USING PEER ASSESSMENT OF PROJECT PRESENTATIONS TO DEVELOP SKILLS AS CONSUMERS OF STATISTICAL INFORMATION

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This paper begins with a description of several learning goals of the two-course Introductory Statistics sequence for undergraduate business students at the International University of Monaco, and then focuses on the goals of communicating statistical results and becoming critical consumers of statistical information. As our students are business students, we aim for them to become both producers and literate consumers of statistical analysis. In line with reform movements in Statistics Education and the GAISE guidelines, we are working to implement teaching strategies and assessment methods that align instruction and assessment with our learning goals. One of the main instructional tools we use is group projects with elements of peer and self assessment. This paper describes how peer evaluations are carried out, how they are summarized and why we believe that explicitly incorporating these self and peer assessments has improved student learning both in communicating and in consuming statistical information.

INTRODUCTION

Across higher education, there has been a strong push toward defining and assessing learning goals and outcomes across the curriculum. Accrediting bodies now regularly require documentation of institutional assessment practices. At the International University of Monaco (IUM) we are working on assessment practices and in particular in the introductory statistics courses. IUM is a small private English-language business school in the Principality of Monaco, offering undergraduate and graduate degrees in business management. Undergraduate students take a two course sequence in Probability and Statistics/Quantitative Methods, with class size typically ranging between 10 and 25 students. Each course runs over 12 weeks with a total of 45 hours of contact time with the professor. Courses meet two days per week with at least one meeting in a computer lab. All classrooms are equipped with computers and projectors so professors can do computer demonstrations in any classroom. Prior to taking these courses students have passed a course on information technology so they are already familiar with Word, Excel and PowerPoint.

The quantitative backgrounds of our students vary considerably, as do their educational systems and native languages. Over the last nine years, we have worked to transform the course from a traditional course to an innovative course stressing statistical concepts, applications, and active learning. We have integrated group projects into these courses and both the style of projects and the manner of assessing them have evolved considerably. In this paper I describe the structure of the projects and how we use peer assessment of projects to help students develop critical listening skills as consumers of statistical information.

LEARNING OUTCOMES, PROJECTS AND THE GAISE RECOMMENDATIONS

The course learning outcomes for the two-semester introductory statistics sequence at IUM include that students should:

1. Correctly apply statistical techniques to common business situations, and use statistics as a tool for making well-informed decisions.
2. Work as a team to analyze real data and present an analysis in varying levels of technical detail in the form of a memo, an oral presentation and a statistical appendix.
3. Critically evaluate statistical information in presentations and in articles on current events.

The advantages of using data driven projects in Introductory Statistics courses are already well documented (Moore, 2000). We have found that group project work is well suited for reaching many of our learning outcomes. In particular, projects require students to gather or

access real data, to use Excel to summarize, graph and produce statistical output and to work in teams in and out of the classroom. Additionally, each project has elements of professor, self and peer assessment. The differing aspects of project work also incorporate many of the six main recommendations for teaching the introductory statistics course as outlined in the GAISE College Report:

1. Emphasize statistical literacy and develop statistical thinking
2. Use real data
3. Stress conceptual understanding rather than mere knowledge of procedures
4. Foster active learning in the classroom
5. Use technology for developing concepts and analyzing data
6. Use assessments to improve and evaluate student learning.

A common drawback, however, is that projects tend to demand a large time investment from professors and students, rendering them difficult to administer in large classes (Cryer, 2005). The small class sizes at IUM make incorporating project work and presentations quite feasible and students complete two or three group projects per semester. A presentation set for the entire class typically consumes one two-hour class session including time for discussion, so of the 22 course sessions, two or three are dedicated to presentations.

Each project consists of three related reports: a written memo, a technical appendix, and an oral presentation. The memo must address an audience of business people for whom the students may assume no particular statistical knowledge. The appendix includes all results clearly presented and commented for a statistician; and the oral PowerPoint presentation is directed toward an audience with a mixed level of technical knowledge. Some projects require students to collect data on their own, while others use data that I provide or that come from other published sources. Students work in groups of two or three, and while they may pick their own groups, no two students may work together more than once.

PROJECT ASSESSMENT

Joan Garfield describes in (Garfield, 2000) the current vision of assessment as "that of a dynamic process that continuously yields information about student progress towards the achievement of learning goals." She goes on to discuss the evolution of assessment from the assignment of grades to an integral part of the teaching and learning process, and in particular to say that the primary purpose should be to improve student learning.

Over the years, the "who" and the "how" of project assessment have evolved. Originally I assessed each project on my own. Currently, each project is also evaluated in part by all class members and by the presenters themselves. While assessment of statistical content tends to stay similar from year to year, I've found developing assessment tools for gauging the learning goals of communicating statistical information and of critically consuming statistical information more challenging.

Communicating Statistical Information

When I assign a project, I provide all students with a grade sheet with four sets of detailed criteria both of what will be assessed --- the presentation and explanation of data, the statistical content and validity of results, the written communication of results and appendix, and the oral presentation --- and how value will be assigned. In line with the course learning goals, specific criteria address student ability to draw valid conclusions from the data and to make appropriate recommendations and address using differing levels of explanation and technical jargon for the varying audiences. I found that the more specific and clear the criteria are, the higher the quality of the projects. However, over time, I realized while many of the criteria addressed the ability to produce and convey statistical information, none adequately dealt with the ability to consume statistical information.

Critical Consumers of Statistical Information

The GAISE guidelines recommend that students should "know how to critique news stories and journal articles that include statistical information, including identifying what's

missing in the presentation and the flaws in the studies or methods used to generate the information." While I do not yet have hard evidence, my experience is that students are much more critical of statistical information they read, than of statistical information they hear. In order to gauge how well students listen to presentations and critically evaluate information conveyed, I first began by using informal peer discussion after each presentation. One year a group of particularly talented and articulate "presenters" gave a presentation with stylish slides, convincing and engaging audience contact, and horrendously flawed statistical reasoning – concluding with a high level of confidence that the price of oil would remain between $26 and $30 for the next five years. When I asked the class for feedback, they were overwhelmingly positive. So impressed were they with the style, that not a single student had noticed the errors in content. From that day on, I have included explicit written peer assessment in the projects as a way to increase students' critical listening skills.

PEER ASSESSMENT

Prior to presentation day, all students use the project criteria to assess their own work. On presentation day, I distribute a paper to each student with three columns. (See Table 1) For each group presentation students must write at least two specific positive comments and two specific comments on how the project could be improved. Two of the four must be *content* related, and all must be constructive or regenerative. I collect the papers at the end of the presentation session and review all comments – circling those that are most pertinent and putting an x next to those of little value. Each student earns +1, 0, or -1 point based on his/her critiques. Each group earns the same project grade, and I then adjust this grade for each individual according to critique points. The motivating factor of this point far exceeds its influence on the final grade.

After completing the first set of critiques, I distribute a summary of all comments (names removed) to all class members, and as a class, we develop vocabulary for evaluating projects. As homework, I ask students to select the four most and the four least constructive comments from each list and rewrite the four least to make them more clear and helpful. For example, some change "good graphs" to "histograms clearly labeled and on same scale, made comparison between the men's and women's salaries easier." In the following class session, we discuss the changes they've written. The entire discussion takes no more than 15 minutes of class time, but has long-lasting implications on the quality of comments.

For all projects, each group receives an anonymous summary of peer comments, example in Table 1. These peer assessments have multiple benefits. Students are strongly motivated to receive positive feedback from their peers, they tend to react more positively to critiques from peers than those from professors, and by doing the assessments they improve their critical listening skills and develop the kind of evaluation skills that are transferable to many other academic and business situations. Project and critique quality improve considerably throughout the two semesters as students gain confidence and a greater comfort level in giving and receiving constructive criticism. An added bonus is the more specific qualitative feedback I receive about the course at the end of the semester which helps me to improve the course.

Final project feedback to students includes one professor grade sheet for each project with a number value and specific written comments on each criterion, comments on each student's self critique where differences exist, and the summary of peer assessments. To ensure that assessment acts a tool to enhance student learning, I include in all written evaluations clear indications of how to improve on future work. I also consciously include comments praising what students have done well, as many come to statistics courses with a negative view of their own ability to succeed in a quantitative, mathematical course and a little praise goes a long way in establishing some self confidence.

Table 1
Examples of Peer Assessment Comments

Team	What went well?	What can be improved?
	Clear analysis of the correlation matrix	Scatter plots should be on same slide in order to compare better.
	Good idea to show all variables in a single chart with trend line	Serious crimes should be in first column of correlation matrix for better visualization
	Interesting analysis comparing male/female future work/study plans, but expected values less than 5 for chi-squared test	Could have done a hypothesis test to show that there is no statistical evidence that the two independent variables used in multiple regression are related
	Clear interpretation of slope for dummy variable fireplace and for lot size.	R-sq almost 1 so it should be a strong line fit, group said it wasn't
		P value of t-test for "male arrests" is bigger than 0.1 so they should not consider it in final model
		Clarify sampling method and population a bit more

CONCLUSION

Student response to project work and to peer evaluations has been overwhelmingly positive. On course evaluations, over 50% of the students respond that projects were the most beneficial/stimulating aspect of the course. Typical comments are that they improved their ability and their confidence in writing and presenting technical information, the topics/areas they did projects on they learned the topics in more depth, they gained valuable experience in working as a team on a common project, and they learned to critique each other. Often there are comments on the amount of work the course requires, however over 90% of numerical responses on a scale of 1 to 5 with 5 as "strongly agree" have been 4 or 5 to the questions "Do you find the quantity of projects appropriate" and "do you find the quality of projects appropriate". Many more students also now use some form of statistical reasoning and analysis in their final thesis projects before graduating, a sign of greater interest in and greater retention of material learned. Colleagues who have the students in class the year after they've completed their statistics courses, regularly give positive feedback as to the level of student engagement in presentations and their ability to make quantitative presentations.

One of the greatest challenges for the instructor, however, is that teaching with projects and especially incorporating peer feedback considerably increases the workload and time investment for these courses. For example, completing the summaries adds significantly to grading time and, to be useful, this must be done quickly after the presentation. For larger classes, I have at times cut comments out and then given groups a stapled stack of peer feedback. Getting other colleagues on board and excited about these methods is another challenge. However, as Robert Wardrop argues in his article on using student projects (Wardrop, 2000), "on certain occasions a teacher should opt for a more difficult way to teach statistics." In my experience, the extra effort to teach this way is well rewarded by the increased satisfaction I feel from seeing students apply what they learn to new situations, engage actively in and learn from the presentations of their peers, and the pleasure in seeing students develop skills they can use throughout their academic and professional lives.

REFERENCES

Cryer, J.D. (2005). Teaching Statistics to Business Students. In J.B. Garfield (Ed) *Innovations in Teaching Statistics: MAA Notes 65*.

Garfield, J. G. (2000) Beyond Testing and Grading: New Ways to Use Assessment to Improve Student Learning. In T. Moore (Ed.). *Teaching Statistics - Resources for Undergraduate Instructors: MAA Notes 52*.

Guidelines for Assessment and Instruction in Statistics Education (GAISE). Retrieved from: http://www.amstat.org/Education/gaise/GAISECollege.htm

Moore,T. (2000). Teaching with Data. In, T. Moore (Ed.) *Teaching Statistics - Resources for Undergraduate Instructors: MAA Notes 52*.

Wardrop, R. (2000). “Small Student Projects in an Introductory Statistics Course.” In, *MAA Notes, 52*.