

A Comparison of Three Teaching Techniques in Anatomy & Physiology

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This project was a systematic examination of student learning outcomes associated with instruction in a course in anatomy and physiology in communication sciences and disorders (CSD). CSD 256: Anatomy & Physiology for Speech and Hearing is a team-taught course that is required for undergraduates majoring in CSD at UW—Eau Claire.

The Course Context

CSD 256 is a large class with over 60 students enrolled. Students are assigned to study teams for in-class work; each team is comprised of five to six students. Individual students complete study guides prior to each class meeting. Study guides are instructor-designed and draw content from the textbook used in the course. The guides are then used as a basis for in-class learning activities. The course meets for four 50-minute sessions per week; the primary presentation format has been lecture/discussion.

The expected learning outcomes for the course are that students will label anatomical structures and describe physiological functions related to normal, hearing, speech, and swallowing. Achievement of these outcomes is measured by performance on written examinations; typically, this course poses enormous challenges for the students.

Ordinarily, four faculty members teach this course, with one faculty member teaching the respiration and phonation sections and the other three each teaching one of the remaining sections of the course: articulation and resonance, the ear, and neurology. However, during the fall 2006 semester, only three faculty taught the course, and a single instructor—Dr. Linda Carpenter—taught the first three of the five units of the course: respiration, phonation, and articulation and resonance. This teaching assignment offered the opportunity to systematically test strategies for enhancing student learning in this course. The intent was to hold the instructor constant while varying instructional strategies.

For this project, Carpenter, a professor in CSD, collaborated with Ms. Andrea Boh, a first-year graduate student in CSD who served as the graduate teaching assistant for the course during the fall 2006 semester.

The Study

The study was designed to compare the effectiveness of three teaching techniques in enhancing student learning in this undergraduate course in anatomy and physiology. The three techniques were study guides, study guides plus group quizzes, and study guides plus student response systems (clickers).

The research question for the study was as follows:

What is the comparative impact on student learning, as measured by performance on written examinations, of study guides, study guides + group quizzes, and study guides + student response systems (clickers)?

Study guides were used to teach the respiration unit, study guides plus in-class group quizzes were used to teach the phonation unit, and study guides plus student response systems (clickers) were used for the articulation and resonance unit.

Study guides helped students organize information about skeletal and muscular structures as well as functions presented in the textbook and the accompanying CD. During each class meeting, students worked in pre-assigned groups to review study guides. Items in need of clarification were discussed with the entire class. This procedure was used in all units.

During every other day of the phonation unit, a 10-item multiple-choice quiz was given in class. Books and notes were not allowed, but students talked over answers in their teams before indicating the team's response on a pre-coded scratch-off card. All questions and their correct answers were discussed during the quiz.

During each class meeting of the articulation and resonance unit, 10 multiple choice questions were presented using the Turning Technologies software and students responded individually using the clickers. Each question, its correct answer, and the other choices were discussed during the quiz.

At the end of each week of instruction, students took a 30-question fill-in-the-blank or short answer quiz. Quiz questions were derived largely from study guides. All quizzes were administered online in D2L, and students were allowed to use notes and books to answer quiz questions. Across the three instructional units, the students took eight weekly quizzes (two for Respiration and three each for Phonation and Articulation and Resonance units), six group quizzes, and 11 clicker quizzes. At the end of the three units of instruction, students were surveyed about their satisfaction with and preferences for the three techniques.

Results

Weekly Quiz Scores

Mean weekly test scores across the three units are displayed in Table 1.

Table 1: Mean quiz scores x instructional unit

	Respiration study guides (2 quizzes)	Phonation study guides + group quizzes (3 quizzes)	Articulation and Resonance study guides + clickers (3 quizzes)
Mean (sd)	79.62 (12.26)	80.40 (10.84)	84.81 (8.62)

Visual comparison of mean scores shows a steady increase in performance from the first to the last unit. Although the difference between scores under the study guides condition and the study guides + group quizzes condition was not significant, the mean score on those quizzes was significantly less than the scores under the study guides + clickers condition: study guides < study guides + clickers ($t = -4.56, p < .01$); study guides + group quizzes < study guides + clickers ($t = -3.72, p < .01$).

Student Satisfaction

Students were surveyed at the end of the three instructional units to determine their satisfaction with the three strategies. The percentages of students indicating each response are displayed in Tables 2 – 5.

Table 2: Which instructional strategy offered the most positive learning experience? (n=59)

Study guides alone	Study guides + group quizzes	Study guides + clickers
0	30.51%	69.49%

An overwhelming majority of students found the study guides in combination with the clicker response system to offer the most positive learning experience. In their open-ended comments, the students noted that the individual focus of the clickers contributed to their personal learning experiences. While talking answers over in a group was beneficial for some students, most felt that it was easy to get lost in the group and that a teams' understanding did not necessarily reflect what individuals learned.

Table 3: Which instructional strategy was most helpful for problematic areas? (n=59)

Study guides	Group Quizzes	Clickers
33.9%	27.12	38.98%

Again, students found the clickers most helpful to them in understanding problematic areas, but this help was coupled to a large extent with use of study guides. As one student stated, "The study guides forced me to read the text carefully as well as looking at the CD. This gave me the overall idea of the information, and both the group quizzes and clickers made me think a little more. They allowed me to evaluate my knowledge and know whether I needed to work on the material more." Another wrote, "Everything helped greatly, but I found that when doing the clickers and hearing explanations of why it would or would not work, things were a lot clearer for me."

Table 4: Which instructional strategy would you prefer to have in the future? (n=62)

Study guides, group quizzes, and clickers	Study guides + clickers	Study guides + group quizzes	Group quizzes + clickers
66.13%	17.74%	14.52%	1.61

The clear preference for the students in this class was for a combination of all three strategies. That is, they would prefer to have study guides, group quizzes, and clickers simultaneously. As one student noted, "It wasn't so much the quizzes or clickers themselves, but the explanations and elaborations [by the instructors] that really clarified the materials. I like the format of having a question posed, time for consideration and the requirement of submitting a response, then feedback and discussion."

Table 5: From which instructional strategy did you gain the most educational benefit? (n=56)

Study guides	Group quizzes	Clickers
67.86%	8.93%	23.21%

An overwhelming majority of the students believed that they gained the most educationally from the study guides. As one student noted, "the study guides are the most effective but the clickers and group quizzes made the class more fun and helped clarify things I didn't understand."

Discussion and Reflection

The data suggest that a combination of study guides and clickers led to best student performance, and students believed that this combination offered them the most positive learning experience. These data suggest strong support for the power of clickers to enhance student learning. However, while it is

tempting to attribute the performances in the articulation and resonance unit to the use of the clickers, it is unclear that this conclusion is true.

It may be that the cumulative effect of being in the course improved students' focus and performance. Early in the semester, students seemed to struggle with completing work before coming to class and spending class time on clarification rather than initial presentation of information. As the semester unfolded, students seemed to "get into the camp program" and take more responsibility for their own learning. As a result, performances during the articulation and resonance unit may have been related more to students learning how to learn the material than to any specific instructional strategy used in teaching.

It may also be that differences in the ways the three sections of the course were taught contributed to the outcome. For example, there were substantial differences in the ways in which the study guides were organized across the three units as well as the ways in which the weekly quizzes were arranged. In addition, the first section spanned only 8 hours of instruction, whereas the other two sections spanned 12 hours each. That first section addressed the respiratory system, and conversations with colleagues suggest that respiratory physiology is among the most complex topics to understand. Moreover, as the instructor, I was more familiar with the articulation and resonance content and felt more confident teaching that section of the course; as a result, information in the other sections may not have been presented as well or as clearly. These variations in instruction and in measurement of learning preclude strong statements about the impact of the clicker system, in spite of significantly higher quiz scores under that condition.

It seems more accurate to conclude that the study guides helped students organize information prior to class, but that clickers solidified their learning during in-class activities. Group quizzes also solidified learning, but to a lesser degree. Moreover, the discussion in class around clicker and group quiz questions may have been the more powerful contributor to student learning. The influence of these factors, along with examination of the apparent "order effect" noted in this study, need to be examined in future studies to further examine the impact on learning of the clicker systems. In addition, future offerings of this course will involve several re-design efforts to equalize student learning experiences across the content units. These efforts will include refining study guides and quizzes and exploring continued use of clickers in conjunction with in-class discussions of course content.