Examining the Role of Collaborative Assessment in a Didactic Dental Hygiene Course


Abstract: The purpose of this study was to evaluate a technique known as collaborative assessment considering students’ and faculty members’ perceptions of the value and utility of this approach. Twenty-eight dental hygiene students took eight individual assessments (quizzes) immediately followed by completion of the same assessment in a five-member peer group as part of a didactic dental hygiene course. At the end of the semester, student perceptions and course performance were examined. Faculty perceptions were also collected. A paired samples t-test was conducted to compare student performance on individual and group assessments. Students reported that this collaborative assessment approach enhanced their learning, provided them with experience in defending their answers, and decreased stress. Concerns for fairness and individual accountability were noted by both students and faculty. The mean group score for all quizzes combined (M=91 percent, SD=2 percent) was significantly higher by 16 percentage points (91 percent versus 75 percent) than the mean individual score for all quizzes combined (M=75 percent, SD=8 percent), t(27)=11.61, α=.05, p<.0005. This study suggests that additional measures are needed to ensure individual preparation and accountability when using the collaborative assessment process as a learning strategy with dental hygiene students.

Prof. Keselyak is Associate Professor, Division of Dental Hygiene; Prof. Saylor is Clinical Assistant Professor, Department of Periodontics; Prof. Simmer-Beck is Assistant Professor, Division of Dental Hygiene; and Prof. Bray is Professor and Director, Division of Dental Hygiene—all at the University of Missouri–Kansas City. Direct correspondence and requests for reprints to Prof. Nancy Keselyak, Division of Dental Hygiene, University of Missouri–Kansas City, School of Dentistry, 650 E. 25th Street, Room 415, Kansas City, MO 64108-2784; 816-235-2052 phone; 816-235-2157 fax; keselyakn@umkc.edu.

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College teachers have established themselves as credible knowledge experts in their chosen field of study. However, many have little formal education in the teaching and learning process. Faced with the responsibilities of helping students learn about their disciplines, many teachers focus teaching and learning at the level of remembering at the expense of more significant learning experiences that may facilitate more sophisticated comprehension of course material. Teachers often use methods that they experienced as students themselves. Despite a variety of documented strategies, the traditional methods of lecturing and leading discussions account for much of the time spent in the classroom in college courses.1

In addition to a lack of preparation in teaching, the tasks of assessment and grading also pose challenges for college teachers.2 While grading has been a part of the education process for generations, many college teachers struggle with developing appropriate student assessments. Fink describes the need for integrating course design with significant learning goals, active learning, and educative assessment. When these elements are properly linked, a more powerful learning experience can occur.3

Although the Institute of Medicine’s 1995 report Dental Education at the Crossroads: Challenges and Change4 recommended significant curricular reforms related to the content and presentation of dental education, a survey of fifty-six North American dental schools in 2002–03 found that 86 percent characterized their curricula as traditional discipline-based or largely discipline-based, with a few interdisciplinary courses.4 The American Dental Education Association (ADEA) continues to support curriculum reform, largely under the auspices of its Commission on Change and Innovation in Dental Education (ADEA CCI). One ADEA CCI goal, now embodied in the “Competencies for the New General Dentist”5 adopted by the ADEA House of Delegates in April 2008, is to cultivate an educational environment that places more emphasis on self-directed learning, problem-solving, critical thinking, and lifelong learning. Such an environment also encourages students to take responsibility for their own learning.6,7
In order to shift from a teaching-centered education to a learner-centered education, college teachers are encouraged to be reflective about teaching and learning in the classroom. Licari suggests that a comprehensive faculty development system is needed in dental education to change the school’s culture and to prepare faculty to teach and assess learning differently if real change in dental education is to occur. Faculty development programs should focus on the requisite skills needed to teach in an active-learning curriculum and should include evidence-based practice strategies, small-group facilitation, active learning, and the productive use of technology.

Institutions routinely provide programs for their faculty that encourage and support growth and development in educational methodologies. In addition to the traditional components of original research publications, service, and student course evaluations, some institutions are now acknowledging the scholarship of teaching as part of the tenure review process. The University of Missouri launched a systemwide approach in 2001 called the New Faculty Teaching Scholars (NFTS) program. Tenure-track faculty members from each of the four campuses are eligible to apply for a position in this year-long program designed to support faculty as they adjust to new academic responsibilities and environments, introduce them to innovative teaching methods, and build collegiality.

Effective teaching and learning is a cornerstone of the NFTS program. Participants review research on learning and discover how to use a variety of college teaching methods to create engaged learning environments. At a recent NFTS conference, leaders in higher education and instructional design presented alternatives to traditional, teacher-centered instructional methods. One of these alternative strategies was the use of group assessment as an educational strategy. Participants were instructed to prepare in advance by reading the assignment and being ready to take a quiz upon arrival at the workshop. Sitting at round tables in the room, participants took an individual test developed by the facilitators, turned it in to the facilitators immediately upon completion, and then took the same test again as a group, consulting with others at their table to reach consensus on the most desirable answer. Only one answer sheet was completed and submitted per table. The answers were then reviewed with the entire group, generating considerable discussion among the participants. In the process, the facilitators demonstrated that cooperative learning could be utilized in any classroom when properly designed.

There is evidence in the literature that a combination of theory, research, and practice makes cooperative learning a powerful learning procedure. A meta-analysis by Qin et al. found that members of cooperative teams outperformed individuals competing with each other when problem-solving. This meta-analysis included participants at all levels of education who were grouped into two age categories: younger (preschoolers through intermediate school) and older (junior high school through college and adults). Of the sixty-three studies included in the analysis, fifty-five concluded that cooperation outperformed competition, and eight studies found competition outperformed cooperation. Qin et al. suggest that the exchange of information and insight among cooperators, the sharing of various problem-solving strategies, and the development of a shared cognitive representation of the problem may contribute to success among students who cooperate.

Studies using cooperative learning methodologies within the health professions are relatively new and few in number. Collaborative testing was studied with a group of second-semester associate degree nursing students who were randomly assigned a partner and were seated beside each other at the start of the exam. Students completed and submitted individual responses to test questions on a Scantron form. They were then each given a second Scantron form and were allowed to collaborate with their assigned partners regarding any or all test questions. This provided them an opportunity to change their original answers and benefit from a collaborative interaction while still having a second individual score. Both individual scores were combined for a final grade. On average, student scores increased by one point for a fifty-point test. At the end of the collaborative testing experience, students completed a questionnaire and reported an increased motivation to study, enhanced communication skills, improved problem-solving skills, and increased comprehension.

The group assessment strategy described by Fink and presented at the NFTS conference was implemented into a first-year, first-semester didactic dental hygiene course entitled “The Introduction to the Preventive Practice of Dental Hygiene” at the University of Missouri–Kansas City Division of Dental Hygiene in 2006 in order to give immediate feedback to students regarding how well they understood core concepts and to engage them in
learning by stimulating them to self-identify gaps in their knowledge. The objective of this course was to provide students with the necessary foundational knowledge to support their first clinical experience.

The purpose of this study was to evaluate the use of a group assessment strategy as an active learning strategy in a didactic dental hygiene course for its impact on students’ perceptions of its contribution to their learning. The following questions were addressed:

1. What did students perceive to be the advantages and disadvantages of the group assessment strategy?
2. What were some of the advantages and disadvantages of the group assessment strategy from a faculty and observer perspective?
3. How was student performance affected by the use of a group assessment strategy?

Background

“Collaborative learning” is defined as any instructional method in which students work together in small groups toward a common goal. This broad term includes all group-based instructional methods, including cooperative learning. The primary emphasis is on student interactions rather than on learning as an individual enterprise. Johnson and Johnson define cooperative learning as a structured form of group work in which students are assessed individually while they pursue common goals. These authors specify five tenets for cooperative learning: individual accountability, mutual interdependence, face-to-face supportive interaction, appropriate practice of interpersonal skills, and regular self-assessment of team functioning. The primary emphasis is on cooperative incentives rather than competition to promote learning.

Johnson et al. conducted an extensive review of the research on cooperative learning and found that cooperation improved learning outcomes when compared to individual work. A structured, cooperative approach is based on the constructivist theory of learning that places the responsibility for students’ learning on the students themselves and encourages learners to construct their own understanding and explanations of facts and concepts as a mechanism to build deeper comprehension. Students are supported by their faculty and peers within a structure that contains the discipline-specific course content.

Webb defines four purposes of assessment. The first is the traditional purpose of assessing achievement by measuring individual competence of students in their subject matter knowledge and thinking skills. The second is to measure an individual’s performance after being given an opportunity to learn from group collaboration. The third is to measure group productivity, and the fourth is to measure students’ ability to interact, work, and collaborate with others as members of a team. Webb describes how competing goals of collaborative work should be carefully considered. Assessments designed to evaluate learning outcomes will not necessarily be the same as those designed to evaluate group productivity and vice versa.

Most students experience grades as reward or punishment for their performance. The goal of “educative assessment” is quite different. It provides immediate feedback to students with the goal of encouraging them to learn from their performance. Characteristic features of educative feedback include frequent reinforcement that is delivered as close in time to the learning experience as possible, clear discrimination that discerns how well students met the criteria, and delivery with respect and encouragement.

Webb reports that “active involvement by all group members is essential for individual learning from collaborative group work.” When the goal of group work is to enhance individual student learning, it is important to stress individual accountability for learning in the instructions and structure of the test. Even a small amount of collaboration may influence a student’s understanding and performance. However, students must be individually prepared to contribute appropriately to the group process. Michaelson and Black describe a process to ensure individual accountability for pre-class preparation using a Readiness Assessment Test covering a set of preassigned readings. This test is taken individually and turned in for credit. Students then take the same test with their group and can turn in their consensus answers for immediate scoring. This process encourages individual accountability to both the faculty and other members of the team since both individual and group scores are used as part of the course grade. When students are in the group, they are defending their choice on every question, which makes them accountable to their peers for coming to class prepared. Cramer also found that a combination of group and individual grades can achieve the goals of collaboration while maintaining individual accountability.
Methodology

This project utilized a mixed qualitative/quantitative research design and was approved by the Social Science Institutional Review Board at the University of Missouri–Kansas City.

Thirty first-year dental hygiene students enrolled in “Introduction to the Preventive Practice of Dental Hygiene” agreed to participate in this study. Table 1 outlines the demographics of the sample. The average student age was twenty-five and ranged from nineteen to forty-four years of age. Twenty-eight students were female, and two were male. Students were predominantly Caucasian with representation from the African American, Hispanic, and Asian American ethnic groups. The overall incoming average college GPA for students was 3.43.

Six groups of five students each were created for each testing period. Groups were reconfigured for each testing session to change membership composition, and students were not aware of their group assignments in advance. At each testing period, groups were formed when all students had completed their individual tests.

Task and Group Performance

The data used in this study were obtained from weekly quizzes and student perceptions via end of course evaluations. Eight group assessment quizzes were administered throughout the course. Each quiz consisted of multiple-choice and true-false questions with some short-answer questions. Quizzes were based on the course content assigned and/or covered prior to the test as per the course syllabus and session objectives. Students were expected to read their assignments, participate in classroom sessions to discuss the materials, and prepare for a quiz on the material to self-assess their knowledge and comprehension of the assigned topic. Students took the quiz individually and turned it in for grading, then worked with an assigned group of students to take the same quiz by reaching consensus on group responses to each item, turned the group quiz in for grading, and reviewed the quiz items in a class discussion with the course director. Figure 1 illustrates the features of this group assessment strategy. Each quiz was worth twenty points with the exception of quiz number one (worth nineteen points) and quiz number two (worth twenty-one points). Only the group score counted towards a student’s final grade. The individual scores were used solely as a means of self-assessment by the student. Faculty members were able to review the individual quizzes to assess the level of individual accountability but did not include the individual score in the final course grade. The lowest quiz score was dropped when calculating the final grade. Additional graded projects were also included in the final grade calculation. Table 2 lists the number of points possible for each graded component of the course and shows that quizzes were worth approximately one-third of the student’s final grade. Eight quizzes were given using the group assessment strategy described above. One quiz (quiz number seven) was given as an individual assessment due to limited class time on that day. Quiz grading was based on group scores in that all students in a group received the same score. However, midterm and final examinations conducted in the course were the individual responsibility of each student; these examinations served as a means to ensure individual competence.

All students were invited to provide feedback on the group assessment process as part of normal course evaluation and were asked to respond to several questions anonymously at the end of the course. Participation was voluntary, and students deciding not to participate were not penalized. An uninvolved staff person word-processed the data for analysis.

Data Analysis

An open response survey was constructed to elicit responses on student perceptions. The questions were based on established outcomes associated with the collaborative learning instructional model. These included influence on learning and retention, influ-

<table>
<thead>
<tr>
<th>Average Age</th>
<th>Gender</th>
<th>Race</th>
<th>Overall GPA</th>
<th>Degrees</th>
<th>Previous Dental Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 (19–44 range)</td>
<td>F</td>
<td>White/Caucasian</td>
<td>3.43</td>
<td>AS 3</td>
<td>15 no experience</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>African American</td>
<td>1</td>
<td>AA 3</td>
<td>14 experience</td>
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<td></td>
<td></td>
<td>Hispanic</td>
<td>1</td>
<td>BS 9</td>
<td>2 formal dental training</td>
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<tr>
<td></td>
<td></td>
<td>Asian American</td>
<td>1</td>
<td>BA 5</td>
<td>2 formal dental training</td>
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</table>
1. Students read assignments
2. Classroom sessions to discuss materials
3. Assessment (quiz)

**GROUP ASSESSMENT STRATEGY**

- Individual quiz
  - Submit to faculty for grading

- Students assigned to a group by faculty
  - Group quiz
    - Submit to faculty for grading
  - Class discussion of answers with faculty

**Notes:**
- Group score counts. Individual scores are available to track progress of individual students.
- Process takes about thirty minutes (give or take fifteen minutes) depending on the quiz.

*Figure 1. Key features of the group assessment strategy*

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individual total points were greater than the group total points.

After all final course grades were submitted, a review of both individual and group scores was conducted to determine if final grades were impacted by an individual outperforming his or her group scores. For any case in which the individual quiz score was higher than the group score, the final grade was recalculated using the higher individual score rather than the group score to compare the impact of individual and group performance on final course grade. These calculations were for observation purposes only and were not part of the grading process for the course.

### Results

Twenty-eight students out of the original thirty completed the course and were included in the study. One student took a personal leave after participating in assessments one through five and was excluded from the data. Group assignments remained the same as originally planned, resulting in one group of four students for the remainder of the course. Another student missed one of the quizzes and was removed from the analysis. Therefore, data from twenty-eight students were evaluated.

### Student Perception Data

A summary of responses to the student surveys at the end of the course appears in Table 3. Students indicated that the group assessment strategy helped them learn and retain information. The following representative comment indicated students considered this a positive experience because they received immediate feedback and enjoyed taking ownership in defending their positions with the group: “I feel working in a group helped to solidify my understanding. Talking through a question with others makes you either have to defend [your answer] or recognize a mistake.”

All respondents indicated that the process influenced their grades in a positive way. The advantages reported by students of taking the quiz independently first were that students could assess their individual preparedness, the repetition led to better retention, they gained experience in defending their answers, and they experienced decreased stress. This comment reflects a general impression of the group: “I liked taking the quiz on my own before taking the quiz as a group because it forced me to see what I really did and did not know pertaining to the course. When doing the quiz as a group, others were able to help me see a different perspective on certain questions and why they thought a certain answer was accurate.”

A number of disadvantages were also identified in the students’ comments: the process was perceived as being time-consuming by some students, concerns were expressed that it is not always right that the majority rules the group’s decisions, some students were uncomfortable with disagreements within the groups, and some students indicated it was not fair that everyone in the group received the same grade when not everyone contributed equally. Here are a few comments that identified disadvantages: “For those that didn’t study, they just waited until the group quiz to agree with everyone else that they got the right answer when really they had no clue”; “Sometimes the group disagreed with an answer, and sometimes people got upset if we didn’t choose their answers”; and “It cut into class-time, but wasn’t such a bad thing because I learned a lot during the quizzes.”
The majority of students indicated that they prepared for an assessment the same whether it would be completed individually only or completed as a group. As one student said, “I didn’t want to let the group down with a bad grade, so it forced me to keep up on material.” Other students indicated that they prepared more for the individual assessment depending on how much time they had available. “If I have time to treat it like an individual quiz,” said one, “I study more because you grade both and will see if I know the information. However, if there is an area I’m struggling with, I will obtain the general information and hope that my group can help clarify it.”

Clearly, respondents preferred having group assessments to individual assessments alone. Those who preferred the individual assessments explained that they did not want to help others or felt that group assessments were not fair. For example, this student wrote, “Personally, I would prefer the individual quiz simply because it is not fair to those of us that do take the time to prepare to get the same score as a group member that didn’t study at all.”

In terms of relationships, respondents indicated that they became more comfortable with other students, became aware of different personalities and learning styles, and mentioned teambuilding as a positive outcome. As one said, “It helped by forcing us to work with people we don’t always interact with. It allowed us to balance our strengths and weaknesses with others.” Approximately half of the respondents noted a positive change in their relationship with the course director and thought the director showed concern for their learning, compassion, and understanding of what students were going through as illustrated by this comment from one of the students: “I thought the group testing portrayed the instructor’s concern or compassion for the success of the students.”

### Course Director and Graduate Assistant Perceptions

Perceptions from the course director and the graduate assistant are highlighted in Table 4. Their shared observations identified changes in student interactions as the semester progressed. In the early part of the semester, students spent more time taking the individual quiz than they did working on the group test. Group interactions were initially limited, with stronger personalities dominating the discussion. Towards the middle part of the semester, groups were more actively engaged in spirited conversation and demonstrated an increased competitiveness for group scores and correct answers. Both weaker and stronger students participated in the process.

### Comparison of Student Performance

The individual and group scores for each of the quizzes are summarized and presented in Table
5. Comparisons indicate that the standard deviations were larger for the individual scores than the group scores. A paired-sample t-test was conducted to evaluate the difference between group score (percent) and individual score (percent) on unit quizzes. The results indicated that the mean group score (percent) for all quizzes combined (M=91 percent, SD=2 percent) was significantly higher than the mean individual score (percent) for all quizzes combined (M=75 percent, SD=8 percent). With a t(27)=11.61, the hypothesis that no differences exist was rejected ($\alpha=.05$, $p<.0005$). A difference of 16 percentage points was noted between group score (percent) and individual score (percent). The standard effect size index, $d$, was 2.19, which is considered a very large effect. The 95 percent confidence interval for the mean difference between the two scores was 14 percent to 19 percent, indicating a very small range between the lower and upper boundaries.

A student’s group score was greater than his or her individual score on the same test 83 percent of the time. Ten individual scores (4 percent) were higher than their respective group scores. For each case, the final grade was recalculated based on the individual score for that quiz to see if the final course grade would have been different. When factoring in additional points to offset the negative impact from the group score, individual course grades remained unchanged.

### Discussion

Collaborative assessment with dental hygiene students in this study found that students enjoyed the opportunity to discuss quiz questions with the group and reported the experience was beneficial in learning the material. In a study on student perceptions of effective classroom education, Schönwetter et al.\textsuperscript{28} also found that dental hygiene students valued group interaction and considered it one of seven categories of effective teaching. All students in our study perceived the group assessment strategy as influencing their grades in a positive way. This is interesting because even when an individual score was better than the group score on a few occasions, by the end of the course all students reported a positive impact on their overall score. Other researchers have observed an increased motivation in students to study so as not to let their peers down.\textsuperscript{14,29} While student comments in our study were consistent with these findings, there were also concerns expressed about unprepared peers benefiting from the group without contributing equally in some cases. Mitchell and Melton\textsuperscript{14} found that 59 percent of nursing students reported the primary negative concern for collaborative testing was the opportunity for an unprepared student to receive a higher exam grade. Student contribution or participation in collaborative strategies may also be influenced by a long list of other factors besides advanced preparation. Hirschy and Wilson\textsuperscript{30} suggest

<table>
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<th>Table 4. Summary of reflections from graduate assistant and course director</th>
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<tr>
<td><strong>Graduate Assistant Reflection</strong></td>
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<tr>
<td>- Changes as semester progressed.</td>
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<tr>
<td>- Initial limited interaction.</td>
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<tr>
<td>- Strong personalities dominated.</td>
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<tr>
<td>- More time spent on individual quiz.</td>
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<tr>
<td>- Later, groups more actively engaged in conversation.</td>
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<tr>
<td>- Increased discussion on rationale for correct answer.</td>
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<tr>
<td>- Increased competitiveness for group score and correct answers.</td>
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<tr>
<td><strong>Course Director Reflection</strong></td>
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<tr>
<td>- Concern for productive use of class time.</td>
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<tr>
<td>- Interested in individual accountability but unsure how important this was to the overall student learning in groups.</td>
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<tr>
<td>- Academically strong students would not contribute in the group when the higher of scores counted (individual score vs. group score).</td>
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<tr>
<td>- When students were not sure I would continue with group quizzes, they were well prepared individually and appreciated the group opportunity.</td>
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<tr>
<td>- This year, there was a sense that not all students were preparing individually as much as in the past, relying on the group.</td>
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<tr>
<td>- Next year, the individual scores must count.</td>
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reasons students might choose not to participate include the fear of appearing stupid, low confidence levels, being shy, experiencing uncomfortable feelings about the topic, being sleep-deprived, feeling frustrated with domineering peers, and being singled out as a model member of the group.

One of the key values of using group assessment as a learning strategy is the immediate feedback students receive about the correct answer; students in our study supported this idea with their survey responses. Without immediate feedback, the pedagogical value of quizzes is reduced. While collectively the group can more accurately determine the correct responses to questions and thereby help students who may not have initially been able to arrive at correct answers independently, using only the group grade inaccurately reflects the abilities of individual members and therefore should be used as an incentive to enhance one’s individual score in a limited manner. Collaborative testing could be used as a learning strategy, but careful weighing of this activity should be considered when determining final course grades to avoid grade inflation and maintain a perception of fairness among students. The literature is clear that individual accountability and advance preparation are critical for successful implementation of this active learning strategy and that individual grades must count towards a student’s overall course grade.  

Although students in our study perceived the group assessment strategy as contributing positively to their learning and retention of the content, the study did not reliably assess comprehension or knowledge retention. The change in quiz scores was consistent with those found by Nieder et al. However, this should not be interpreted as representing actual increases in knowledge retention. Others have studied differences between students who tested collaboratively and students who tested individually. Lusk and Conklin concluded that although nursing students tested better using collaborative testing, overall comprehension of materials was equivalent between the two groups. Carefully designed control groups and further investigation on comprehension and retention are recommended. Given the recent report of team-based learning in dentistry, it would also be interesting to investigate how team-based learning groups might differ from students working in randomly assigned groups.

As this study illustrates, locally initiated faculty development programs may lead to positive changes.
in the classroom. Nationally recognized programs such as the Carnegie Academy for the Scholarship of Teaching and Learning\textsuperscript{43} are leaders in fostering changes in higher education and have many resources available to support institutions and faculty interested in these initiatives. Bender and Gray\textsuperscript{36} suggest that faculty members can move beyond their individual disciplines and apply intellectual inquiry to their teaching. They must use what they learn from the data to justify or change their practice in the classroom. Sharing what they learn about teaching should be one of the essential topics of conversation within the disciplines. This study was initiated as a result of support from other administrators and faculty members who believe in the scholarship of teaching and the value it has for the academy.

### Conclusions

The purpose of this study was to evaluate a technique known as collaborative assessment to determine its impact on dental hygiene students’ learning and assess students’ and faculty members’ perceptions of the value and utility of this approach. Students perceived several advantages with this technique, including enhanced learning, experience in defending their answers, and decreased stress. Concerns for fairness and individual accountability were noted by both students and faculty members. Reflecting on the student perception data, a review of the literature, faculty observations, and the impact on student course performance, this study suggests that additional measures are needed to ensure individual preparation and accountability when using the collaborative assessment process as a learning strategy with dental hygiene students. In the future, structure (such as counting both individual and group scores in the final student grade) must be added to ensure that individual accountability is formally in place and consequences are appropriately connected to individual effort.

### REFERENCES

10. Personal communication with LD Fink, Facilitator, Course Design Retreat, University of Missouri New Faculty Teaching Scholars Program, Osage Beach, MO, October 5–6, 2001.


