Traditional versus Non-traditional Teaching: Perspectives of Students in Introductory Statistics Classes

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Abstract

Although there has been a considerable amount of work evaluating the effects of different (non-traditional) instructional styles, inquiries into students’ preferences of instructional style have been few. From 1998-2001, we surveyed introductory statistics students regarding various aspects of their class preferences, especially the teaching style they prefer. We analyzed the data for the purpose of seeing if there has been an increasing trend in preference towards non-traditional methods. Our results are inconclusive (p = 0.35) about the presence of such a trend. However, the overall proportion of students preferring non-traditional classes is higher than students preferring traditional classes (p < 0.001). We also used the survey data to investigate the possible attributes that relate to preference. Using Stepwise Logistic regression (with \( \alpha = 0.10 \)) we find that the students’ ideal class-size, the number of years since they graduated from high school, the perceived learning styles of the students, and the attitudes of students towards the use of visual aids and hands-on activities are all significantly related to the teaching style preferences of students.

1. Introduction and Literature Review

Researchers examining different approaches for teaching at the college and university level have observed positive results from the use of cooperative learning and through the use of the Internet. Keeler and Steinhorst (1995), Giraud (1997), McCarthy and Anderson (2000), and Hinde and Kovac (2001) report higher test scores in cooperative learning (active learning) classes in comparison with traditional
lecture classes. Keeler and Steinhorst (1995) also observed a higher percentage of students successfully completing the course in the cooperative learning classes. Davidson and Kroll (1991) state that students in cooperative environments developed more positive attitudes towards mathematics than students in traditional environments. Johnson and Johnson (1985, 1986a, 1986b) advocate cooperative learning not only for the positive effect it has on student performance but also for the positive effect it has on motivation, classroom socialization, the student’s confidence in learning, and attitude toward the subject being learned. In a study of the comparison of Internet versus lecture instructional methods for teaching nursing research, Woo and Kimmick (2000) state that although there were no significant differences in scores or satisfaction, Internet students were significantly more stimulated to learn. In comparing lecture/videotape with multimedia CD-ROM methods for teaching oral medication administration, Jeffries (2001) observes higher satisfaction and greater cognitive gains for the multimedia group.

An evaluation of the impact of these different methods of teaching however would be incomplete if we failed to consider the perspectives of the students who are on the receiving end of these methods of instruction. These perspectives have received little attention in the literature. To gain some insight into the student perspective, the authors surveyed students in introductory statistics classes taught from 1998-2001. The data collected were used to address two questions:

Question 1: Has students’ preference for traditional (lecture) method declined over the recent years? (Q1)
Question 2: What factors are related to the style of teaching preferred by students? (Q2)

The style of teaching preferred by a student is a reflection of his or her learning style. In the research literature, there have been many demonstrations of how addressing the learning style of students has led to improved learning (Davidson, 1990; Henak, 1992; Spoon & Schell, 1998). By addressing the two questions above, the authors attempt to attain knowledge regarding the learning styles of students in introductory statistics classes. The instructors can use this knowledge in choosing appropriate instructional methods, in turn increasing the amount of statistics learning that takes place in the classroom.

2. The Setting

We conducted this study at Washington State University, which enrolls approximately 22,000 students. Each semester, the Statistics Department at the university offers two sections of a course in introductory statistics. In the 1998 Spring Semester, the instructor (the second author) asked the students in one section of this course to design a survey. They first had to submit 5 hypotheses they thought were relevant to learning styles and teaching preferences of college students. From the hypotheses generated by the class, the instructor compiled twenty-five hypotheses that addressed most of the questions of the students. Using these twenty-five hypotheses, students put together a survey to address these questions. Students worked in 2 to 3 person groups to design a survey. The instructor then selected questions from the different surveys that resulted to form one survey.

Upon receiving permission from the Institutional Review Board at the University, the instructor administered the survey to the students in the class around mid-semester. For the next five years, students in the same introductory statistics course, taught by the same instructor, filled out the survey around mid-semester, following a few changes made to the survey as a result of suggestions from students and faculty. Thus, this survey is essentially a survey instrument put together by students for students. We attach the Fall 2001 survey in the Appendix 1.

3. Description of the Sample
In total, 462 students comprise the convenience sample used in this study. These students took the introductory statistics course sometime between 1998-2001. Table 1 provides a description of the sample broken down by semester. The table entries are the averages, counts and percentages broken down by year and attribute. From the table, there was a good mix of male and female students as well as a good mix of students in regard to their year of study.

Table 1: Description of Sample

| Characteristic         | Spring 1998 | Spring 1999 | Spring 2000 | Spring 2001 | Fall 2001 |
|------------------------|-------------|-------------|-------------|-------------|-----------|
| Gender:                |             |             |             |             |           |
| Male                   | 64 (47.4%)  | 20 (43.5%)  | 22 (32.8%)  | 34 (49.3%)  | 36 (24.8%)|
| Female                 | 71 (52.6%)  | 26 (56.5%)  | 45 (67.2%)  | 35 (50.7%)  | 109 (75.2%)|
| Year of Study:         |             |             |             |             |           |
| Freshmen               | 12 (8.9%)   | 8 (17.8%)   | 7 (10.4%)   | 16 (23.5%)  | 21 (14.6%)|
| Sophomore              | 36 (26.7%)  | 8 (17.8%)   | 33 (49.2%)  | 18 (26.5%)  | 51 (35.4%)|
| Junior                 | 46 (34.1%)  | 14 (31.1%)  | 18 (26.9%)  | 22 (32.3%)  | 40 (27.8%)|
| Senior                 | 28 (20.7%)  | 8 (17.8%)   | 6 (9.0%)    | 10 (14.7%)  | 23 (16.0%)|
| 5+ year undergrad      | 10 (7.4%)   | 6 (13.3%)   | 3 (4.5%)    | 2 (2.9%)    | 8 (5.6%)  |
| Grad student           | 3 (2.2%)    | 1 (2.2%)    | 0 (0%)      | 0 (0%)      | 1 (0.7%)  |
| Average Age:           |             |             |             |             |           |
| (# of students)        | 21.2        | 22.4        | 21.2        | 20.9        | 21.0      |
| Average Student Math Skill Rating: Scale: 1 to 10 (# of students) | * | 6.5 (42) | 4.1 (63) | 6.4 (69) | 7.2 (145) |
| In Honors Program?:    |             |             |             |             |           |
| Yes                    | 14 (10.6%)  | 3 (6.5%)    | 10 (14.9%)  | 7 (10.3%)   | 11 (7.6%) |
| No                     | 118         | 43          | 57          | 61          | 134       |
4. Methods/Statistical Issues

In regard to question 1 (Q1 given in Section 1), the ongoing research about the greater effectiveness of non-traditional methods over traditional methods prompted us to hypothesize that there would be an increasing trend over recent years in the preference of non-traditional methods. That is, as time went along, the percentages of students preferring non-traditional methods would increase. Here we denoted “lecture” style classes as traditional and all other types of classes as non-traditional (this included Discussion-Based, Activity and Group-work Based, Distance Learning and Internet Classes). Let \( \pi_i \) denote the true proportion of students who prefer non-traditional method at time period \( i, i = 1, 2, ..., 5 \). Hence, our hypotheses, over our 5 time periods are as follows:

\[
H_0 : \pi_1 = \pi_2 = \pi_3 = \pi_4 = \pi_5 \\
H_1 : \pi_1 \leq \pi_2 \leq \pi_3 \leq \pi_4 \leq \pi_5, \text{ with at least one strict inequality}
\]

The authors used Cochran-Armitrage trend test (Armitage, 1955; Cochran, 1954) to test this null hypothesis.

In regard to question 2 (Q2 in Section 1), we hypothesized that many factors, would relate to whether a students prefer a traditional or nontraditional approach to instruction and these factors should be taken into consideration when considering the mode of instruction to be used. We performed a Step-wise logistic regression analysis (Agresti, 1990; Hosmer and Lemeshow, 2000; McCullagh and Nelder, 1989) to address Question 2. Table 2 provides a description of the explanatory and response variables.
Table 2: Description of Explanatory and Response Variables used in Logistic Regression Analysis

| Variable Name        | Description                                                                 |
|----------------------|-----------------------------------------------------------------------------|
| **Response Variable:**                          |                                                                             |
| TEACHSTYLE           | Mode of instruction preferred by students (Lecture = 1 Other = 0)           |
| **Explanatory Variables (Type):**               |                                                                             |
| SEMESTER (POLYTOMOUS)| What semester he or she was enrolled 4 indicator variables for the 5 semesters from which data are available |
| GENDER (DICHOTOMOUS) | Male = 0 Female = 1                                                         |
| AGE (CONTINUOUS)     | Age of student                                                              |
| YEAR OF STUDY (POLYTOMOUS)| What year in school 4 indicator variables for Freshman, Sophomore, Junior, Senior, Graduate student |
| HIGHSCHOOL (CONTINUOUS)| Number of years since graduating from high school                          |
| HONORSCOLL (DICHOTOMOUS)| Whether or not the student was in the Honors College (no = 0, yes = 1)   |
| LEARNSTYLE (DICHOTOMOUS)| How does the student describe his or her learning style (Active or visual = 1, Auditory = 0 |
| NOTETAKER (DICHOTOMOUS)| Does the student prefer taking notes in class (no = 0, yes = 1)           |
| VISUALAID (DICHOTOMOUS)| Does the student think visual aids are critical (no = 0, yes = 1)         |
| CONVERSATION (DICHOTOMOUS)| Does the student think conversation and humor are critical in the classroom (no = 0, yes = 1) |
| ACITIVITIES (DICHOTOMOUS)| Does a student find hands on activities critical (no = 0, yes = 1)       |
| HOMEWORK (DICHOTOMOUS)| Does the student think homework assignments are useful (no = 0, yes = 1)   |
| LABS (DICHOTOMOUS)   | Does the student find computer lab useful (no = 0, yes = 1)                |
5. Results

There was not an increasing trend in the percentages preferring nontraditional approaches for teaching in our study (refer to Table 3). The p-value resulting from performing the Cochran-Armitage trend test was 0.35. It is worth noting that the overall percentage of students preferring non-traditional methods was significantly higher than the percentage of students preferring lecture style classes (p-value < 0.001). For the individual years students preferred non-traditional methods significantly (p-value < 0.05) more than traditional methods in Spring 1998, Spring 2000 and Fall 2001. We used a Bonferroni correction to correct for the multiplicity of testing the five individual hypotheses.

Table 3: Students Preferring Traditional and Nontraditional Approaches by Semester

|                | Spring 1998 | Spring 1999 | Spring 2000 | Spring 2001 | Fall 2001 | Total |
|----------------|-------------|-------------|-------------|-------------|-----------|-------|
| **Traditional**|             |             |             |             |           |       |
| Count          | 46          | 26          | 21          | 29          | 49        | 171   |
| Column Percent | 34.1%       | 56.5%       | 31.3%       | 42.0%       | 33.8%     | 37.0% |
| **Nontraditional** |       |             |             |             |           |       |
| Count          | 89          | 20          | 46          | 40          | 96        | 291   |
| Column Percent | 65.9%       | 43.5%       | 68.7%       | 58.0%       | 66.2%     | 63.0% |
| **Total**      | 135         | 46          | 67          | 69          | 145       | 462   |

The analysis presented here indicates there are still some students who prefer lecture style teaching. Overall, 37% of the students in the sample preferred a traditional lecture-based approach to instruction. Given this, one question becomes, ‘What factors seem to relate to students preferring one approach over the other?’, the second question addressed in this study. To answer this question, we conducted a Stepwise logistic regression analysis. To determine which variables, of the several explanatory variables under consideration, are useful predictors of the teaching style preference, we used a stepwise procedure, with the stopping rule being that the p-value of all variables not in the model is > 0.10 (for both entering and leaving the model). We chose this .10 cutoff as opposed to the traditional 0.05 cut-off mark because of the exploratory nature of our study. We identified several explanatory variables.
(ACTIVITIES, CONVERSATION, HIGHSCHOOL, IDEALCLASSSIZE, LEARNSTYLE, SEMESTER, and VISUALAID) as being related to preferred teaching style and these variables were included in our final model. Table 4 provides the results from performing a logistic regression.

Table 4: Results of Logistic Regression Analysis

| Parameter       | Estimate | Standard Error of Estimate | Odds-RATIO | P-value |
|-----------------|----------|---------------------------|------------|---------|
| Intercept       | 1.0884   | 0.46520                   | ----       |         |
| SEM1            | -0.1773  | 0.29340                   | 0.867      | 0.5457  |
| SEM2            | 1.0447   | 0.39560                   | 2.839      | 0.0083  |
| SEM3            | -0.1709  | 0.35920                   | 0.839      | 0.6343  |
| SEM4            | 0.1360   | 0.34890                   | 1.142      | 0.6967  |
| HIGHSCHOOL      | 0.0607   | 0.03250                   | 1.062      | 0.0614  |
| ACTIVITIES      | -1.1899  | 0.31890                   | 0.305      | 0.0002  |
| LEARNSTYLE      | -2.0031  | 0.36740                   | 0.137      | <.0001  |
| VISUALAIDS      | -0.4311  | 0.25950                   | 0.632      | 0.0967  |
| CONVERSATION    | -0.5803  | 0.29190                   | 0.545      | 0.0468  |
| IDEALCLASSSIZE  | 0.0105   | 0.00557                   | 1.010      | 0.0598  |

From the table, various interesting results emerge. Here we use the odds-ratio as our parameter of interest and interpret our results in terms of odds-ratios (Hosmer and Lemeshow, 2000), holding all other variables constant. We first interpret the dichotomous explanatory variables, LEARNSTYLE, ACTIVITIES, VISUAL AIDS, and CONVERSATION. The estimated odds-ratio of 0.137 for LEARNSTYLE indicates that students who think of themselves as non-traditional learners are 0.137 times as likely to prefer lecture classes than the students who consider themselves traditional learners. Similarly, students who prefer hands-on activities, prefer visual aids, and like conversation in the classroom are 0.305, 0.632, 0.545 times as likely to prefer lecture–style classes as opposed to their counterparts, respectively.

For the continuous explanatory variables, HIGHSCHOOL and IDEALCLASSSIZE, we use odds-ratios as well, keeping the remaining explanatory variables constant. For every one year increase in the number of years ago they graduated from high school (HIGHSCHOOL), the odds of preferring lecture to non-lecture classes is 1.062 times greater. For IDEALCLASSSIZE, every increase in a single student in their ideal class size, the odds of a student preferring lecture to non-lecture is 1.01 times greater. We can also interpret the logistic regression coefficient in terms of log-odds ratios. Overall, these results (from odds-ratios and signs of the regression coefficients) tacitly indicate that students who consider themselves non-traditional learners, and who like activities, conversation and visual aids, show a preference for non-lecture style classes, while students who like larger classes and have graduated
earlier from high school have a preference for lecture-style classes.

The overall concordance for our final model was 75.5%. The Hosmer-Lemeshow Goodness of Fit indicates the logistic regression model provides a good fit for the data (p-value = 0.71). The deviance residual, Pearson residual and influence diagnostics did not show any influential cases worth discussion.

As noted earlier, the students in the classes put the survey together and, as a result, the explanatory variables reflect the factors they thought might be important to their preferred teaching style. In addition, there were also questions on the survey about blackboard/slide projector usage, when they prefer to have their classes (morning, noon or afternoon) and what kinds of tests they prefer. We felt that these variables would not be useful in explaining preference in teaching style and did not add them to the already lengthy list of explanatory variables in the logistic regression analysis.

Other factors that we included in the survey post-1998 were students’ perceived math skills; hours spent on the Internet, cumulative GPA and SAT math scores. The missing data for these variables were considerable. The authors did consider including in the data set only those students who provided answers to all the question on the survey. However, doing so would have resulted in an insufficient sample size. Also, only a handful of students filled out their cumulative GPA and SAT math scores. The authors felt that the few students who reported their scores were probably the higher scoring students who were not embarrassed to report their scores, thus introducing bias. Ultimately, we made the decision to exclude these variables from the analysis.

6. Conclusion

There is a considerable amount of literature about nontraditional approaches for instruction (cooperative learning, internet, etc.) and the benefits derived from implementing such approaches. Left out in these discussions, however, has been the perspectives of those on the receiving end of the instruction. From the results of the exploratory study presented in this paper, we are able to gain some insight regarding the perspectives of introductory statistics students. Students’ perspectives about their preferred teaching style are important because there is the idea that if students are taught classes in their preferred style, they will be able to learn better. The manuscripts discussed at the end of Section 1 advance this view.

Our results indicate that over recent years there has not been an increasing trend in the percentage of students preferring nontraditional approaches for instruction. This finding is contrary to our initial hypothesis (Q1). However, we do see a greater percentage of students preferring non-traditional methods overall. Further, in three of the five semesters studied, students preferred Non-traditional teaching styles. The term “non-traditional teaching style” is very generic and encompasses Discussion Based, Activity Based, Distance Learning and Internet Based classes. We also looked at these individual methods over the five years to see if any increasing trend exists in any one of these categories. The results from performing Cochran-Armitage test did not provide evidence of such trends.

We performed a logistic regression to provide explanations for the preference students have for either a traditional or nontraditional approach to instruction. We identified several attributes that relate to a student’s preference in teaching style and these attributes are included in Table 5.

| Table 5: Variables Identified as Being Related to Preference in Teaching Style |
|---------------------------------|
|                                |

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Students who prefer larger classes are more likely to show a preference for lecture style classes than those students who prefer smaller classes. Students who consider themselves active or visual learners are more likely to prefer non-traditional than their counterparts. Visual aids, activities in the classroom and conversation in the classroom are some of the aspects of the non-traditional approaches, and hence the results are not surprising.

Our Step-Wise procedure did not select “liking to take notes in class” as a “significant” predictor. However, we think this warrants some discussion. This factor had a positive slope for the regression coefficient, again indicating that note-takers show more of a propensity towards lecture style classes in comparison to their counterparts. Taking notes in class is a hallmark of the traditional lecture style classes and this preference makes sense intuitively.

It is worth noting that Semester 2, identified as the Spring Semester in 1999, did have a somewhat different pattern than the others. In this semester, the number of students who participated in the survey was fewer and unlike the other years, as a majority of them (56.5%) preferred lecture style teaching. To eliminate the possible “ironing out of effects” from incorporating this semester, we ran our step-wise (α = .10) logistic regression without this semester and observed the results. These results are provided in Table 6.

### Table 6: Results of Logistic Regression Analysis without Spring 1999 Data

| Parameter       | Estimate | Standard Error of Estimate | Odds-RATIO | P-value |
|-----------------|----------|----------------------------|------------|---------|
| Intercept       | 1.56     | 0.35                       | -----      |         |
| ACTIVITIES      | -1.13    | 0.34                       | 0.324      | 0.0008  |
| LEARNSTYLE      | -1.98    | 0.37                       | 0.138      | 0.0001  |
| VISUALAIDS      | -0.46    | 0.27                       | 0.630      | 0.0936  |
In this analysis in which Spring 1999 data were excluded, HIGHSCHOOL and IDEALCLASSSIZE, which were marginally significant in the original analysis, were not identified as significant. All other variables that were significant in the original analysis remained significant, with no other significant variables being identified.

In conclusion, our overall findings indicate that though there is not an increasing trend in preference towards non-traditional teaching methods from our data, several interesting themes emerge. It appears that there is a certain cohort of students with some of the attributes we mention who prefer lecture style classes and maybe this will always remain to some extent. One interesting result from the data is that there is a fair amount of variability in terms of student preferences over styles of teaching. Though there may be a shift towards non-traditional methods, this trend is hard to discern from the five years worth of data used in this study.

More detailed and focused research in this area will illuminate further patterns. Because the student perspective is important, we share our findings from this study. The generalizability of the results is somewhat limited but we do begin to understand some of the factors that go into student preferences. It is important to keep in mind the results do not indicate that just because they prefer one method over another, they are unable to learn in other methods. It is just a documentation of their preference. Obviously one cannot “please” all, so in view of the old adage, “we can please some of the people, some of the time”, we would suggest an eclectic approach to teaching encompassing varied techniques, e.g. lecture, activities, discussion and interactive work. We tacitly assume here, that if a student is taught in their preferred method, they will be “pleased”, which some of the referenced literature indicate will result in increased learning. Increased learning by students is the ultimate goal and we hope that the findings presented here is a step in the right direction.

Appendix 1

STATISTICS 2**, Fall 2001
Survey to study the effects of Teaching and Learning Styles

Please take a few minutes to answer the following questions. You may leave blank certain questions. But the survey is going to be kept COMPLETELY anonymous.

Student Information:

1. What is your gender?
   o Male
   o Female

2. What year are you in WSU?
   o Freshman
   o Sophomore
   o Junior
3. How long ago did you graduate from High school? __________

4. How often do you access the internet? # of hours a week)________________

5. What is your age? _______________

6. On a scale of 1-10 how would you rate your Math skills? ________

7. Are you a part of the honors program?________

8. What is your cumulative GPA? ______

9. How many semesters have you attended at WSU? ____________

10. For your classes do you seek help from your instructor or TA? ________________

11. What was your SAT MATH score?________

Questions:

1. Do you think that having classes be shorter and held more frequently each week would improve your ability to concentrate on the material and remember better?
   - Yes
   - No
   - No opinion

2. Your ideal class number size is? ________________

3. Which style of classes would suit you best?
   - A lecture based class.
   - A discussion type class.
   - Activities and group work based class.
   - Distance learning type class.
   - Class taught over the internet.
   - Other, specify. ________________

4. How would you describe your learning style?
   - Visual learner.
   - Active learner.
   - Learn best in a lecture format.
   - Auditory.

5. What form of note-taking do you prefer?
   - Taking notes in class.
   - Having pre-made notes given to you.
   - Having notes available on the internet.
Does not matter.

6. How helpful are visual aids in learning?
   - I cannot learn without it.
   - It helps me somewhat.
   - I do not care.
   - They bother me and take away from learning.

7. How helpful are hands-on activities?
   - I cannot learn without it.
   - It helps me somewhat.
   - I do not care.
   - They bother me and take away from learning.

8. How would you like lectures to be presented to you?
   - Written on a chalk board/white board.
   - With pre-made slides on a slide projector.
   - Written with a pen on the slides on overhead projector.
   - With computer generated projected images.
   - A combination of these. Please specify: ________________________
   - It does not matter to me.

9. Which style of testing would you prefer?
   - Just one final exam at the end.
   - One midterm and a final.
   - A shorter test every month or so.
   - Weekly quizzes and a final exam.

10. Weekly home-work assignments and quizzes are ...?
    - Helpful.
    - A waste of time.

11. Computer labs, in conjunction with lectures are ...?
    - Useful.
    - A waste of time.

12. You prefer classes in the ...?
    - Morning.
    - Midday.
    - Afternoon.
    - Late evening classes.
    - Does not matter.

13. When class information is posted on the INTERNET, how often do you access it? # of times on an average week ____________

14. Do you think having syllabus, notes and assignments on the internet is ...?
    - Useful.
    - Somewhat useful.
    - Not at all useful.
15. How important is the personality of your instructor in your learning process?
   o Very important.
   o Somewhat important.
   o I do not care.

16. Does conversation and humor have a place in the classroom?
   o Yes, I cannot learn without it.
   o It helps.
   o It is not important.
   o I learn better without humor.

17. Does the gender of the instructor affect your learning?
   o I learn better from a male instructor.
   o I learn better from a female instructor.
   o It does not matter.

References

Agresti, A. (1990), Categorical Data Analysis, New York: John Wiley.

Armitage, P. (1955), “Tests for linear trends in proportions and frequencies,” Biometrics, 11, 375-86.

Cochran, W. G. (1954), “Some methods for strengthening the common tests,” Biometrics, 10, 417-51.

Davidson, G. V., (1990), “Matching Learning Styles with Teaching Styles: Is it a useful Concept in Education?” Performance and Instruction, 29(4) 36-38.

Davidson, N., and Kroll, D. L. (1991), “An Overview of Research on Cooperative Learning Related to Mathematics,” Journal of Research in Mathematics Education, 22(5), 362-65.

Giraud, G. (1997), “Cooperative Learning and Statistics Instruction ,” Journal of Statistics Education [Online], 5(3). ww2.amstat.org/publications/jse/v5n3/giraud.html

Henak, R. M., (1992), “Effective Teaching: Addressing Learning Styles,” Technology Teacher, 52 (2) 23-28.

Hinde, R. J. and Kovac, J. (2001), “Student Active Learning Methods in Physical Chemistry,” Journal of Chemical Education, 78(1), 93-99.

Hosmer, D. W., and Lemeshow, S. (2000), Applied Logistic Regression, 2nd Ed. New York: John Wiley & Sons.

Jeffries, P. R. (2001), “Computer versus Lecture: A Comparison of Two Methods of Teaching Oral Medication Administration in a Nursing Skills Laboratory,” Journal of Nursing Education, 40(7), 323-29.

Johnson, R. T., and Johnson, D. W. (1985), “Student-Student Interaction: Ignored but Powerful,” Journal of Teacher Education, 34(36), 22-26.
----- (1986a), “Action Research: Cooperative Learning in the Science Classroom,” *Science and Children*, 24(2), 31-32.

----- (1986b), *Encouraging Student/Student Interaction. Research Matters ... to the Science Teacher*, ERIC Document ED266960, United States: National Association for Research in Science Teaching.

Keeler, C. M., and Steinhorst, R. K. (1995), “Using Small Groups to Promote Active Learning in the Introductory Statistics Course: A Report from the Field,” *Journal of Statistics Education* [Online], 3(2) [ww2.amstat.org/publications/jse/v3n2/keeler.html](http://ww2.amstat.org/publications/jse/v3n2/keeler.html)

McCarty, J. P. and Anderson, L. (2000), “Active Learning Techniques versus Traditional Teaching Styles: Two Experiments from History and Political Science,” *Innovative Higher Education*, 24(4), 279-94.

McCullagh, P., and Nelder, J. A. (1989), *Generalized Linear Models, 2nd Ed*. London: Chapman & Hall.

Spoon, J. C., and Schell, J. W., (1998), “Aligning Student Learning Styles with Instructor Teaching Styles,” *Journal of Industrial Teacher Education*, 35 (2), 41-56.

Woo, M. A., and Kimmick, J. V. (2000), “Comparison of Internet versus Lecture Instructional Methods for Teaching Nursing Research,” *Journal of Professional Nursing*, 16(3), 132-39.

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