diagnosis is unreasonable based on provided clinical findings and patient history.	The differential diagnosis is weakly supported or there are several incorrect links between findings and diagnoses. "Pros" and "cons" not indicated or not clearly or accurately described.	The differential diagnosis is appropriate, well-supported, and prioritized. The list should include the correct diagnosis. The "Pros" and "cons" are clearly and accurately described.
Treatment Plan	Diagnostic workup places patient in unnecessary risk or danger.	The proposed plan for diagnostic workup is ineffective, essential tests are missed, irrelevant tests are included. The included prescription information is incomplete and/or Lexicomp is not used as a reference.	The plan for a diagnostic workup is effective and efficient and includes all essential "next steps". Clear prioritization of the patient care plan.
Resource Utilization (NB: Please reference your work and indicate what resources you used and details such as: differential diagnosis tables in the back of the oral path book, a specific page number in the book, Lexicomp, notes from specific courses). Please list PEER-REVIEWED sources (no Wikipedia, random internet sources please).	The utilization of auxiliary resources including: differential diagnosis tables, pharmacology database, is unacceptable, dangerous or inappropriate.	The student calls upon resources appropriately but there are examples of over- and under-utilization in specific areas.	The student consults and uses proper resources appropriately.

"GRADING": Homework Assignment Evaluation Rubric

FIGURE 1 Rubric used for both cohorts (minor corrections were provided in the 2021 cohort). Students were asked to provide feedback on each of these domains, with three levels for each domain as a guide to help them determine potential issues with the assignment they are reviewing.

In order to provide peer review, the approaches were slightly different for the two cohorts. Both cohorts received instructions on how to provide high-quality feedback in these courses as well as others across the dental school curriculum. These instructions were created based on an institutional resource that assists instructors in providing peer review.[13] In 2020, students filled a Google Form (Alphabet Inc.) to respond to the quantitative aspect of the rubric for each domain. They were also asked to provide any three things they felt the reviewed student did well and any three things they felt the student should improve (regardless of what domain was used). In 2021, students were given additional instruction for how to give high-quality feedback (including both high-quality and low-quality feedback examples from 2020, see Figure 2) and were asked to give a single piece of open-ended feedback for each domain in order to ensure that some feedback on each domain was given. The rubric was essentially unchanged. In both cohorts, the results from this feedback were aggregated and given to the student who had submitted their assignment for that week.

Following peer feedback, students attended the regular course didactic session, where the instructor discussed the cases, reviewing common themes that were identified in the submitted homework, included any pitfalls noticed during instructor review of the assignments, and corrected any overtly incorrect feedback that the instructor noticed. At the conclusion of the class, groups met for approximately 10 min to discuss the peer feedback in person. The purpose of these meetings was to allow the student receiving peer feedback to ask for additional feedback and clarity from the group. Following the group meeting, the reviewed student had to participate in a brief self-reflection exercise about how they could improve.

At the conclusion of the course, an anonymous end-of-course survey was distributed to the class to capture student perceptions of feedback. The survey was administered electronically via Qualtrics. A short series of initial questions obtained general demographic information

Suggested Feedback Starters

*Your differential included...but I would have included...**because**...
*How does this compare to...? I think they're related **because...**
*You mentioned (something **specific**). I think that (describe the issue). You can consider (**constructive** comment).
*I appreciated how you (something **specific**). It would even be better if you...**because**...
*I appreciated how you (something **specific**). Could you explain how you account for... (specific **inconsistency**).
*I appreciated that you included (something **specific**). That was helpful for this assignment **because**...

Quality	Explanation	Examples
General	Domain is mentioned but not specific enough to be actionable	"I think the description could have been more detailed" "You could write more differential diagnosis for case #2" "I would recommend asking thorough questions about the patient's condition" "Maybe use another resource or two?"
Specific	Something potentially actionable but not explained	"I think that your description could have included that the pits were on both maxillary and mandibular teeth and that the size of the pits was about the size of a pinhead." "Differential diagnosis of fibroma and papilloma for the second case seems to be too inconsistent to be considered as differentials" "Explain more why you would wait for the results of the bx in case #2." "Perhaps you could have used more detail on which chapters you relied on."
Constructive	**Actionable with an explanation**	**"I noticed you did not mention anything about whether or not the lesions in case 1 were elevated or not. This is an important feature to have in your lesion description, as it also can really alter your ddx."** **"You note a con for erosive lichen planus is that the patient was on topical and systemic corticosteroids, which should have helped. Why, then, would you still choose erosive lichen planus as your tentative diagnosis? I would consider adding your explanation to that."** **"I noticed that you would not recommend a medical consult for the first case, but maybe next time you could explain why you would not recommend one since the patient was diagnosed with Giardia 4 months ago."** **"For case #2, I would use the Neville textbook as it has really good information on this syndrome."**

FEEDBACK Examples for the Homework Assignment

FIGURE 2 Examples of low-quality (general) and high-quality (specific and constructive) feedback given to the 2021 cohort (all examples are from students in the 2020 cohort). Instructors repeatedly emphasized this document and encouraged students to give constructive feedback.

and informed consent. The survey was modeled after a study aimed at capturing student perceptions of teacher feedback.[14] Our decision was based on a scoping review of student perceptions of assessment feedback,[15] where the authors identified this study among 164 reviewed publications as a strong example of survey application. These questions are grouped into four domains for both providing and receiving feedback: utility, sensitivity, confidentiality, and retention (perceived confidence was also added for providing feedback). Factor analysis was performed and items that had low reliability in 2020 were either reformatted or removed in 2021 (four questions, modifications noted in the tables). Basic descriptive statistics were performed on the domains.

If students fully participated in the homework, feedback, and self-reflection in a timely fashion, and if they received a minimum of 70% on the case-based midterm examination, they were permitted to not take the final examination and undergo self-grading. Because some students were permitted to skip the final examination, we sought to compare feedback quality to the midterm examination as a quantitative metric of course performance.

After the conclusion of the course, peer feedback was analyzed. In the 2020 cohort, due to the structure of the feedback, we imported the peer feedback comments for the "suggestions for improvement" field into brat,[16] an open-source text annotation software (2020 cohort). In 2021, the structure (broken out into multiple domains) was more amenable to assessing in a spreadsheet. In both cohorts, each piece of feedback was annotated with the domain and the quality of the feedback. The feedback quality was defined as: "no mention" (the domain is not mentioned), "general" (the domain is mentioned, but there is inadequate discussion to be actionably helpful for the student), "specific" (the feedback is specific enough to be actionable but does not describe why the feedback is useful), and "constructive" (the feedback is actionable and describes why the feedback is useful). The lowest quality of feedback given was "general," whereas the highest quality was "constructive." This is a modification to categories defined in other studies[5,17]; we felt that in this context that the

problem diagnosis was more important than providing an alternative solution, as it indicated higher engagement with the material. When students gave multiple instances of feedback in a single prompt, the highest-quality instance was recorded. One of the authors (B.V.) annotated the quality in 2020, and two authors (B.V. and L.G.) annotated the feedback quality in 2021, following a training session with periodic review meetings. Author B.V. (a content expert) noted instances of overtly factually incorrect feedback (i.e., diagnostic possibilities that, although unlikely, were technically possible were considered to be correct).

After feedback was annotated, descriptive and comparative statistics were performed for both cohorts. Pearson's r test was used to assess correlations, the Mann–Whitney U-test was performed to assess distribution similarities, the Wilcoxon signed-rank test was used to assess differences in mean student feedback quality before and after the week they were reviewed, and the Mann–Kendall test was used to assess the trend in feedback quality of both students and instructors. After confirming that the distributions were similar between 2020 and 2021 feedback quality, the results from both cohorts were then aggregated into a single dataset for analysis. Because the number of students in a group were variable, statistics that did not use the mean were normalized to account for group size.

3 | RESULTS

Feedback data were available for 252 (98.4%) students (the four students without feedback did not submit their assignment on time and only received instructor feedback; these were excluded from analysis). This resulted in 6804 individual instances of feedback recorded. While the quality of feedback varied, most of the feedback was at least specific (Figure 3). The maximum quality of feedback each student received was calculated for each domain; most students received at least one piece of specific or constructive feedback for all domains (Figure 4).

Statistical analysis revealed no significant correlation between mean feedback quality given or received and midterm examination scores of the feedback givers and feedback receivers ($r = -0.1$ to 0.1, $p > 0.1$). However, the number of specific and constructive feedback instances received and given were positively associated with the midterm exam scores of the receiving students ($r = 0.31$, $p < 0.001$) and giving students ($r = 0.33$, $p < 0.001$), respectively. There was also a substantial correlation between feedback quality and the length of feedback ($r = 0.64$, $p < 0.001$), and also between feedback quality and the number of feedback given ($r = 0.44$, $p < 0.001$).

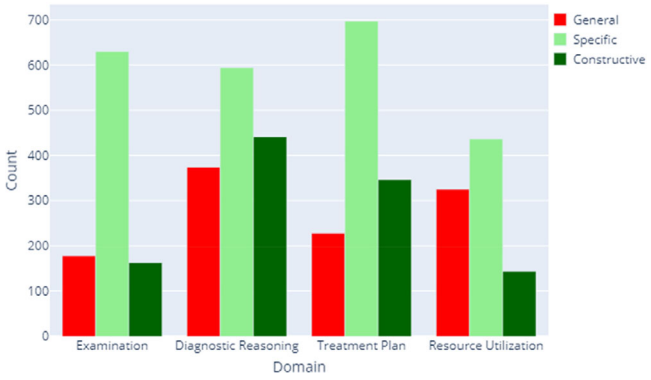


FIGURE 3 Counts of feedback given for each domain and whether the feedback was general (technically addressed but generally unhelpful), specific (a specific action was suggested for improvement), or constructive (a specific action is suggested as well as an explanation for why that action would be beneficial).

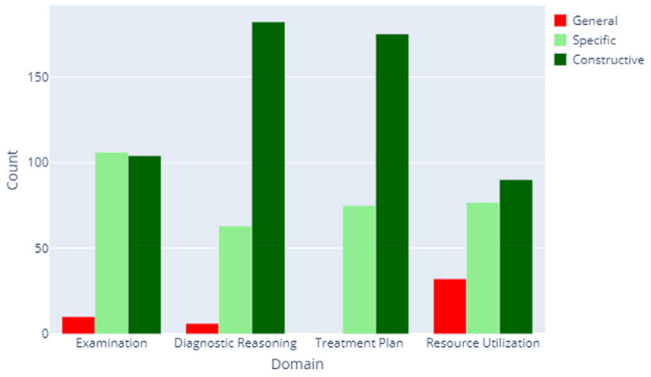


FIGURE 4 The maximum feedback quality received by students; the majority of students received at least specific feedback for all categories.

For students giving feedback, students with higher midterm scores tended to give longer feedback ($r = 0.14$, $p = 0.02$) and they tended to give lower rubric scores ($r = -0.14$, $p = 0.03$). For students receiving feedback, students with higher midterm scores tended to receive fewer feedback instances ($r = -0.14$, $p = 0.03$), yet the length of the feedback they received tended to be longer ($r = 0.21$, $p = 0.001$). The rubric scores that students received were positively correlated with the receiving students' midterm scores ($r = 0.13$, $p = 0.03$).

Students who gave lower rubric scores received higher midterm scores ($r = -0.14$, $p = 0.03$), while students who received higher rubric scores tended to receive higher midterm scores ($r = 0.13$, $p = 0.03$). The student perception surveys showed a high perceived utility for feedback after reviewing the means and confidence intervals (receiving, 3.99 [2.89–5.1]; providing, 3.74 [2.61–4.88]); the remaining values are reported in Table 1.

TABLE 1 Student perception survey, domain-aggregated results.

	Receiving	Providing
Utility	3.99 (2.89–5.09)	3.74 (2.61–4.88)
Sensitivity	2.20 (0.97–3.43)	2.62 (1.45–3.80)
Confidentiality	3.08 (1.79–4.37)	3.39 (2.17–4.60)
Retention	2.44 (1.27–3.61)	3.47 (2.23–4.72)
Perceived competence	N/A	3.33 (2.12–4.53)

Note: Values denote mean (confidence interval). These values are based on a five-point Likert scale as reported in Ref.[14] The domains include utility (usefulness of feedback), sensitivity (higher scores indicate that students are more embarrassed by feedback), confidentiality (higher scores indicate that students prefer feedback to be private rather than public), retention (higher scores indicate that students feel they retain feedback), and perceived competence (student perception of their own competence at providing feedback).

4 | DISCUSSION

In this study, we identified significant associations between a summative case-based examination and the quantity of high-quality feedback (defined as at least specific feedback) that was provided and received. Students who gave higher numbers of high-quality feedback performed better on the exam, and students who received higher numbers of high-quality feedback also performed better on the exam. While we cannot make a definitive statement toward causality, it is possible that students who gave high-quality feedback were more skilled in the subject matter and were able and willing to assist their teammates in understanding aspects of diagnostic sciences in these cases. This finding—that high-quality feedback is correlated with examination scores not only for the receiver of the feedback but also for the giver—suggests a demonstration of successful knowledge transfer among students. This was also corroborated with rubric scores. High-performing students tended to give lower rubric scores, and because these students also tended to give more high-quality feedback, this suggests that students with a better understanding of the course material were able to more frequently identify errors and gave lower rubric scores and explanatory feedback as a result.

A legitimate concern for faculty and students is the quality of peer feedback even after students received guidance in the peer review process. We found that there was a significant difference between the overall quality of peer feedback as compared to instructor feedback. The quality of qualitative forms of peer feedback is not frequently assessed in the broader literature, although differences in quantitative peer feedback is mixed, with some publications supporting a difference between peer and instructor[10,18] and others finding no significant difference.[3,19–21] We suspect this is a multifactorial problem that varies based on task, institution, and the specifics of the course. At least in our context, the difference between peer and instructor was replicated in two different cohorts of students in two consecutive years. While it may be tempting to use these results to dismiss peer feedback as an approximation for instructor feedback, we found that the *best* feedback that students received was on-par with instructor feedback quality. As a result, providing multiple instances of peer feedback as occurs in a group-based setting is ensuring that feedback recipients have at least some high-quality peer feedback; our next approach is to assist students with identifying and reinforcing these instances of high-quality feedback. Given that providing in-depth instructor review and the provision of feedback for a large number of case-based student assignments each week was very time-consuming (previous publications have expressed this challenge[2,22]), we feel that this finding would support the use of peer feedback as a substitute for instructor feedback in settings where instructor feedback is not feasible.

In the second cohort, we provided additional training on how to give effective feedback, including specific examples from the 2020 course. Unfortunately, the difference in mean feedback quality in the two cohorts was not significantly different, and in prior studies, training to improve feedback quality has also failed to improve quality.[8] While we believe that this training is useful in highlighting optimal and suboptimal feedback while also providing some rationale and hopefully motivation for the students to fully engage in providing and receiving feedback, it does not appear to be a potential solution for improving feedback quality.

Reviewing the quality of thousands of instances of peer feedback was time-consuming in this study. We were able to identify a potential surrogate of feedback quality: feedback length, which is relatively simple to assess in near-real-time. However, we believe that applying a requirement for minimum feedback length would probably cause this to lose its effectiveness ("Goodhart's law"—loosely, using this measure as a target would cause it to lose its effectiveness as a measure). Still, it may be possible to use this as a metric to direct instructor attention to high-quality and low-quality feedback for reinforcement during debrief sessions.

While we did not directly evaluate student preferences for peer feedback versus expert feedback, other studies have highlighted student reticence to use peer feedback,[23] while others have noted that students have positive perceptions of peer feedback.[24] At our institution, we found that students generally held favorable opinions about the utility of feedback despite the near neutrality of the confidentiality and sensitivity of peer feedback. We hope that the findings presented in this study assist in promoting buy-in for those students who are skeptical of allocating

additional time to provide high-quality feedback (particularly without the possibility of an extrinsic reward), and also for administrative stakeholders who may be unsure of expending valuable resources to add additional labor to coursework.

There are some limitations to this study. First, this was in a diagnostic sciences course and it is unclear if these findings are replicable in other contexts of predoctoral dental education. Second, our choice of coding scheme was well-intentioned and would be relatively simple to replicate, but it is possible that other coding schemes would progress the understanding of how feedback can be used. Further research is needed to assess how dental educators should approach the assessment of feedback and how well these findings translate to other aspects of predoctoral dental education. Additional possibilities for the translational use of this research could include using blinded feedback to identify high-quality feedback givers who could assist low-performing students as a supplement to other tools instructors may use for assisting these students.

5 | CONCLUSION

An important finding of our study is that peer evaluation in group settings allows for multiple assessors, which provides a learner with high-quality feedback that approximates instructor feedback and correlates with overall course performance. These benefits are provided with an overall student favorability for the utility of peer feedback.

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