

CLASSROOM RESEARCH WORKING PAPER SERIES

Volume 1

Featuring projects by the 2011-2012 Graduate
Research and Teaching Fellows and Teagle Fellows:

Kevin Carrico (Anthropology)

Shoshanna Cole (Astronomy and Space Sciences)

Jess Keiser (English Language and Literature)

Emily Pollina (Ecology and Evolutionary Biology)

Baidurja Ray (Mechanical Engineering)

Jennifer Row (Comparative Literature)

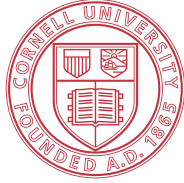
Lauren Schnabel (Comparative Biomedical Sciences and Veterinary Medicine)

CENTER FOR TEACHING EXCELLENCE
Sponsored by the Teagle Foundation



Editors: Kimberly Williams, Ph.D., and Runjini Raman





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2011–2012 Graduate Research and Teaching/Teagle Fellow Contributors

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Cornell University

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All articles in this collection of working papers (either in their entirety or summaries of them) have been published in:

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A published version of Baidurja Ray's classroom research project, co-authored with Rajesh Bhaskaran and entitled "Integrating simulation into the engineering curriculum: a case study" is published in the July 2013 *International Journal of Mechanical Engineering Education*, 41(3), 269-280.

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Kevin Carrico's "The Pedagogy of Controversy in the Field of China Studies: Teaching the Cultural Revolution" full project is forthcoming in the June 2014 issue of the journal *Learning and Teaching: The International Journal of Higher Education in the Social Sciences*, 7(2).



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INTRODUCTION

What is Teaching as Research and the Scholarship of Teaching and Learning?

Kimberly Williams

Published (forthcoming 2014) "Doing Research to Improve Teaching and Learning: A Guide for College and University Faculty" Routledge: Taylor and Francis

INTRODUCTION AND BACKGROUND

As costs of college and university attendance continue to skyrocket, calls for accountability of student learning have grown louder. Even without outside calls for accountability, as a professor for over two decades at a variety of institutions, ranging from my start teaching at a two-year agriculture and technological state institution to a couple of different institutions in the Ivy League, I, like most of my faculty colleagues, *want our students to learn what we believe is important enough to be teaching them. We want them to engage with the material in meaningful ways—we want them to think critically about it. We want to know that learning is taking place, and that what we do as faculty in the classroom matters and makes a difference. We want to be good teachers in the classroom. Even beyond the walls of our classrooms and the ever-growing classrooms without walls, such as online courses and Massive Open Online Courses (MOOCs), the best way to improve our society is to build the knowledge-base and critical thinking skills of ourselves and our next generation of the world's citizens. We hope that future generations continue to build upon existing knowledge to make the world a better place. Higher education strives to contribute to the generation of new knowledge. To do so, we must pass along existing knowledge through teaching to the future generations.*

But how do we know if we are effectively accomplishing these lofty goals?

We have assessments (papers, exams, reports, etc.). We have final course evaluations that our students

complete about our performance. Sometimes we have colleagues observe our teaching. But how do we know if our students are learning anything or if they are retaining it or how they are being changed as a result of their time with us? And how can we continue to improve our own practice of the art and science of teaching?

The answer to many of these questions is addressed in this book and involves using what we as faculty know best—research. We can draw upon our skills as researchers and knowledge producers to ask questions about our teaching and student learning. We can systematically collect data. We can analyze data and share it. We can use data to inform new ideas we have about teaching and learning and continue the cycle again. As faculty members, we think like researchers. We received our academic credentials based on our ability to do research, whether in the Humanities, Social or Natural Sciences. We must demonstrate research skills (or at least the ability to generate new ideas and knowledge) to receive the doctorate.

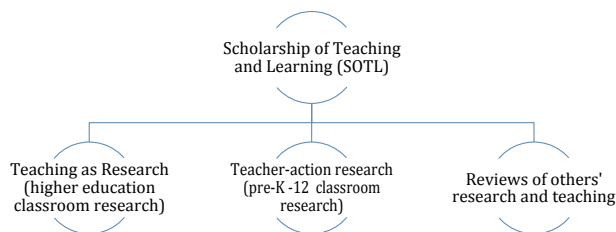
The use of research to inform teaching seems so elegant in its simplicity, and yet can be so difficult in actual practice without some basic assistance. We have so many students and so little time. We have so much content to cover, and we have so many committees and, of course, our commitment to our own disciplinary research. How can we possibly have time for this additional research that will not necessarily help us in obvious ways toward promotion or tenure? (The truth is that by improving teaching, you improve your odds of promotion and tenure).

It is possible to do this kind of research within the context of work you are already doing. This book will give you ideas and practical examples to guide you through the process that will make the task manageable as you juggle the many demands of academe.

Classroom research in higher education settings is not a new idea—it has been around for decades. In fact, the Carnegie Foundation started an initiative in 1998 called the Carnegie Academy for the Scholarship of Teaching and Learning (CASTL) that was based on the scholarly report published in 1990 called “Scholarship Reconsidered” by Ernest Boyer calling for the use of research to inform and improve teaching in the college and university classroom. More recently, Pat Hutchings, Mary Taylor Huber, and Anthony Ciccone have published a book called “The Scholarship of Teaching and Learning Reconsidered: Institutional Integration and Impact” (Jossey-Bass, 2011). And a consortium of several universities nationwide has been working collaboratively under the name of Center for the Integration of Research, Teaching and Learning (CIRTL) funded by the National Science Foundation. The movement is gaining momentum as students, parents, taxpayers, and faculty themselves are clamoring for ways to improve learning in the college classroom.

What exactly do we mean by “Teaching as Research” and “Scholarship of Teaching and Learning”? These terms have become quite popular in higher education. What do they mean exactly? For the past couple of decades, this field of inquiry has been known as “the Scholarship of Teaching and Learning.” The notion of “teacher-action research” (a phrase more associated with teacher-conducted classroom research in K-12 education) has been around for decades as has “the Scholarship of Teaching and Learning.” In “teacher-action research” and “teaching as research” the teacher uses research to inform his or her own classroom teaching and student learning in systematic ways. Using qualitative research methods (e.g. interviews, journals, observation, open-ended surveys), quantitative research methods (e.g., numeric surveys, pre and post-tests, control/comparison groups, etc.) and assessment strategies (e.g., formative and summative assessment of student learning) teachers collect data about their own classrooms, as researchers collect data, to inform and improve their teaching and ultimately student learning. The notion is that good research will result in good teaching.

The Scholarship of Teaching and Learning (SOTL) typically encompasses teacher-action research and teaching as research, but is broader and beyond just the teacher or professor doing research on his or her own classrooms, and includes the whole scholarship of the enterprise of research on teaching and learning—not focused as specifically on one’s own classroom research.



Truth is, good teachers use research (or variations of it) to inform their teaching every day, sometimes without knowing it. They are constantly reviewing assessment data, making critical observations of their students and themselves, and collecting qualitative and quantitative data. *Teaching as research* formalizes the process—that is, makes data collection and analysis more purposeful and grounded in specific learning outcomes for students. In addition it also considers deeply the existing research on teaching as well as considers how their work may contribute to the improvement of teaching in general and in one’s own discipline.

Higher education is perfectly positioned to make this shift to a culture of teaching as research and embracing the scholarship of teaching and learning because research is such a major part of the responsibility of the faculty member, and as part of their intellectual preparation for academic work, faculty members have been prepared in research skills. One challenge, however, is that faculty have been trained in discipline-specific research strategies and rarely have been explicitly taught pedagogical/teaching strategies or research strategies outside of the ones they use regularly. Making the leap between a faculty member’s discipline-specific research skills and research strategies (ways of producing new knowledge) that can be used to inform and improve teaching is not quite as much of a stretch as one might think, but it does require some background knowledge and effort.

Bridging this gap is the primary goal of this working paper series. In short, the articles published in this series seek to provide examples of college and university faculty who have taken their skills from their research worlds, expanded them and learned new strategies outside of their discipline-specific strengths, and applied the tools of research to their teaching to inform and improve learning in their classrooms by using “teaching as research” as a model.

WHAT IS THE “SCHOLARSHIP OF TEACHING AND LEARNING?”

In their article written for the Carnegie Foundation for the Advancement of Teaching, Mary Taylor Huber and Sherwyn Morreale wrote of the Scholarship of Teaching and Learning: “The scholarship of teaching and learning in higher education currently belongs to no single national association and has no unique campus address. As befits a vigorous, emergent area of intellectual discourse and debate, the scholarship of teaching and learning is springing up in established departments, programs, and centers, and developing new forums and outlets of its own. Yesterday, in every discipline, you could find small cadres of faculty who made education in that field their subject of research. Today, inquiry into college teaching is more than just a specialist’s concern. Across the academy, ‘regular’ faculty members are taking systematic interest in curriculum, classroom teaching, and the quality of student learning. Professors in disciplines from anthropology to zoology are beginning to consult pedagogical literature, look critically at education in their field, inquire into teaching and learning in their own classroom, and use what they are discovering to improve their teaching practice. In addition, many are making this work public so that it can be critiqued and built upon.” (Huber and Morreale, para. 1). This scholarship of teaching and learning is not limited to those in education fields, but includes all of us within the education profession—any faculty member who is dedicated to teaching and learning and uses research systematically to analyze and improve these.

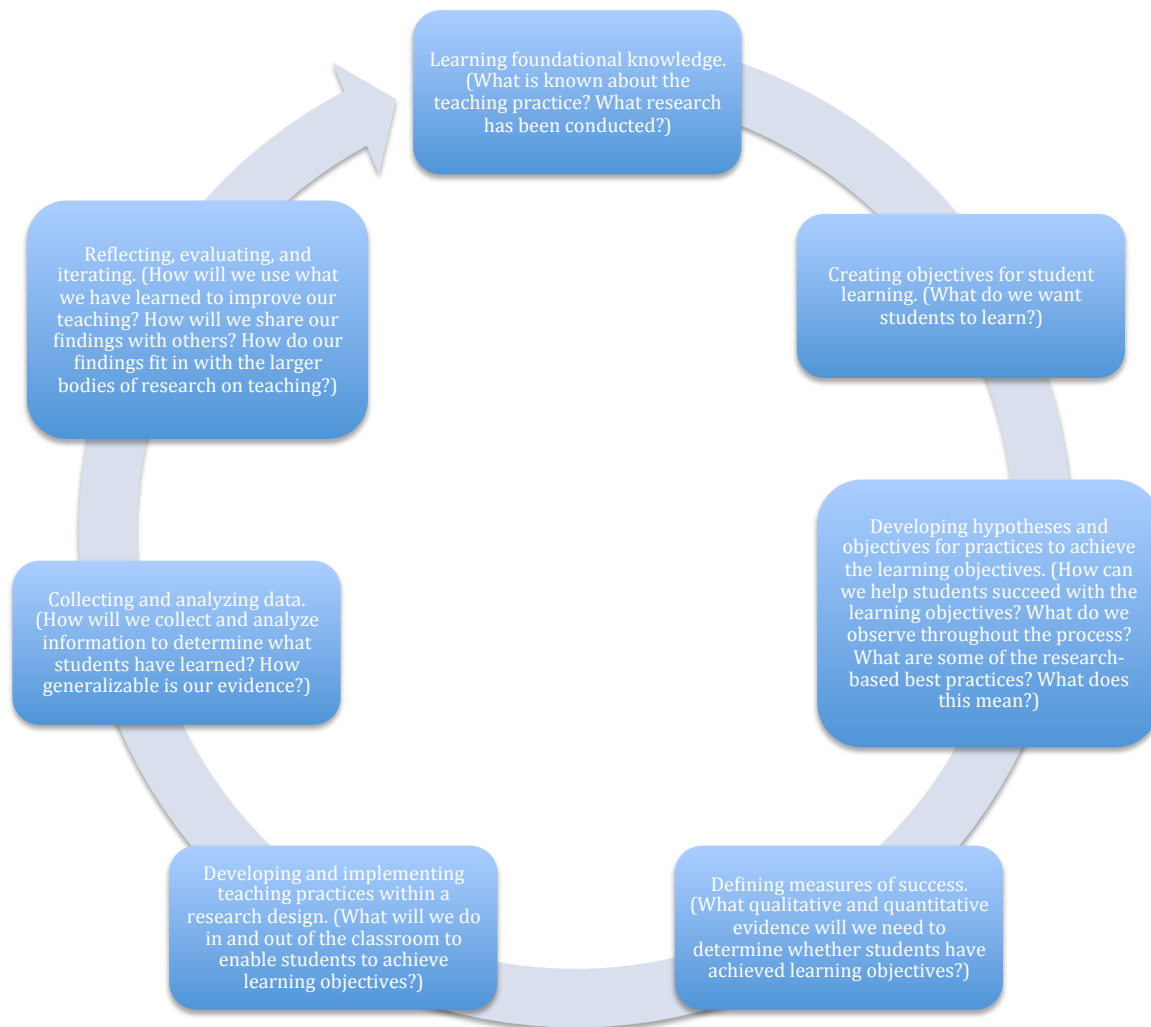
These authors offer a succinct yet purposefully vague definition of the scholarship of teaching and learning that considers the past few decades of

work on the topic: “While it may be unnecessary to attempt too precise a definition for the scholarship of teaching and learning (see Boyer 1990; Cambridge 1999; Glassick, Huber, and Maeroff 1997; Hutchings 2000; Hutchings and Shulman 1999; Shulman 1998), its distinctive character, for most of our authors, lies in its invitation to mainstream faculty (as well as specialists) to treat teaching as a form of inquiry into student learning, to share results of that inquiry with colleagues, and to critique and build on one another’s work.” (para. 40).

Keeping the definition broad helps allow all disciplines to engage in the process. The notion that we basically “treat teaching as a form of inquiry into student learning” is the main idea followed by the sharing of the results and an opportunity to critique and build upon others’ work. The Carnegie Foundation has supported the Scholarship of Teaching and Learning for decades and promoted the sharing of materials and opportunities for critique. This organization has promoted this notion for decades encouraging faculty to engage in the practice.

WHAT IS “TEACHING AS RESEARCH?”

Similarly, and perhaps more specifically, Teaching as Research tends to focus more on individual classroom teaching and learning and research within it. For decades, different organizations have come on board, seeing the value of using research to improve teaching and learning. Recently, a consortium of over 20 U.S. institutions have worked together to create a center called “The Center for the Integration of Research, Teaching and Learning” (CIRTL). This organization uses the term “Teaching as Research” taking the Scholarship of Teaching and Learning perhaps a step farther to argue that in fact, good teaching is research. According to the Center for the Integration of Research, Teaching and Learning “Teaching-as-Research involves the deliberate, systematic, and reflective use of research methods to develop and implement teaching practices that advance the learning experiences and outcomes of students and teachers. Participants in Teaching-as-Research apply a variety of research approaches to their teaching practice.” They outline the following steps as important in the teaching-as-research process:



1. Learning foundational knowledge. (What is known about the teaching practice? What research has been conducted?)
2. Creating objectives for student learning. (What do we want students to learn?)
3. Developing hypotheses and objectives for practices to achieve the learning objectives. (How can we help students succeed with the learning objectives? What do we observe throughout the process? What are some of the research-based best practices? What does this mean?)
4. Defining measures of success. (What qualitative and quantitative evidence will we need to determine whether students have achieved learning objectives?)
5. Developing and implementing teaching practices within a research design. (What will we do in and out of the classroom to enable students to achieve learning objectives?)
6. Collecting and analyzing data. (How will we collect and analyze information to determine what students have learned? How generalizable is our evidence?)
7. Reflecting, evaluating, and iterating. (How will we use what we have learned to improve our teaching? How will we share our findings with others? How do our findings fit in with the larger bodies of research on teaching?)

(Adapted from the Center for the Integration of Research, Teaching and Learning—CIRTL's "College Classroom Course: A Guidebook" available at http://www.cirtl.net/files/Guidebook_CollegeClassroomCourse_0.pdf)

The tide is shifting in higher education—there is a push for improved student learning, and to accomplish this we need improved teaching. College and university professors are skilled researchers. We are trained in research skills in our doctoral programs. We think like researchers. We have knowledge of research methodology within our academic disciplines. Will this alone be sufficient to do teaching as research well? Perhaps. However, learning new strategies outside of one's academic discipline and merging them with existing research strengths can considerably improve one's results when engaging in Teaching as Research. Some of the philosophical underpinnings of these research methodologies may seem to be in conflict, but I believe these are easily reconciled within the context of improving teaching and learning.

PART I: ASSESSMENT OF PRACTICAL SKILLS

Use of a Formal Assessment Instrument for Evaluation of Veterinary Student Surgical Skills

Lauren V. Schnabel¹, DVM, Diplomate ACVS; Paul S. Maza², DVM, PhD; Kimberly M. Williams³, PhD; Nita L. Irby¹, DVM, Diplomate ACVO; Carolyn M. McDaniel¹, VMD; Brian G. Collins¹, DVM

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Objectives: To (1) evaluate the design and use of a global rating scale assessment instrument in veterinary medical education and; (2) examine the effectiveness of 2 surgical techniques courses for improving the surgical skills of veterinary students.

Study Design: Instrument development; observational; survey-based.

Sample Population: Students (n=16) registered for 2 elective surgical techniques courses were enrolled on a volunteer basis.

Methods: A 5-point global rating scale instrument was designed for the evaluation of 12 basic surgical skills by faculty evaluators and used to obtain student start and end scores during the courses. Upon conclusion of the courses, students completed a survey from which their opinions on their improvement as well as their desire for feedback were obtained.

Results: All authors agreed the instrument was

easy to use. As groups, 3rd year students, 4th year students, and all students combined had significantly higher total skill scores at the end of the courses compared to the start of the courses. Individually, 10 students (63%) had significant improvement in surgical skills as a result of their participation in the courses: 4 (100%) 3rd year and 6 (50%) 4th year students. Student survey responses revealed a strong desire for feedback as well as support of formal assessment methods. Only weak agreement was found between student opinions on their improvement and the authors' assessment scores.

Conclusions: Assessment instruments are useful for (1) student evaluation and (2) for providing students with feedback on their surgical skills.

Surgical principles and skills are often difficult to teach and evaluate¹ and further complicated by use of live animals or surgical simulators, typically in a laboratory setting, which is expensive and necessitates a large number of faculty to be effective.¹⁻³ However, it is highly desirable that veterinary students be well trained in surgery because veterinarians are expected to perform at

least basic surgical procedures upon graduation without further specialty training.^{1,4-6} least basic surgical procedures upon graduation without further specialty training.^{1,4-6}

Several methods to evaluate veterinary student clinical skill training including surgical skills have been discussed^{2,3,7} and are necessary as accreditation requirements continue to become more stringent for clinical competency outcomes assessment.⁸⁻¹⁰ Both checklist³ and point scoring systems have been described,^{2,5,7} generally in the context of structured examinations such as the Objective Structured Clinical Examination (OSCE)³ rather than on observations of students in clinical settings such as the Clinical Observed Performance Evaluation (COPE).¹¹ Whereas several Likert-type or global point rating scale evaluation instruments have been described for assessment of medical student surgical skills using OSCE and COPE,¹²⁻¹⁴ we are unaware that similar instruments have been used for assessment of veterinary student surgical skills.

Thus, our purpose was (1) to evaluate the design and use of a global rating scale instrument in veterinary medical education and (2) to use the instrument to examine the effectiveness of 2 week-long surgical techniques courses for improving surgical skills in veterinary students. The 2 courses used for student observation and evaluation (VTMED 6528 Equine Surgical and Anesthetic Techniques and VTMED 6529 Food Animal Surgical and Anesthetic Techniques) have been taught for many years, but have never included a formal assessment of the students' surgical skills. Our first hypothesis was that student surgical skill scores attained by the end of the second week-long course would be significantly higher (improved) than those demonstrated at the beginning of the first week-long course. Our second hypothesis was that student opinions about their improvement in surgical skills, as determined by survey results, would agree with our findings. Both these hypotheses were based on previously reported findings from the medical education literature where medical students completing surgical skills training courses improved both their surgical skill proficiency level as well as their ability to perform accurate self-assessments of their proficiency level.^{15,16}

METHODS

The University Institutional Review Board (IRB) for Human Participants reviewed this study and found it to qualify for Exemption from IRB Review according to paragraph 1 of the Department of Health and Human Services Code of Federal Regulations 45 CFR 46.101(b).

Assessment Instrument

A global rating scale instrument was designed for assessment of veterinary student surgical skills based on 2 instruments previously validated for the assessment of medical student, resident, and fellow surgical skills.^{12,13} Notably, we chose to use a 5-point scale with response anchors placed at points 1, 3, and 5 as it was determined that it would be too difficult to differentiate skill levels into >5 categories. The first author created the initial draft of the instrument and then met with the other authors to further refine the instrument into its final version (Appendix). Each individual skill as well as the response anchors for each skill score were discussed and agreed upon by all authors as well as by the course leaders before use of the instrument in the courses. All authors expressed concern regarding both the wording on the assessment form and our ability to score skills 9 (hemostasis) and 12 (knowledge of the specific procedure) accurately because of the observational nature of the study and the complexity of the courses being evaluated. Both skills were kept on the assessment form, however, and their evaluation attempted.

Surgical Techniques Courses

The use of animals in these courses was approved and performed according to guidelines of the Institutional Animal Care and Use Committee.

The 2 week-long courses during which the students were observed and assessed were Equine Surgical and Anesthetic Techniques (VTMED 6528) and Food Animal Surgical and Anesthetic Techniques (VTMED 6529). These elective courses offered during the winter intersession in January were only open to 3rd and 4th year veterinary students. Despite the fact that students must give up 2 weeks of vacation to participate, there has always been a strong student response to the call for registration, and the courses typically fill to the

enrollment limit necessitated by available facilities, equipment, and staffing. Each course is led by a board certified large animal surgeon and by 2 licensed veterinary technicians and further instructed by other board certified large animal surgeons, large animal surgery and anesthesia residents, veterinarians, and licensed veterinary technicians. Students work in groups of 3 per animal and rotate through the positions of surgeon, assistant surgeon, and anesthetist. Students receive printed notes on each procedure before the start of each course and also have access to videos for most of the surgical procedures performed. Although the students continuously receive informal feedback from instructors, they officially receive pass/fail grades only with no formal assessment about their performance or skill level.

The equine course occurs during the 1st week and includes the following procedures on live ponies: castration (with scrotal ablation) and ventral median exploratory celiotomy with pelvic flexure enterotomy and small intestinal resection and anastomosis (general anesthesia); abdominal laparoscopic exploratory and assisted rectal palpation (standing under sedation and with local anesthesia). The ponies are euthanatized after the procedures and their carcasses are used for the remainder of the course in which students perform procedures including enucleation, split bone removal, periosteal stripping, palmar digital neurectomy, and inferior check ligament desmotomy. Additionally, students practice cast application on the limbs and have a laboratory session sponsored by Synthes Vet (West Chester, PA), in which they practice fracture repair techniques on synthetic bone models.

The food animal course occurs in the 2nd week and includes the following procedures on live animals: right paramedian abomasopexy and right paralumbar fossa exploratory celiotomy with enterotomy, typhlotomy, and omentopexy (sheep, general anesthesia); bilateral exploratory celiotomy and omentopexy or pyloropexy (cows, standing with local anesthesia); ventral median exploratory celiotomy with umbilical and apex of the bladder resection and umbilical herniorrhaphy as well as castration and enucleation (calves, general anesthesia). All animals that had general

anesthesia were euthanatized after completion of the procedures. The cows that had standing surgery were sold at auction upon recovery. Additionally, students use carcasses to practice udder/teat procedures as well as foot trimming and foot surgeries.

Student Enrollment

Students registered for both courses were eligible for this study and enrolled on a volunteer basis. Preliminary enrollment occurred by email communication. Official enrollment took place once the students signed individual informed consent forms on the 1st day of the equine course. Students were informed of the purpose of the study but were not allowed to view the assessment instrument until after study conclusion and completion of the student surveys. So, students were aware that they were being assessed on their surgical skills, but were unaware of the specific skills being examined.

All students had received the same basic skills training throughout their 1st and 2nd years of veterinary school in 4 laboratories (1.5 hours each; 1/semester) on cadavers or models. The laboratories were staffed by surgeons and surgical residents and included the basic skills 1–9 and 11 included in the assessment instrument. All students had the same live animal practice in the fall semester of their 3rd year performing and assisting in feline ovariohysterectomy. Further, all students had online access to an instrument atlas, suture and suture pattern atlas, as well as knot-tying procedural videos at all times during their veterinary training which they were made aware of at the start of their 1st year of veterinary school.

Use of Assessment Instrument

Four of the authors were assigned to score the students using the assessment instrument and are hereon referred to as evaluators in that context. All have taught surgical techniques courses in the past, either on large or small animals. To avoid biases, none of the evaluators were course instructors for the 2 courses in this study. Each evaluator was assigned a group of students to evaluate by the first author based on student proximity to each other. The evaluator scored that same group of students for both their start and end scores and

scored each skill in the instrument. Each student was scored only once for start scores and once for end scores by that assigned evaluator.

Students were observed and assessed during equine abdominal surgery (exploratory celiotomy, pelvic flexure enterotomy, and small intestinal resection and anastomosis) as well as palmar digital neurectomy surgeries to obtain beginning (start) surgical skill scores. These procedures were performed on multiple days throughout the beginning of the 1st week because of interspersed laboratories not relevant to this study such as the casting laboratory. Students were observed and assessed during sheep abdominal surgery (right paralumbar fossa exploratory celiotomy, enterotomy, typhlotomy, and omentopexy) as well as calf surgical procedures (exploratory celiotomy, umbilical, and apex of the bladder resection, umbilical herniorrhaphy, and castration) to obtain final (end) surgical skill scores. These procedures were also performed on multiple days throughout the end of the 2nd because of interspersed laboratories not relevant to the study. To avoid biasing the study, evaluators did not assist the students unless there was an emergency and did not correct any improper techniques observed until the final procedures after end scores had already been obtained. It is important to note, however, that although the evaluators were not assisting or correcting the students throughout the courses, the course instructors were actively assisting the students and providing instruction and feedback on a daily basis.

Student Survey

Upon completion of the courses, students were asked to complete a brief paper survey consisting of 4 "yes" or "no" questions. The first question "Do you believe that your surgical skills have improved significantly over the past 2 weeks because of your participation in VTMED 6528 (Equine Surgical and Anesthetic Techniques) and VTMED 6529 (Food Animal Surgical and Anesthetic Techniques)?" was designed to generate data for testing our 2nd hypothesis that student opinions on improvement of their surgical skills would agree with our scored findings. The 2nd question "Did you feel that your participation in this study affected your learning in any way during the

courses?" was intended to determine whether or not the students felt that the presence of the evaluators and the potential pressure of observation affected their learning in any way.¹⁷ This question also included a response box which stated: "If yes, please state whether the effect was positive or negative." The 3rd and 4th questions ("Would you like me to review your completed Veterinary Surgical Skills Assessment Forms with you?" and "Do you think that future implementation of formal assessment methods for courses such as these would be of benefit to students?") were designed to assess student desire for feedback and student acceptance of formal assessment methods. The 4th question also included a response box which stated: "Please briefly explain the reason for your response." Because of the authors' use of the data generated from the 1st question to evaluate our 2nd hypothesis, student surveys were not anonymous.

Student Debriefing

At study end and completion of student surveys, a voluntary meeting was held with the students in which the first author gave a presentation on the study background, methods, and results. The results were then discussed as a group and student opinions on both the assessment instrument and the surgical technique courses were obtained. After the group discussion, the first author met with each student on a voluntary basis to discuss their own scores and provide feedback on the skills that showed improvement and the skills needing additional work.

Statistical Analyses

Our 1st hypothesis was that student surgical skill scores would improve during the 2 week-long courses. In statistical terms, our null hypothesis (H_0) stated that there was no difference between start and end surgical skill scores, whereas our alternative hypothesis (H_A) was that there was a significant difference (improvement) between start and end surgical skill scores. Paired t-tests were used to compare the differences in start and end scores for 3rd year students, 4th year students, and all students combined. Wilcoxon rank sum tests were used to compare 3rd and 4th year student start and end surgical skill scores as well as the differences in their start and end scores.

Our 2nd hypothesis was that student opinions on their improvement in surgical skills would agree with our scored findings. In statistical terms, our null hypothesis (H_0) stated that the probability of a student finding an improvement in their skills (yes or no) would equal the probability of our scores finding an improvement (yes or no), whereas our alternative hypothesis (H_A) was that the probability of a student finding an improvement in their skills would not equal the probability of our scores finding an improvement. A McNemar's symmetry (χ^2) test was used to assess the significance of agreement between student opinions and our scores above that of chance alone. A kappa (k) coefficient was also calculated to quantify the magnitude of agreement.

All analyses were performed with software (Statistix 9, Analytical Software, Tallahassee, FL) and a value of $p < .05$ was considered significant to reject the null hypothesis. Data are reported as (mean \pm standard error (SEM); range). Results of paired t-tests are reported as $t(\text{degrees of freedom}) = t\text{-value}$, $P = p\text{-value}$. Results of Wilcoxon rank sum tests are reported as $W_s(n_1; n_2) = \text{lowest mean rank}$, $P = p\text{-value}$. The result of the McNemar's symmetry test is reported as $\chi^2(\text{degrees of freedom}, n) = \chi^2\text{-value}$, $P = p\text{-value}$.

RESULTS

Student Enrollment

Registration for both courses was 21 students per course. Of the 21 students, 17 (81%) registered for both the equine and food animal course and were eligible for this study. Of the 17 eligible students, 16 (94%) volunteered and were enrolled in the study, 4 (25%) of which were 3rd years and 12 (75%) of which were 4th years. The 3rd year students had not completed any clinical rotations before these courses, whereas 4th year students had completed 1 year of clinical rotations which may or may not have included surgical rotations.

Use of Assessment Instrument

As 16 students enrolled in the study, each of the designated evaluators scored 4 students. The 1st author assigned each evaluator their students based on student groups and surgery table locations so that the 4 students were as close to each other as possible, allowing for easier observation.

The 1st author also provided each evaluator with an identification picture of each student as well as the printed assessment form on a clipboard. Instead of having 1 form for each student during the observation, all evaluators found it easier and more efficient to use 1 form only and to write each of their assigned student's initials under or next to the point number given for each skill.

Overall, all evaluators found the assessment instrument itself easy to use. As anticipated, however, the evaluators had difficulty scoring skill 9 (hemostasis) because of the type of surgeries being observed and the fact that they were terminal in nature. Because the authors felt that the students justly chose to spend their limited time performing the surgical techniques such as enterotomies and resections rather than spending the time controlling hemostasis in some cases during terminal procedures, skill 9 was eliminated from the study and excluded from any analysis. For this reason, skill 9 does not appear in the results figures and the maximum possible total surgical skill score for each student dropped from 60 points as indicated on the original assessment form (Appendix) to 55 points.

Skill 12 (knowledge of specific procedure) was also challenging for the authors to score given that some procedures were more complicated than others and some of the notes and videos provided to the students for preparation were more

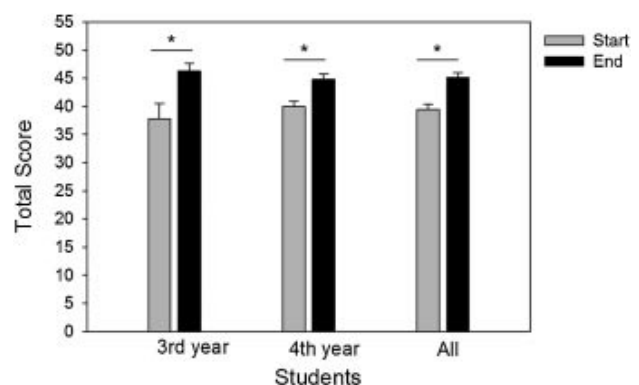


Figure 1 Mean \pm SEM of 3rd year ($n = 4$), 4th year ($n = 12$), and all 3rd and 4th year students ($N = 16$) total start and end surgical skills scores. An asterisk indicates a significance difference between start and end scores for each group as determined using paired t-tests with significance set at $p < .05$.

detailed than others. Nevertheless, the authors kept to their agreed upon anchors and were able to assign a start and end score to each student. For this reason, skill 12 was kept in the study and included in the analysis.

Other challenges faced while scoring the students were the rotation of students through the positions of surgeon, assistant surgeon, and anesthetist, and that some procedures were not originally planned to be sterile in nature for the purposes of the courses such as the limb surgeries performed on carcasses. Both of these challenges necessitated the 1st author and the 2 licensed veterinarian technicians who led the courses to ask students enrolled in the study to maintain sterile technique in instances where other students were not asked to. Additionally, in rare circumstances, students that had been filling the role of anesthetist had to be asked to specifically perform a procedure so that they could be scored.

Student Surgical Skill Scores

Total Surgical Skill Scores. Each student had an end total surgical skill score that was higher than their start total surgical skill score. When the differences in total start and end surgical skill scores were compared for 3rd year students ($n = 4$), 4th year students ($n = 12$), and all students combined ($N = 16$), each group had a statistically significant improvement as shown in Figure 1 (3rd year students: $t(3) = 5.47, p < .01$; 4th year students: $t(11) = 6.47, p < .01$; all students combined: $t(15) = 7.45, p < .01$).

As anticipated based on experience, the mean \pm SEM start surgical skill score of 3rd year students (37.75 ± 2.78 points; range, 32–42 points) was less than that of 4th year students (40.00 ± 0.90 points; range, 36–45 points), but this difference was not statistically significant, $W_s(4;12) = 18.00, P = .51$. Although the mean end surgical skill score of the 3rd year students (46.25 ± 1.43 points; range, 44–50 points) was higher than that of the 4th year students (44.83 ± 0.96 points; range, 38–50 points), this difference also was not statistically significant, $W_s(4;12) = 17.50, P = .46$. The mean difference in start and end surgical skill scores, however, was significantly higher in 3rd year students (8.50 ± 1.55 points; range, 5–12 points) compared to 4th year students (4.83 ± 0.75 points; range, 1–9

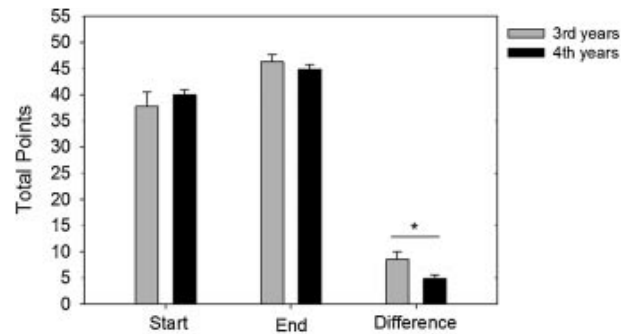


Figure 2 Mean \pm SEM 3rd ($n = 4$) and 4th year ($n = 12$) student total surgical skill scores and differences in end and start surgical skills scores. An asterisk indicates a significance difference between the 2 groups as determined using a Wilcoxon rank sum test with significance set at $p < .05$.

points) as shown in Figure 2, $W_s(4;12) = 7.50, P = .04$. Interestingly, the 4th year students that had the lowest differences in start and end scores (i.e. least improvement) were those with the lowest start scores.

Individual Surgical Skill Scores. When differences in student start and end surgical skill scores were compared for individual skills, students (3rd and 4th year students combined) had significant improvement in all skills except skill 1 (surgical preparation: student) and skill 12 (knowledge of specific procedure) as shown in Figure 3. For skill 1 (surgical preparation: student), the mean end

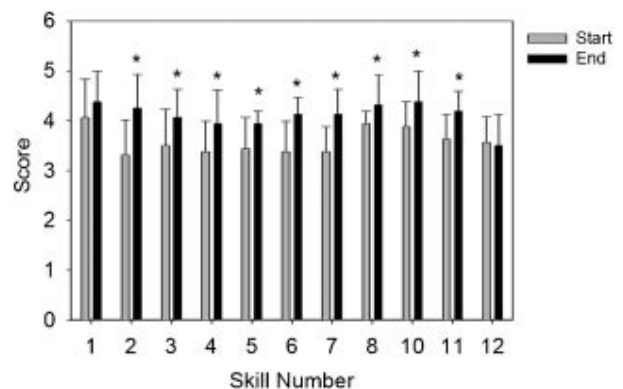


Figure 3 Mean \pm SEM total start and end scores for individual skills of all 3rd and 4th year students. An asterisk indicates a significance difference between start and end scores for each skill number as determined using paired t -tests with significance set at $p < .05$. Note: Skill number 9 is not present as this skill was eliminated from the study.

surgical skill score (4.38 ± 0.15 points; range, 3–5 points) was higher than the mean start surgical skill score (4.06 ± 0.19 points; range, 3–5 points), but this difference was not significant, $t(15) = 2.08$, $P = .06$. Skill 12 (knowledge of specific procedure) was the only skill in which the mean end surgical skill score (3.50 ± 0.16 points; range, 3–5 points) was lower than the mean start surgical skill score (3.56 ± 0.13 points; range, 3–4 points), although this result was not significant, $t(15) = -0.32$, $P = .75$. When individual surgical skill scores were examined for 3rd year students and 4th year students as separate groups, statistical significance for skills remained unchanged. Notably, however, the mean skill 12 end score for 3rd year students (3.75 ± 0.25 points; range, 3–4 points) was higher than their mean start score (3.50 ± 0.29 points; range, 3–4 points), whereas the mean skill 12 end score for 4th year students (± 0.19 points; range, 3–5 points) was lower than their mean start score (3.58 ± 0.15 points; range, 3–4 points).

Individual Student Improvement. For individual students, a 5 point or more improvement in total surgical skill score was considered a significant improvement as determined by the authors. As such, 10 students (63%) had significant improvement in their surgical skills. Importantly, all 4 of 3rd year students had significant improvement, whereas only 6 (50%) of the 4th years had significant improvement.

Student Surveys

All 16 enrolled students completed the paper surveys immediately after completion of the food animal course. In response to the 1st question, "Do you believe that your surgical skills have improved significantly over the past 2 weeks because of your participation in VTMED 6528 (Equine Surgical and Anesthetic Techniques) and VTMED 6529 (Food Animal Surgical and Anesthetic Techniques)?" 13 students (81%) answered "yes." Of these 13 students, 9 (69%) were also considered to have significant improvement in their surgical skills based on our criteria (with significant improvement defined as a 5 point or more improvement in total surgical skill score) whereas the other 4 (31%) did not. All 3 students who answered "no" to the 1st question were 4th year students. Of these, 2 (77%) were also considered not to have significant improvement in their surgical skills

based on our criteria whereas 1 (33%) had significant improvement. Using a McNemar's symmetry test, the null hypothesis that the probability of a student finding an improvement in their skills would equal the probability of our scores finding an improvement was accepted ($X^2[1,16] = 1.80$, $P = .18$), however the calculated k coefficient of 0.24 revealed only weak to moderate agreement.

In response to the 2nd question, "Did you feel that your participation in this study affected your learning in any way during the courses?" 7 students (44%) answered "no." Of the other 9 students (56%) that answered "yes," all felt that their participation in the study affected their learning in a positive way. The most common explanation given by the students for this response was that the study made them more conscientious of their technique. Several of the 9 students also commented that they chose the responses "yes" and "positive" in anticipation of the feedback that they would receive from the first author.

In response to the 3rd and 4th questions that assessed student desire for feedback and student acceptance of formal assessment methods, the responses were overwhelming in support of both. Fourteen (88%) of students answered "yes" to the 3rd question "Would you like me to review your completed Veterinary Surgical Skills Assessment Forms with you?" and 14 (88%) of students answered "yes" to the 4th question "Do you think that future implementation of formal assessment methods for courses such as these would be of benefit to students?" Interestingly, the 2 students who answered "no" to the 3rd question were not the same 2 students who answered "no" to the 4th question. The most common explanation for the answer "yes" to the 4th question was that the students felt that it was important to get feedback so that they would know what they needed to work on in order to improve. The 2 students that answered "no" to this same question stated that they felt that actual assessments were not necessary for learning or improvement.

Student Debriefing

Five students (36%) who responded "yes" to the 3rd survey question attended the voluntary evening meeting. Four other students who could not attend the meeting because of clinical rotation ob-

ligations contacted the first author to obtain feedback via email. During the meeting, the first author gave a brief presentation on the study background, methods, and results, and then discussed the study with the students as a group. Through this discussion, valuable insight was gained that was not obtained through the student surveys. For example, whereas none of the students who responded "yes" to the 2nd survey question "Did you feel that your participation in this study affected your learning in any way during the courses?" qualified their response in a "negative" way, several of the students at the meeting admitted that the presence of the authors performing the scoring and standing at their surgery table made them very nervous and that at times they felt that this nervousness took away from their experience in the courses. All of the students present at the meeting also expressed their frustration at not being able to ask the evaluators for help when they were standing right there at their table. Whereas this was a concern of the authors from the beginning, this was the first time that such a feeling was voiced by the students. Despite such feelings, all students expressed gratitude for the author's initiative to create an objective assessment method for evaluating their surgical skills and for providing them with feedback on their performance and how they could improve in the future.

The debriefing meeting with the students also yielded valuable feedback about the importance of access to videos of procedures for student preparation. For example, whereas students had access to videos of the procedures that they were assessed on for their start surgical skills scores, they did not have access to videos for the some of the procedures on which they were assessed for their end surgical skills scores including the umbilical and apex of the bladder resection, and umbilical herniorrhaphy. Students felt that this was the likely reason why their end scores for skill 12 (knowledge of specific procedure) were lower than their start scores.

DISCUSSION

Our purpose was to both evaluate the design and use of a global rating scale instrument in veterinary medical education and to use this instrument for the first time to examine the effectiveness of

2 surgical techniques courses for improving the surgical skills of veterinary students. Although all evaluators found the instrument easy to use, some of the surgical skills were more difficult to assess than others. Also, the nature of the 2 surgical techniques courses created several challenges in performing the assessments. That students were evaluated during different surgical procedures to obtain start and end scores may have had an impact on our results. Nevertheless, this study provides readers with the basis of an assessment instrument which can be modified for use in specific veterinary colleges and/or specific courses. Additionally, our data reveals valuable insights into student desire for objective assessment methods and formal feedback mechanisms.

We believe that there is a clear need for assessment instruments like this in veterinary medical education. In designing such an instrument, we hoped to provide colleagues with one that would be easy to apply with or without minor modifications. For this reason, we chose to use a global rating scale instrument, which has been shown to be more reliable and consistent than checklist systems,¹⁴ and to only include important basic surgical skills that would be easy for veterinarians of all levels of training to evaluate.⁶ The summation of the individual skill scores, as previously described,^{12,13} also allows for an overall evaluation of surgical skill proficiency. However, as we experienced, what seems like a basic surgical skill can be difficult to evaluate, particularly in the setting of a COPE which lacks the structure and consistency of an OSCE. Because of challenges faced during assessment in these particular surgical techniques courses, we were forced to eliminate the critical surgical skill of hemostasis from the evaluation. Had the students been assessed one at a time performing a more simple recovery procedure such as a feline or canine ovariohysterectomy, we believe this particular skill could have been evaluated without difficulty. It would perhaps be better to use an instrument like this, especially initially, during a course in which each student performs an entire basic surgery by themselves in the context of a COPE or during a standardized surgical exercise in the context of an OSCE. Another option for using this instrument would be to have the students each perform one standardized basic

surgical procedure before the start of the course and then again at the end of the course on which all evaluations would be made.

It is important when using an assessment instrument that all evaluators agree on every skill and every response anchor to avoid any confusion or inconsistencies in scoring. Although similar instruments used in human medical education have yielded excellent inter-rater reliability results,¹² we should have tested the inter-rater reliability of this instrument for use in veterinary medical education. This could have been performed on a trial group of students each performing the same surgical procedure and being evaluated by multiple evaluators whose scores were then compared. This also could have been tested by having the evaluators rate overlapping groups of students throughout the course of the study and then comparing the scores of the overlapping students assigned by the different evaluators. One potential way to make the process of multiple evaluators assessing the same student easier, and perhaps also make the assessment process more appealing would be to videotape students during surgery and then perform the assessments using videotapes.^{7,18,19} Not only would this allow for more flexibility in scheduling, it also allows the evaluators to go back and watch a student multiple times before assigning a point value for a specific skill. Because each of the evaluators in this study had to assess 4 students simultaneously, there were certainly times when skill scores were assigned based on a single observation. Had students been videotaped, each performance of a specific skill could have been observed multiple times allowing for a more accurate assessment. In addition, had assessments been made from videotapes, student frustration at not being able to ask evaluators for assistance during surgery would have been avoided. It is important to note, however, that the use of videotapes alone to perform evaluations can be problematic as it is difficult to get the full perspective by camera on the performance of skills such as preparation of student and patient, especially scrubbing and draping.

Despite the previously described issues caused by the nature of the courses examined and the surgeries that the evaluators observed, the authors were able to draw several important conclusions

from the data regarding student improvement in surgical skills and student acceptance of formal assessment methods. Whereas results based on only four 3rd year students must be interpreted with some degree of caution, a statistically significant difference between 3rd and 4th year students was found when comparing improvement in total surgical skill scores with 3rd year students having a 1.75 times greater improvement than 4th year students in terms of points. In addition, all 3rd year students had individual improvement in their total surgical skill scores compared to only 50% of 4th year students. Whereas it might have been expected that the 4th year students who had the least improvement were the ones that started with the highest start total surgical skill scores (i.e. those who did not have much room for improvement), this was not the case. The 4th year students that had the least improvement in their total surgical skill scores were actually the ones with the lowest start total surgical skill scores. There are a couple of possible explanations for this finding. The first is that these 4th year students may have had the unfortunate opportunity to learn incorrect surgical skills or "bad habits" before these courses either on clinical rotations or in other settings in which they may have received less guidance than they did in these courses. These "bad habits" would then be harder to correct whereas 3rd year students who are essentially starting de novo soon after their live animal practice are easier to train.^{1,20} The 2nd possible explanation is that because of the increased number of 4th year students compared to 3rd year students, we were able to detect several 4th year students who perhaps lack natural surgical ability or manual dexterity.⁷ Had we examined a comparable number of 3rd year students, a similar phenomenon in which several 3rd year students displayed little improvement in surgical skills despite the intensive learning environment of the surgical techniques courses may have been found. The significant difference between 3rd and 4th year students we observed raises some interesting questions about which students benefit most from surgical techniques courses such as these and suggests that such courses may be more effective earlier in the curriculum. This finding needs further examination in a larger group of students before any definitive conclusions can be made.

A strong and consistent theme throughout this study was student desire for feedback. Tied into this concept is student acceptance of formal objective assessment methods because they will result in meaningful feedback. This desire was evident in all aspects of the study from student enrollment through student survey results and information obtained during the student debriefing meeting. Students felt strongly that they needed more formal and regular feedback to know where they needed to improve. They also stressed that this feedback would be most useful if it could be given halfway through a course or clinical rotation while there is still time for improvement and preferably opportunities for re-evaluation. The benefit of feedback on long-term improvement in the surgical skills of human medical students has been previously reported^{21,22} and there is no reason to believe that this would be any different for veterinary students. The use of an objective assessment instrument as we described, provides an excellent opportunity to give formal feedback either in a written format or verbally through meetings with students. That only a weak to moderate agreement was found between student opinions on their improvement in surgical skills and our assessment scores underscores this need for feedback.

Veterinary surgical skill assessment instruments like the one we designed are useful for student evaluation and for providing feedback they can use to improve as veterinary surgeons. Furthermore, formal assessments are necessary for objective student assessment as accreditation requirements continue to become more stringent for student learning outcomes. Additional work needs to be performed to determine the most efficient way to incorporate these assessments into the curriculum either through COPEs or OSCEs, and possibly with the use of videotaping. Additional work needs to be performed to determine how surgical techniques courses can be used most effectively to improve the surgical skills of veterinary students. Whereas our results suggest that these courses are more effective earlier on in the curriculum than after the students have already started their clinical rotations, the sample size is small and the courses examined are very specific advanced courses that may not be generalizable

to all surgical techniques courses. In conclusion, we have developed a surgical skill assessment instrument that can be readily adapted and incorporated into outcomes assessment of a veterinary curriculum.

ACKNOWLEDGMENT

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APPENDIX: VETERINARY SURGICAL SKILLS ASSESSMENT FORM

Date / / Student Name _____ DVM Class _____ Course #: _____ Evaluator _____

1. Surgical preparation (student): scrubbing, gowning, and gloving	1	2	3	4	5
Improper technique, unable to maintain sterility			Mostly proper technique, hesitates/ inefficient		Consistently demonstrates proper technique, efficient
2. Surgical preparation (patient): scrubbing, four corner draping	1	2	3	4	5
Improper technique, incorrect use or placement of drapes			Mostly demonstrates proper technique and drape placement, hesitates/ inefficient		Consistently demonstrates proper technique and drape placement, efficient
3. Scalpel handling	1	2	3	4	5
Holds incorrectly, changes grip often			Holds correctly some of the time, occasional awkward movements		Holds correctly, consistent smooth handling
4. Process of making an incision	1	2	3	4	5
Disjointed, unsure movements, depth uneven			Somewhat smooth, occasional unsure movements, depth generally even		Smooth, sure movement, depth even
5. Use of forceps on tissue	1	2	3	4	5
Holds incorrectly, awkward or inappropriate use			Holds correctly some of the time, occasional awkward use		Holds correctly consistently, uses forceps with precision
6. Needle handling with needle holder	1	2	3	4	5
Repeatedly handles and loads needle incorrectly, i.e. not perpendicular to driver and/or not 2/3 up needle shaft			Mostly acceptable handling and loading, occasional incorrect use		Consistently smooth handling, loads needle properly, clamps driver onto needle
7. Needle handling when suturing	1	2	3	4	5
Incorrect use and placement of needle, does not follow curve of needle			Mostly acceptable use and placement, occasionally does not follow curve of needle		Consistently correct orientation and distance from incision, follows curve of needle
8. Quality of finished sutures	1	2	3	4	5
Poor quality (not square) knots, incorrect knot tension, asymmetric			Most knots correct, tension sometimes incorrect, partially symmetric		Square knots, appropriate tension, symmetric
9. Hemostasis	1	2	3	4	5
Rarely exposes vessels, uses incorrect technique to obtain hemostasis			Sometimes exposes vessels and uses correct technique		Consistently exposes vessels and uses correct technique to obtain hemostasis
10. Use of assistant	1	2	3	4	5
Rarely uses assistant strategically, poor communication with assistant			Sometimes uses assistant strategically, generally good communication with assistant		Consistently uses assistant strategically and communicates effectively with assistant
11. Knowledge of instruments	1	2	3	4	5
Rarely uses correct instruments, unable to identify instruments			Sometimes uses correct instruments, not always familiar with instruments		Consistently uses and is familiar with correct instruments
12. Knowledge of specific procedure	1	2	3	4	5
Deficient knowledge in majority of steps, needs guidance at each step			Knows important aspects of most steps, sometimes needs guidance		Knows all important steps, does not need guidance to know what to do next
TOTAL SCORE (Out of 60) _____					

Integrating Simulation into the Engineering Curriculum: A Case Study

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Abstract

In this paper, we describe improved strategies for teaching computational fluid dynamics (CFD) using the commercial software ANSYS Fluent to upper-level undergraduates and graduate students. We consider a case study from an upper-level elective fluid dynamics course and evaluate various out-of-class learning materials and in-class active learning techniques. We show that, in agreement with previous research, most student learning happens out of class. We show a direct correlation between the materials developed in a reference hand-out and the students' expertise in the area. We introduced i-clickers as a means of promoting active learning in the classroom to emphasize the 'expert approach' in simulation. Their use received a mixed response from the students and we discuss the reasons and a possible remedy. We demonstrate that carefully designed out-of-class learning materials are crucial to students' learning of CFD, and that i-clickers have to be used with care if they are to be effective in engaging students during the lectures. All of these findings inform not only future renditions of this course, but also instruction of CFD in general.

Keywords

simulation; CFD; out-of-class learning; i-clicker

INTRODUCTION

In recent years, computer-based simulations have emerged as a powerful tool for the design and analysis of a variety of engineering systems. With the continuous advancement in the speed and memory of supercomputers, the widespread availability of government-funded supercomputing resources (e.g. XSEDE, at <https://www.xsede.org/>) and the maturing of off-the-shelf commercial simulation software packages, computer simulations will certainly play a critical role in engineering (and consequently in engineering education) in this century. Therefore, it is crucial that graduating engineers are able to use simulations effectively as they enter the workforce.

Traditionally, instruction in numerical simulations – here we will focus on computational fluid

dynamics (CFD), which consists of numerically solving the equations of fluid flow on a computer – has focused on teaching the fundamental techniques of discretization and numerical solution algorithms, as applied to simple problems, for which it is possible for students to write their own codes (see, for example, the classic text by Anderson [1]). While this approach is useful for students intending to pursue graduate studies or intending to solve certain specialized problems, it may not be particularly useful for the 'generalist engineer'. This is because problems encountered in industry are usually less specialized but more complex. There, the CFD engineer needs to possess the skills to assess and validate the results, choose meshing and discretization schemes judiciously, choose the right turbulence model for the problem, and so on. S/he has less of a need to know the intricate details of the various discretization schemes and algorithms, or their implementation on the computer [2]. Therefore, with

the widespread availability of commercial CFD software, it is essential that the engineer is trained to *expertly* use the various options provided by the software, and obtain validated results. Usually, industrial training in simulation software tends to focus more on navigating the software interface and less on the *concepts* underlying a CFD solution. This is where the engineering curriculum can make a substantial contribution. The present work stems from such an attempt, where upper-level undergraduates and graduate students are trained in solving CFD problems using the commercial software ANSYS Fluent, focusing on fundamental CFD concepts, and how they apply to the solution of a variety of problems.

The issue of integrating simulation into the engineering curriculum has been considered in some detail in recent times. Stern *et al.* [3] developed a CFD educational interface to help students learn both the concepts and the implementation of CFD, with a focus on use in their careers in the industry. They also reported [4] the development of teaching modules for complementary computational and experimental fluid mechanics and uncertainty analysis to integrate simulation technology into undergraduate engineering courses and laboratories. Engineering faculties from a range of public and private universities and their software partner, Fluent, Inc., collaborated to develop, implement, evaluate and disseminate web-based teaching modules utilizing simulation technology based on further development of the commercial software FlowLab. They report the first two years' formative and summative student evaluation data from the University of Iowa, the Iowa State University and Cornell University, which identified successful learning outcomes, as well as areas for improvement, including the need for an efficient, hands-on, 'computational fluid dynamics educational interface' to better simulate engineering practice.

In the present study, the ANSYS workbench educational version has been used as the CFD software [2]. Bhaskaran [5] describes the planning and implementation of integrating computer-aided engineering (CAE) into the engineering curriculum at Cornell University, emphasizing the importance of out-of-class learning exercises such as web-based tutorials, accompanying notes and lectures, and carefully designed assignments. In the present

study, we made improvements to the out-of-class learning materials and lectures, and evaluated their impact on student learning.

A related goal of this work was to introduce active learning techniques in the classroom, to better promote student engagement. The effectiveness of active learning in the science and engineering classroom is well documented [6, 7]. Prince [7], however, cautions against blindly implementing these techniques and advises the instructor to carefully consider the methods most suitable to the scenario at hand (based on the targeted learning outcomes, existing reported data, etc.). Rosenthal [8] reports an interesting study which attempted to bring active learning techniques into an upper-level advanced mathematics classroom. The author successfully employed small-group peer-based learning, to quite positive student reviews. He also tried out essay-writing exercises about technical topics and had the students review each other's work. Such a non-traditional teaching method received mixed reviews from students. Here, we used i-clickers to engage the students in a 'pre-analysis' step in problems presented in lectures, as the first step in our proposed 'expert approach' to simulation. This slightly non-traditional way of using clickers received a mixed response from the students. The reasons and possible remedy will be discussed under 'Results and discussion', below.

The rest of the paper is organized as follows. In the next section, we describe the methodology adopted for this study, which included pre- and post-surveys, and the class demographics. The following section reports the results from the survey, focusing on student learning of the important CFD concepts, and students' evaluation of the various instructional tools. We then present concluding remarks and end with a list of best practices, which enumerates some of the lessons learned in integrating simulation into the engineering curriculum from this course and elsewhere.

METHODOLOGY

The results presented in this paper were obtained over one semester from an upper-level elective course in fluid dynamics. Junior and senior undergraduates and masters and PhD students were

enrolled in the course. The course was divided into two components. The ‘theoretical’ component comprised the majority of the lectures and covered topics ranging from compressible flows to turbulence. The ‘numerical’ component consisted of seven lectures and eight homework assignments, dedicated to introducing the numerical solution of various fluid flow problems using the commercial software ANSYS Fluent. The masters and PhD students were required to complete a computational design project for an extra credit. Some seniors also opted for this option, but the class size for the design project was limited to 20 (about 30% of the total). The students enrolled in the design project were required to attend an additional weekly 50-minute section, introducing them to the use of the ANSYS workbench in a hands-on fashion. This session covered some advanced topics, such as meshing and user-defined functions (UDFs), which were required for completion of the project. There were 13 such sessions over the semester.

We conducted surveys (see Appendix for survey instruments) at the beginning and the end of the course based on voluntary participation during class hours. Details of the surveys are presented at the end of this section.

Our goal in this course was to introduce students to the ‘expert approach’ in simulation, which constitutes pre-analysis, solution, and verification and validation. We compiled a hand-out introducing the students to CFD in general and the finite volume method in particular. Fluent uses the finite volume method to discretize the governing equations and our goal was to enable students to appreciate the procedure Fluent is using ‘under the hood’ to compute the solution. We also included discussions on convergence and residuals, and an introduction to iterative techniques in the hand-out. We intended this hand-out to be a reference, so that students could appreciate the underlying workings of the software as they used it to solve a variety of problems. The lectures were focused on demonstrating the ‘expert approach’ in solving a canonical problem using Fluent.

We introduced pre-analysis during each of the lectures using i-clickers, as an attempt to promote student engagement in the process. The general

solution procedure for these problems was described in class, with reference to the details in the online tutorials and comparison with the analytical solutions obtained in the main part of the course. The online tutorials have been deployed (and continuously updated) for a number of years now [5] and all of these materials are available online for the community to use (see <https://confluence.cornell.edu/display/SIMULATION/FLUENT+Learning+Modules>). All of our efforts are based on the understanding that student learning of simulations (when integrated with a broader course goal) involve substantial out-of-class learning [2]. RB was responsible for delivering the lectures and conducting the hands-on sessions for the numerical component of the course, while BR was responsible for developing and analyzing the student surveys, clicker questions and certain course materials.

The surveys conducted at the beginning and end of the semester accounted for all the data presented in this paper. Both instruments are summarized in the Appendix. The pre-survey was conducted at the beginning of the semester; students were asked about their previous experience with CFD/ Fluent and their grasp of nine key concepts related to understanding and using CFD effectively.

At the end of the semester, we conducted a post-survey, which asked the same questions as the pre-survey plus a few additional ones (see Appendix). We asked students to rate the usefulness of the different instructional methods we

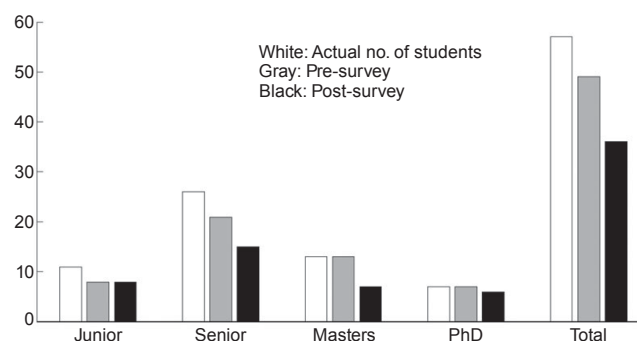


Fig. 1 Numbers of students who responded to the pre- and post-survey, differentiated into different groups by the degree they were pursuing. The post-sample is slightly smaller than the pre-sample, but overall they represent the class composition quite well.

used. We also solicited feedback regarding the use of clickers in the classroom and asked their opinion regarding how their approach to CFD had changed as a result of taking this course. The pre- and post-surveys were conducted in class (during the first and the final CFD lecture, respectively). They were anonymous and the survey sample was different for the pre- and post-surveys.

Fig. 1 shows the samples for the pre- and post-surveys, as well as the actual number of students enrolled in class. The class consisted of 11 juniors, 26 seniors, 13 masters and 7 PhD students, combining to give a total of 57. The respective numbers of students belonging to these four groups were 8, 21, 13 and 7 for the pre-survey, and 8, 15, 7 and 6 for the post-survey. We find that we have a good sample representation of the class, insofar as the samples represent the overall relative number of different groups in the class.

RESULTS AND DISCUSSION

In this section, we present the results of the surveys. As mentioned in the previous section, undergraduate and graduate students at different stages of their degree enrolled in this course, so we would expect that the knowledge they brought to the classroom would be quite varied. Fig. 2 shows their previous experience with CFD/ Fluent. We find that the juniors in the class had had no exposure to it, whereas the most of the seniors had used it before. Just under 50% of both masters and PhD students had had previous exposure to it. It is interesting to note that the seniors seem to have had more previous experience with CFD than the graduate students. This might be because the seniors in this department were required to take a lab course that involved using Fluent. The graduate students, having come from diverse

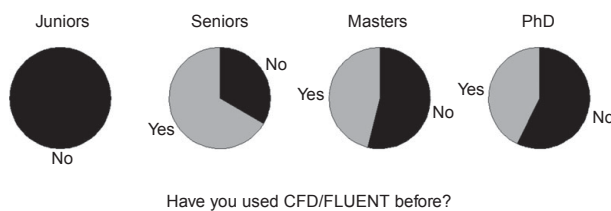


Fig. 2 Variation in students' previous experience with CFD/ Fluent for the different groups. Data from pre-survey.

backgrounds, may or may not have had such a requirement. However, the previous CFD experience of the graduate students tended to be at a higher level than that of the seniors who had just used it for a lab course. But there were seniors who were using CFD as part of their undergraduate project and hence had more extensive experience. This large variation in students' previous knowledge of CFD/Fluent needs to be borne in mind when interpreting the results that follow.

Let us now look at the students' self-reported grasp of the key CFD concepts tested in the survey. This is shown in Fig. 3. We can see that the

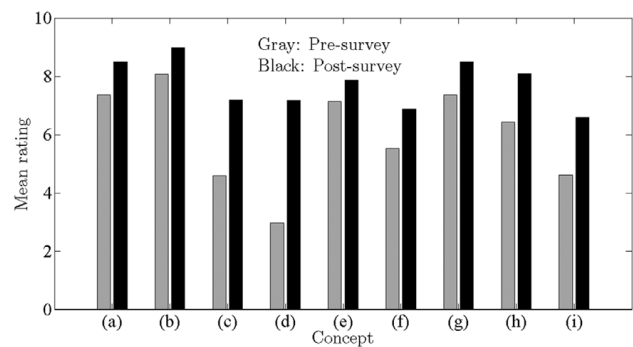


Fig. 3 Students' mean ratings of their grasp of various CFD concepts at the beginning and end of the course. (a) Governing equations. (b) Initial and boundary conditions. (c) Finite difference method. (d) Finite volume method. (e) Taylor series expansion. (f) Truncation error versus round-off error. (g) Iterative convergence. (h) Validation of solution. (i) Gauss divergence.

mean rating of all of the concepts increased in the post-survey compared with the pre-survey. To determine whether the increase is significant, we performed an unpaired t-test on the data at a 95% confidence level and found that the increase is significant ($p < 0.05$) for all of the concepts except (e) (Taylor series expansion). We further note the strong improvement in concept (d) (finite volume method), which can be correlated with the explicit focus on it in the 'Intro to CFD' hand-out. This shows evidence that students are able to appreciate the discretization method that Fluent is using 'under the hood', and this is an important step in being able to use the software effectively. This also shows the importance the out-of-class learning materials, and we will show further evidence of this in what follows.

Let us now consider question 1 in the post-survey (see Appendix), where the students rated the different instructional methods we used. Their responses, on the 10-point scale, are compiled in Fig. 4. We can see that the out-of-class learning materials and the hands-on session received overall high ratings. The online tutorials received the highest rating, confirming previous research on students' learning of simulations [5]. These tutorials allow the students to learn at their own pace and provide step-by-step instructions on how to use the software. This, coupled with the hand-out and the homework problems, strengthens students' learning of simulations. The hands-on sessions were found to be as useful as the online tutorials for those who took the course for extra credit.

The lectures were primarily used to provide a recipe for students to follow the 'expert approach' to simulations, which they could then apply out of class, while interacting with the materials. Although this goes well with the overall course strategy, previous experience has shown student engagement to be a problem in this fairly non-traditional mode of instruction. To remedy this, we tried the use of i-clickers for the first time in this course, to promote active learning in the classroom. One of the well known practices with clickers is to pose a question and then, based on the clicker response from the students, they are either given the answer right away or asked to discuss in a think-pair-share setting, after which they are

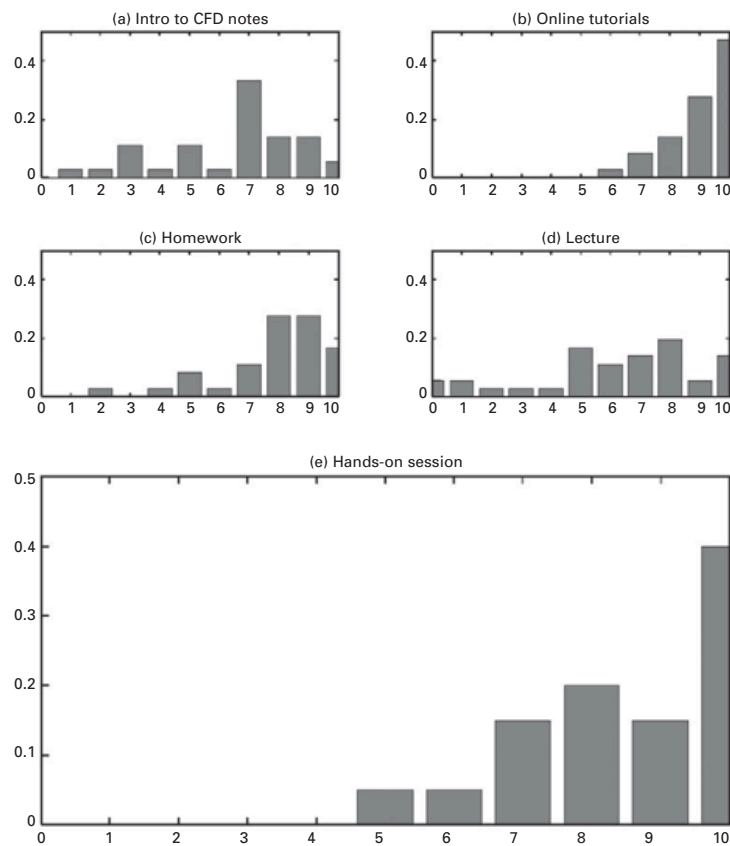


Fig. 4 Distribution of students' ratings of the various instructional tools. The hands-on session was rated only by those who took the course for the extra credit. Data from post-survey.

polled again [6]. This approach has been proven to work in a variety of settings. But here we tried a different strategy, in keeping with our goal of teaching the 'expert approach' to simulation and the time available to cover the materials. We used clickers for pre-analysis, where the students were asked to predict the expected behavior of some quantity in the problem before it was solved, and then, at the end of the solution process, we would compare the students' responses with the software output. This was also an opportunity to clarify certain misconceptions

among students and to point out subtleties in the numerical solution, among other things.

We asked the students in the post-survey whether they found the use of clickers helpful or not. The results are shown in Fig. 5. There was a large variation in their responses to this question. All of the PhD students found them helpful, whereas few of the juniors did. The seniors and masters students were more evenly divided. This result highlights once again the wide range of expertise, backgrounds and expectations of students in class. Among the reasons students provided for not finding the use of clickers helpful were the absence of an attached grade and the easiness of the questions. The usefulness and methods of attaching a grade-point to the clicker questions has been documented before [9, 10]. We also need to be aware of the diverse backgrounds of the students in this class and design questions with varying degrees of difficulty. Some of the students

who did find the clickers useful indicated that they wanted them used more extensively and that it helped them engage with the class better. Therefore, our first attempt at introducing clickers in the lectures to promote active learning received a mixed response, which will be used to inform future offerings of the course.

Finally, in question 4 of the post-survey, we asked the students how their approach to simulations had changed as a result

of taking this course. A majority of the students demonstrated a qualitative understanding of at least one aspect of the expert approach to simulation. A more complete demonstration of this would be in the analysis of homework, exams and projects. Although students generally did well on the CFD homework, we did not do a thorough analysis of their work with respect to the specific learning outcomes for the course (and the individual homework). This is something that we intend to do in the future, to better interpret the survey data.

CONCLUSIONS

In this paper, we have described improved strategies to teach CFD simulations to upper-level undergraduates and graduate students in the context of an upper-level elective course in fluid dynamics. We developed an 'Intro to CFD' handout to describe the basic discretization and solution procedures that Fluent uses. This can help the students to appreciate the software's solution procedure beneath the user interface, which can then lead to 'expert usage' of the software's capabilities. We conducted pre- and post-surveys in class on a sample of students that reflects the overall class composition. The survey data reiterated our

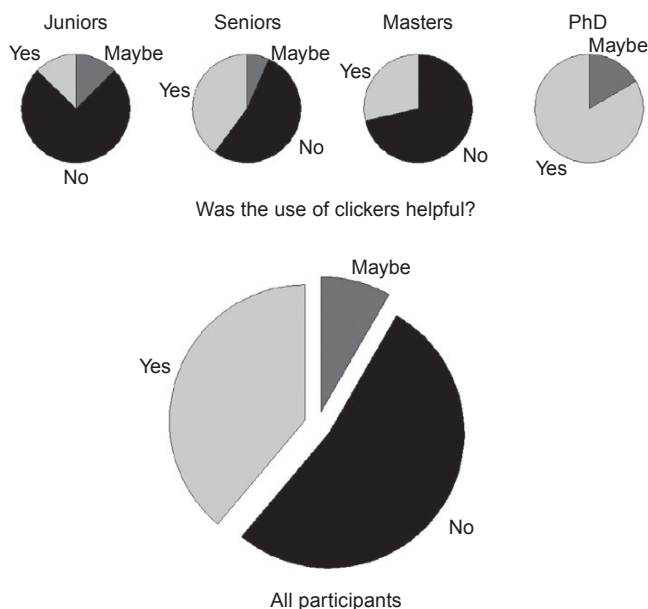


Fig. 5 Student feedback on the use of clickers classified as 'Yes' (positive), 'No' (negative) or 'Maybe' (neutral). Data from post-survey.

understanding that out-of-class learning materials are very important in students' learning of simulations. The lectures were perceived to be less useful but important, and we tried to promote engagement during the lectures by using i-clickers. We posed clicker questions to guide students' pre-analysis of canonical CFD problems, and the use of clickers received a mixed response. The class was divided in half regarding their usefulness, with a wide variation among

the different groups of students. We conclude from the survey data that assigning a small percentage of the grade to the clicker questions, and posing questions with a wider range of difficulty to cater to the diverse student backgrounds in class, may encourage more active student participation. In the post-survey, most students could demonstrate a qualitative understanding of the expert approach to simulation. For more conclusive evidence, we need to carefully analyze student work, which we intend to do in future offerings of the course. Our findings help shed light on the effective ways to teach simulations, and can inform future instruction of the present course (and similar courses).

LESSONS LEARNED / BEST PRACTICES

The following points describe the primary lessons learned from this study, which could inform future teaching of simulations within the engineering curriculum. These also include some knowledge of best practices drawn from RB's personal experience in teaching simulation for a number of years, as well as analysis of feedback from students.

Most of the student learning of simulations happen out of class. It is therefore crucial to design ef-

fective out-of-class learning materials, closely tied to the learning outcomes for the course. The most useful out-of-class learning materials are found to be online software tutorials and homework problems (all of which can be designed to achieve specific learning outcomes).

Classroom time could be spent focusing on training students to use the out-of-class materials most effectively.

More specifically in relation to CFD, the finite volume method, which forms the basis for most industrial CFD codes, can be covered in a couple of lectures by focusing on its application to simple (one-dimensional) model equations. Students can be shown how to apply it to a model equation through one or two lectures and a handout. This can be followed by homework where students need to apply the method to a different model equation. In the process, students develop code to implement key ideas such as discretization and iteration, which carry over to exercises in the CFD software.

A 'pre-analysis' step can be introduced to precede the simulation. In this step the mathematical model to be solved using the software is summarized and the likely answer is predicted through analytical calculations, reflecting how an expert would approach the problem. Since this step precedes any work within the simulation software, it serves as the 'connective tissue' between conventional analytical content and the simulation. Before simulation steps are presented, students can be asked to do their own 'pre-analysis' and predict selected results through i-clicker questions.

The use of i-clickers appears promising as a tool to engage students in this fairly non-traditional lecture setting. To encourage student engagement in such an i-clicker segment, a grade could be attached; the questions should be suited to the level of expertise among the students.

It is important to recognize the diversity in the classroom in terms of previous knowledge or experience with simulation. This can affect not only the learning materials developed for the course, but also more subtle issues, such as the difficulty of the clicker questions.

For a stand-alone course on simulations, it is crucial to focus on projects different from canonical textbook problems. Real learning of the workings of simulation software tends to happen when students encounter unexpected, problem-specific issues.

Every software interface is different, but they solve the same equations using similar solution schemes. It is therefore important to emphasize the underlying concepts, and what goes on 'under the hood' in the software, as students navigate the software interface.

ACKNOWLEDGEMENTS

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APPENDIX

Pre-survey conducted in-class during the first CFD lecture

1. Have you used Fluent or another CFD code before? If so, in what context?
2. On a 10 point scale (0, I have no idea; 5, I have some idea but not very confident; 10, I can define and work with this concept with relative ease), rate your grasp of the following concepts:
 - (a) Governing equations for fluid flow
 - (b) Initial and boundary conditions
 - (c) Finite difference method
 - (d) Finite volume method
 - (e) Taylor series expansion
 - (f) Truncation error versus round-off error
 - (g) Iterative convergence of numerical solution
 - (h) Validation of numerical solution
 - (i) Gauss divergence theorem
3. If you cannot determine the analytical solution to a problem but have generated a numerical solution, how can you tell whether your solution is correct?
4. What degree are you pursuing?
 - (a) Undergraduate (mention which stage: F, S, J or Snr)
 - (b) Masters
 - (c) PhD
5. Your gender

Post-survey conducted in-class during the final CFD lecture

1. Rate the usefulness (0, not useful at all; 5, somewhat useful; 10, extremely useful) of the following in your learning of CFD (using Fluent) so far in this course. Please give reasons.
 - (a) 'Intro to CFD' hand-out (by Ray, Bhaskaran and Collins)
 - (b) Online Fluent tutorials
 - (c) CFD homework assignments
 - (d) Fluent lectures
 - (e) Hands-on sessions ('Tuesday section') (if applicable)

2. On a 10-point scale (0, I have no idea; 5, I have some idea but not very confident; 10, I can define and work with this concept with relative ease), rate your grasp of the following concepts.
 - (a) Governing equations for fluid flow
 - (b) Initial and boundary conditions
 - (c) Finite difference method
 - (d) Finite volume method
 - (e) Taylor series expansion
 - (f) Truncation error versus round-off error
 - (g) Iterative convergence of numerical solution
 - (h) Validation of numerical solution
 - (i) Gauss divergence theorem
3. Did you use Fluent (or any CFD code) before taking this course (please include previous courses, internships, etc.)?
4. How has your approach towards CFD simulations and/or simulation results changed across this course? Please explain briefly.
5. Did you think the use of i-clickers in the lectures was helpful for you? Explain your response briefly.
6. If you cannot determine the analytical solution to a problem but have generated a numerical solution, how can you tell whether your solution is correct?
7. What degree are you pursuing?
 - (a) Undergraduate (mention which stage: F, S, J or Snr)
 - (b) Masters
 - (c) PhD

8. Your gender

PART II: CONTROVERSY AND RISK IN THE CLASSROOM

The Pedagogy of Controversy in the Field of China Studies: Teaching the Cultural Revolution

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Graduate Research and Teaching Fellow and Teagle Fellow 2011-2012

Based on the ethnographic analysis of a first-year writing seminar at Cornell University on the history of the Cultural Revolution, this paper examines the challenges as well as the potential inherent within the pedagogy of contentious historical and political issues in the field of China Studies. The intersection of a politicized field of study, recent demographic shifts in the American university, and uncertainty and blind spots in the pedagogy of controversy combine to produce a challenge for scholars who are interested in teaching and discussing controversial topics in China Studies. This project thus asks how instructors might overcome this politicization, and the often simplistic binary thinking that it produces, in order to address controversial topics in a way that enhances rather than blocks discussion. In response to this question, I propose two new concepts for the pedagogy of controversy: (1) de-identification, which refers to a process of disengagement from the binaries that structure and reproduce controversy, and (2) humanization, which refers to a process of moving beyond abstractions to reidentify with the fundamentally human experience of contentious historical moments. In conclusion, I argue that the pedagogy of controversy might be best served by teaching against humans' instinctive reactions to controversy.

LITERATURE REVIEW

The Pedagogy of Controversy

Controversial and sensitive topics are, by their very nature, uncomfortable and even difficult to discuss. Despite these inherent challenges, however, the scholarship on teaching and learning is largely in agreement that such topics have an important place in the classroom. If education is not simply an end in and of itself, one of its essential roles should be preparing students for their lives after graduation: lives in which avoiding difficult issues and decisions will unfortunately not be an option.¹ A quick glance at the recent news cycle provides a snapshot of not only the inevitability but indeed the centrality of such issues in the daily life of the world today: in recent months, we have had Quran burnings in Afghanistan, followed by apologies, and denunciations of said apologies; a collision between reproductive rights and religious institutions, exacerbated by a certain radio talk-show host's less than thoughtful comments on the topic; discussions of what constitutes work for stay-at-home moms, as well as what constitutes "self-defense" in Florida; the slaughter of

¹ cf. Arnold Burron, "Controversial Issues: They Belong in the Classroom." *Education Policy Center Issue Backgrounder* (IB-2006-D). Accessed at www.procon.org/sourcefiles/they_belong_in_the_classroom_4-06.pdf

protesting civilians in Syria, illusorily justified under the immunizing auspices of “national independence” and sovereignty; allegations that 81 House Democrats are members of the Communist Party; and of course a colorful exchange about two presidential candidates’ treatment of dogs. Our world seems to thrive upon perpetual controversy and an eagerness to offend, or be offended by, the opposing sides of each controversy; these multitudinous controversies are emotionally charged, complex, and even at times simply odd. In a global society in which a state of emergency “is not the exception but the rule,”² such topics are inescapable. And because a functioning democratic society relies upon the ability of citizens to engage in thoughtful and rational discussion with fellow citizens, including those with whom they disagree,³ the skills to address such topics with careful thought and sustained deliberation should be a central component of the educational process, and particularly institutions of higher education.

Yet if there is widespread agreement about the importance of confronting difficult topics and the “educative power of intellectual conflict,”⁴ the question of how to confront such topics remains open for discussion. Researchers in the Scholarship of Teaching and Learning have examined strategies for presentation, discussion, debate, and reflection in the study of controversy. Central topics raised in these studies include:

Demystifying the ideal of the “neutral” instructor:

O’Brien and Howard⁵ have argued that a teacher as a model of responsible authority cannot be value neutral. Acknowledging one’s values and adopting a critical reflective posture toward these values and their effects upon one’s teaching, the authors argue, models “responsible authority,” while attempting to separate oneself from said

values under the guise of neutrality is fundamentally “irresponsible.” Concretely demonstrating this principle in practice, Diana Hess’s analysis⁶ of the ways in which instructors’ political views influence their teaching recounts a class debate from the 1960s on the Equal Rights Amendment. After class, Hess heard two students trying to figure out “what the teacher’s opinion was.”⁷ Patting herself on the back as an exemplary neutral teacher, she was surprised to find that, in discussion over lunch with fellow instructors, her neutral approach to controversy generated a great deal of controversy: one colleague memorably characterized her as a “political eunuch.”⁸ Looking back on this now decidedly less controversial controversy with the benefit of four decades’ distance, Hess concludes that feigning neutrality on a controversial subject is not only in many cases impractical, but also irresponsible. Yet at the same time that she reaches this conclusion, Hess still emphasizes the importance of not overpowering the discussion with one’s own opinion, and, instead, striking a balance between neutrality and opinion.

Instructors’ presentation: Oxfam’s 2006 guide “Teaching Controversial Issues”⁹ proposes a series of potential “styles” for teachers in confronting controversies; the largely self-explanatory approaches include: committed, academic, devil’s advocate, advocate, impartial chairperson, and declared interest. No particular approach is suggested over and above the others, and the guide recommends, in the midst of these various approaches, approximating a “balanced” approach to controversy. Similarly indeterminate is Carolyn Gallaher’s examination of the pedagogy of political violence,¹⁰ which raises the question of how extreme experiences can best be represented in the

² Michael Taussig, *The Nervous System* (London: Routledge, 1992), 34.17

³ cf. Keith Barton and Alan McCully, “Teaching Controversial Issues... Where Controversial Issues Really Matter,” *Teaching History*, Vol. 127 (June 2007).

⁴ David W. Johnson, Roger T. Johnson, and Karl A. Smith, “Constructive Controversy: The Educative Power of Intellectual Conflict,” *Change* (Jan-Feb 2000).

⁵ Jodi O’Brien and Judith A. Howard, “To Be or Not to Be: The Paradox of Value Neutrality and Responsible Authority,” *Teaching Sociology* 24, No. 3 (July 1996), 326-330.

⁶ Diana Hess, “How do teachers’ political views influence teaching about controversial issues?,” *Social Education* 69, No. 1 (January 2005), 47-48.

⁷ Hess, “How do teachers’ political views influence teaching about controversial issues?,” 47.

⁸ Hess, “How do teachers’ political views influence teaching about controversial issues?,” 48.

⁹ Oxfam, “Teaching Controversial Issues.” *Global Citizenship Guides*. Fall 2006. Accessed at www.oxfam.org.uk/education/teachersupport/cpd/controversial.

¹⁰ Carolyn Gallaher, “Teaching about Political Violence: A Primer on Representation,” *Journal of Geography in Higher Education* 28, No. 2 (July 2004), 301-315.

classroom, particularly in light of the passions that surround any attempt to represent and understand often incomprehensible acts of violence. Yet Gallagher's analysis is similarly lacking in terms of specific recommendations for pedagogical practice. Susan Schramm-Pate and Richard Lussier's study based on the implementation of a critical pedagogical approach to the confederate flag controversy in South Carolina¹¹ highlights far more clearly the importance of diversifying media to promote new perspectives in a rural, working class, white, and conservative community. Moving beyond the state-mandated textbooks with their "traditional narrative of progress, peace, freedom, democracy, and prosperity with things just getting better all the time" and their reliably conservative interpretation of the notion of "Southern heritage,"¹² these instructors incorporated novel reading materials, including newspaper articles from the local and national press and statements from the American Civil Liberties Union and the National Association for the Advancement of Colored People on the 2000 controversy surrounding the display of the Confederate Flag on the grounds of the South Carolina State House. Such diversity of materials provides a useful albeit quite general guideline for instructors, advice to which I will return later in my analyses.

Discussion and debate: Schramm-Pate and Lussier's article¹³ further highlights their approach to moving beyond conventional lecturing by getting students involved in a far-reaching program of journaling, debating, researching, writing reflective essays, and role-playing on the Confederate Flag controversy. On a similar theme, Barton and McCully¹⁴ directly confront the challenges of presenting and discussing controversial historical issues within the educational context of Northern

¹¹ Susan L. Schramm-Pate and Richard Lussier, "Teaching Students How to Think Critically: The Confederate Flag Controversy in the High School Social Studies Classroom," *High School Journal* 87, No. 2 (2003): 56-65.

¹² Schramm-Pate and Lussier, "Teaching Students How to Think Critically: The Confederate Flag Controversy in the High School Social Studies Classroom," 61.

¹³ Schramm-Pate and Lussier, "Teaching Students How to Think Critically: The Confederate Flag Controversy in the High School Social Studies Classroom."

¹⁴ Barton and McCully, "Teaching Controversial Issues... Where Controversial Issues Really Matter."

Ireland. In this politically charged atmosphere, in which the controversies addressed are both immensely powerful and personal, the authors provide recommendations that instructors (1) be prepared for emotional responses and deal openly with emotions, (2) avoid hiding their own positions on these controversies, and (3) explore the full diversity of viewpoints that exist amongst students.

Past scholarship in each of these areas, from the role of the instructor to the presentation of the topic and the facilitation of discussion, thus provides essential background knowledge for instructors hoping to address controversial topics in the classroom. At the same time, however, past scholarship leaves many questions unresolved: how can we move beyond the myth of the neutral instructor without dominating or disrupting the balance in the classroom discussion of controversial topics? What sorts of media are useful in addressing controversial topics? How might we acknowledge emotional investments and identifications without their blocking discussion and the exchange and development of ideas? Just as there are no easy answers in the face of the controversial historical and political issues addressed by each of these articles, no clear-cut or easy answers to these questions of pedagogy exist. While I certainly cannot feign to provide a final answer to these questions, my experiences teaching a highly emotionally charged and controversial historical topic—the Cultural Revolution in China—might contribute a new perspective to begin thinking through these issues.

Disciplinary, Political, and Demographic Context

The complications and uncertainties described above in relation to the pedagogy of controversy are only further compounded in this case by their location within the field of China Studies. This case study thus provides two unique additions to the study of controversy. First, China Studies as a whole is an immensely politically charged discipline, as a result of (1) the political investments of scholars, (2) extensive state monitoring of scholarship both within China and abroad, and (3) recent trends in academia. In a process of disciplinary self-selection, researchers and instructors in the field of China Studies have often held a largely benign if not overly positive perspective on the modern history of China, investing themselves more

often in the task of countering perceived misunderstandings and bias than in confronting the often harsh realities of history and politics.¹⁵ One cannot fully ascertain whether these ideological propensities are a product of, or only further reinforced by, the Chinese state's visa policies, which from 1949 to the present have rewarded scholars with "politically correct" viewpoints and never shied away from blacklisting scholars who confronted tough issues that, at least from the state's perspective, would be better left unstudied.¹⁶ There are, we must remember, quite a number of such topics: the Great Leap Forward, the Cultural Revolution, and Tiananmen; Taiwan, Xinjiang, Mongolia, and of course Tibet; ethnic tensions, media control, state corruption, religious repression, and political persecution. Yet whatever the cause of these ideological propensities may be, these trends have been further compounded by the "cultural turn" in the social sciences and rise of a culturally relativistic postmodernism, which promotes a simplistic and homogenizing celebration of an idealized "subaltern" and rationalizes turning away from critical approaches to sensitive topics outside of "the West."¹⁷ These currents have come together to produce a politically charged field of studies filled with controversies, for which its instructors are often eager to avoid discussion of said controversies.

In an ironic and memorable anecdote highlighting the often ironic products of these intersecting currents, Chinese scholar and recent Nobel Peace Prize winner Liu Xiaobo arrived at Columbia University in the spring of 1989 as a visiting scholar, hoping to finally find an open space in which to critically assess the modern history and contemporary dilemmas facing his home country, China. Yet Liu's time at Columbia coincided with the emergence of postcolonial theory in academia, a

¹⁵ Zhang Longxi, "Western Theory and Chinese Reality," *Critical Inquiry* 19, No. 1 (Autumn 1992), 105-130.

¹⁶ Perry Link, "Turned Back at China's Door: Why Princeton Should Speak Out Against a Blacklist of Scholars," *Princeton Alumni Weekly* (February 9, 2005) 31; Daniel De Vise, "US Scholars Say their Book on China Led to Travel Ban," *Washington Post* (August 20, 2011).

¹⁷ Jean-Francois Bayart, *Les etudes postcoloniales: Un carnaval academique* (Paris: Editions Karthala, 2010); Elizabeth M. Zechetner, "In the name of culture? Cultural relativism and the abuse of the individual," *Journal of Anthropological Research* 53, No. 3 (August 1997), 319-347.

trend that was less than concerned with his own concerns, while ironically claiming to speak in his "voice": "people expected him, as a visitor from China, to fit in by representing 'the subaltern,' by resisting the 'discursive hegemony' of 'the metropole,' and so on."¹⁸ Liu was purportedly amazed at the naïveté of many Western scholars in taking government statements and policies at face value, as well as the great lengths to which such scholars would go to justify and rationalize these tendencies through complicated theories fundamentally detached from experience.¹⁹ Institutional and disciplinary self-reproduction ensures that the environment which Liu encountered twenty-some years ago has not changed greatly.

Second, beyond the complexities of the field of Chinese Studies as a whole, the Cultural Revolution itself is a topic surrounded by both emotions and uncertainties. It was once hailed as the first step toward the creation of a "new world" by Mao's Comrade-in-Arms, Lin Biao, a viewpoint still able to be reliably and monotonously found amongst the mountains of documents produced throughout the decade from 1966 to 1976. Yet just a few years later, the Cultural Revolution was simply labeled "a decade of catastrophe" in a Party resolution on historical questions since the founding of the People's Republic²⁰ and completely barred from open discussion and research in China.²¹ Such conflicting views are also present in what might be called "Western academia," varying from unabashed romanticism²² to dismissal and denunciation.²³ A possible source of these po-

¹⁸ Perry Link, Tienchi Martin-Liao, and Liu Xia, eds. Liu Xiaobo: *No Enemies, No Hatred* (Cambridge: Harvard University Press, 2011), xvi.

¹⁹ Link, Martin-Liao, and Liu, Liu Xiaobo: *No Enemies, No Hatred*.

²⁰ Deng Xiaoping, "Resolution on Certain Questions in the History of Our Party Since the Founding of the People's Republic," *Selected Works of Deng Xiaoping, Vol. II* (Beijing, Foreign Languages Press, 1997), 230-254.

²¹ CCP Central Propaganda Department and State Press and Publications Administration, "Regulations Governing the Publication of Books about the 'Great Cultural Revolution'" in Michael Schoenhals, *China's Cultural Revolution, 1966- 1969: Not a Dinner Party* (Armonk: ME Sharpe, 1996).

²² Lee Feigon, "The Passion of the Mao," Indie Pictures, 2006.

²³ Simon Leys, *Chinese Shadows* (New York: Pen-

larized sentiments is the contradictory fact that the Cultural Revolution was on the one hand initiated under the auspices of truly inspiring ideals (equality, innovation, anti-bureaucratization) while on the other hand being implemented to the most disastrous of effects (ideological fanaticism, senseless violence, irreversible suffering and death). Such intellectual and emotional conflict, caught between the promise of idealism and the sad record of its implementation, is thoughtfully addressed by William Donahue²⁴ in his discussion of a course on the 1968 Red Terror in West Germany. Donahue recommends directly confronting both the ideals and the unfortunate consequences of the ideals of political movements, leaving room for many different types of lessons to be taken away from this moment. Unfortunately, in the case of the Cultural Revolution, both scholars and students far too often tend to take away whichever lessons they find most amenable to their own ideological stances: the polemical battle that began with the spring 1966 debate on Wu Han's play "Hai Rui Dismissed From Office" ironically continues to live on in the academic attempt to sift through the events that followed.

The difficulties surrounding this topic are further complicated by a recent demographic shift in education in the United States, namely the influx of undergraduate students from China to institutions of higher education. Having tripled in population over the past three years, students from China now constitute the largest group of international students in the United States.²⁵ The roots of this growing trend can be found in, on the one hand, rapidly growing wealth in China and widespread demand for the type of high-quality secondary education that is not generally available through domestic higher education. In addition, widespread demand in the United States for a more diverse

guin Books, 1981); Roderick MacFarquhar and Michael Schoenhals, *Mao's Last Revolution* (Cambridge: Belknap Press, 2008).

²⁴ William Collins Donahue, "Elusive '68: The Challenge to Pedagogy," *Teaching German* 41, No. 2 (Fall 2008), 113-123.

²⁵ Helen Gao, "Clash of Civilizations: The Confusion of Being a Chinese Student in the United States," *The Atlantic* (December 12, 2011), accessed at <http://www.theatlantic.com/international/archive/2011/12/clash-of-civilizations-the-confusion-of-being-a-chinese-student-in-america/249787/>.

student body and, amidst the economic difficulties and budget cuts of the past few years, for students who can pay full tuition, has also contributed to the increasing numbers of Chinese students.²⁶ This is fundamentally a win-win situation: diversifying student bodies, promoting cultural exchange, and helping colleges make ends meet. Based upon my own observations and discussion with fellow scholars and teachers, many students from China in United States' institutions of higher education have also elected to take courses on the topic of China. On the one hand, these students enrich classroom discussions, and on the other hand, they have an opportunity to see and consider new perspectives on their home country.

However, students coming from China have, in the first 18 years of their lives, been raised within an extremely constrained narrative of modern Chinese history and politics.²⁷ To briefly summarize this narrative in relation to the Cultural Revolution, this decade is characterized solely as "a mistake" implemented by a few bad apples, known as the Gang of Four, who somehow weaseled their way to the top of an otherwise pure and always correct party. Similarly incomplete and inaccurate narratives exist for many important moments in modern Chinese history. As such, this ideological background can pose a new challenge for instructors in the field of Chinese Studies. For example, a recent article in *The Atlantic* entitled "Clash of Civilizations: The Confusion of Being a Chinese Student in America,"²⁸ written by a former undergraduate student in the U.S. from China, cites self-censorship, defensive reactions, and an "instinctive compulsion to take China's side" when controversies related to one's homeland emerge.²⁹ The article discussed above by Barton and Mc-

²⁶ Tom Bartlett and Karen Fisher, "The China Conundrum," *Chronicle of Higher Education* (November 3, 2011). Accessed at <http://chronicle.com/article/Chinese-Students-Prove-a/129628/>

²⁷ Edward Friedman, "Raising Sheep on Wolf Milk: The Politics and Dangers of Misremembering the Past in China." *Totalitarian Movements and Political Religions* 9, No. 2 (June-Sept. 2008), 339-410.

²⁸ Gao, "Clash of Civilizations: The Confusion of Being a Chinese Student in the United States."

²⁹ Gao, "Clash of Civilizations: The Confusion of Being a Chinese Student in the United States."

Cully,³⁰ examining the pedagogy of controversy in Northern Ireland, addresses similar issues of emotional investment and defensive reactions in a different context. Yet both Barton and McCully, along with their students, pursued these questions as insiders: this paper builds upon and expands their research by examining how an “outsider” can successfully pursue controversial topics with “insiders” in an outside and open classroom context. Or rather, it explores the question: how does a so-called “Western” instructor, once concerned with righting misperceptions or perceived bias amongst non-Chinese students of contemporary China, confront this new conundrum of addressing and discussing controversial topics in Chinese history in a way that does not automatically provoke defensive reactions amongst students from China?

This project thus analyzes the process of teaching a difficult topic within a complex field of study in light of diverse student backgrounds and demographic shifts. Within these intersecting yet conflicting currents, how can we pursue taboo topics in modern Chinese history without immediately turning students off as “anti-China propagandists”? From another perspective, how can we deal with these taboo topics without constructing a simplistic “anti-China” narrative? Can the inherent complexity and sensitivity of historical events serve as an object of discussion rather than a hindrance to discussion? How can we grapple with the full weight of modern Chinese history, from the Cultural Revolution to Tiananmen, without ourselves or our students of any national and ideological background becoming trapped in a binary of “us” and “them”? Although the combination of controversial topics and diverse student backgrounds raises new questions and new challenges for approaches to teaching, it also provides new and exciting opportunities. Which scholar of contemporary China would, after all, be willing to pass up the opportunity to openly discuss the history of the Cultural Revolution and post-Maoism with students from China? This project, based in just such an opportunity and challenge in the form of a seminar on the Cultural Revolution (1966-1976) with a primarily Mainland Chinese student body, examines the pedagogy of controversy within a

demanding yet always exhilarating field of study, confronting these challenges and the lessons learned in this process, to suggest methods for future instructors to confront these issues.

METHODOLOGY

In order to contemplate the questions posed above, this project draws upon my experiences teaching a first-year writing seminar at Cornell University. My seminar addressed the history of the Cultural Revolution and the ways in which this history has been processed both domestically and internationally since the initiation of this movement in 1966 and its conclusion in 1976. Participants in this course came from a diverse array of backgrounds: six were recently arrived international students from the People’s Republic of China, another eight were of Chinese descent, and another four were “Caucasian.” Writing seminars at Cornell University are required courses for all first-year students, and students were placed in this course by completing a request form for the Knight Institute for Writing in the Disciplines in which they listed their top three selections for a fall writing seminar. Based upon students’ comments, as well as the lengthy wait-list for this course, most students appeared to have listed the course as their first selection.

The students selected and engaged with a course that was intertwined with controversial and sensitive subjects: the role of the still-revered leaders of the Maoist era in inciting violence, popular participation in persecution, the enactment and experience of political violence, student violence against teachers and children’s violence against parents, cannibalism, the politicization of culture and human relationships to the ideas of tradition and culture, ethnic relations and ethnic persecution, state constructions of history, and the burdens of national identity and national guilt. This combination of a series of difficult topics and a student body with vastly divergent relationships to and understandings of the events and labels under discussion posed a challenge to everyone involved. Yet my focus throughout this seminar was to use these difficulties as catalysts rather than hindrances to reflection and discussion, with positive results.

³⁰ Barton and McCully, “Teaching Controversial Issues... Where Controversial Issues Really Matter.”

This paper is, for lack of a better word, an “ethnography” of this process, and, as such, does not feign to provide any irrefutable statistical evidence of the effectiveness of a particular approach, or any final answers about how to teach controversial issues. Numerous reasons exist for the application of this methodology, not the least of which is my own disciplinary proclivities as an anthropologist and my propensity toward “methodological anarchism.”³¹ Yet to provide a more robust justification of this approach for the sake of non-likeminded readers, let us first consider a potential methodological counter-example. In an alternate quantitative universe, I could have attempted to isolate particular independent and dependent variables and trace the relations between the two with, on the one hand, a quite small sample (n=18) and, on the other hand, a quite diverse variety of course materials, discussions, assignments, and not to mention students: a terrain which could and indeed should raise serious doubts about any attempt to isolate any single variable, not to mention somewhat more realistically distinguishing and evaluating multiple variables. The ability to transform my findings into numbers and graphs would indeed be comforting, providing both myself and my readers with an intellectually immunizing aura of certainty. Yet considering sample size and the multifaceted course context, even I, as the author of such a study, would be hard-pressed to be convinced of any statistical significance, even if no such statistical significance were to be found. Furthermore, any instructor who has taught even the same course to two different groups of learners will remember that no two courses are the same, and significant statistical findings from one course unfortunately do not equal success in another. Such variability not only highlights the potential pitfalls of a quantitative approach, but also highlights the potential benefits of a qualitative approach. These differences attest to the fundamental variability and indeed unpredictability of course dynamics, an unpredictability which can be conveniently and thus compulsively removed from journal articles through numerical abstractions, yet which remains unavoidable in real-life situations, and the details of which are best confronted and analyzed through a qualitative approach atten-

³¹ Paul Feyerabend, *Against Method (New Edition)*, (London: Verso, 2010).

tive to the nuances of actual practice.

Ethnographic reflection and a certain methodological anarchism, in this author’s opinion, provide an opportunity to confront and analyze the details of classroom dynamics and the unexpected developments that make both the teaching and the research process not only interesting but also instructive, mining the details of the learning process to produce arguably more resonant although undeniably less experimentally reproducible results. The end goal of my qualitative analysis then is not statistically verifiable results, but rather the “creation of concepts”³² to generate new perspectives, suggestions, and approaches in the navigation of this inevitably unwieldy process known as teaching. As is always the case, the real verification of these results can only be found in their implementation in other teaching contexts and subsequent development.

CONCEPTS

The whole country’s got a fu--ed up mentality. We all got a gang mentality. Republicans are f---ing idiots. Democrats are f---ing idiots. Conservatives are idiots and liberals are idiots. Anyone who makes up their mind before they hear the issue is a f---ing fool! Everybody is so busy wanting to be down with a gang! I’m a conservative! I’m a liberal! I’m a conservative! It’s bulls---!
Be a f---ing person.

—Chris Rock, “Never Scared”³³

From Re-identifying Binaries to De-identification

When I visited China during my undergraduate education and told friends and acquaintances that one of my main research interests was the Cultural Revolution, the response that I received was nearly unanimous: “Why would you study that?” Friendlier acquaintances recommended that I pursue the study of a topic that might be more redeeming: “You know, China’s economy has been developing particularly rapidly in recent decades. Why don’t you do some research on the economic growth of the past thirty years?” Other acquaintances, less inclined to friendly advice,

³² Gilles Deleuze and Felix Guattari, *What is Philosophy?* (New York: Columbia University Press, 1996), 10.

³³ Chris Rock, “Never Scared,” HBO Productions, 2004.

suggested that my choice of topic was a deliberate attempt to demonize China, and that my research was part of the vast “anti-China conspiracy” that had been seemingly meticulously documented in a series of paranoid-nationalist bestsellers in the late 1990s.³⁴ Beyond revealing the troubled relationship in contemporary Chinese society to quite recent history, these responses, when examined from a microsociological perspective, reveal the all-too-easy binaries into which individuals tend to drift when discussing historical controversies in a cross-cultural context.

In raising the topic of the Cultural Revolution as a research interest, a binary schema was immediately produced in my listeners’ minds between “us” and “them.” The Cultural Revolution was tied to “us”—my acquaintances—and the research in this area was being conducted by “them,” with the results that personal relations and conversations, when touching upon issues of national history, are alienated through national imaginaries. This pattern is not, however, solely a product of the unique political context in China: my experiences discussing this topic in the United States have often similarly resulted in comfortable distancing and condemnation of the events known as the Cultural Revolution as a totalitarian problem “over there,” or equally misplaced “revolutionary” enthusiasm, seeking out some sort of pure political experience which is lacking in our own society. Within such a framework, history is not treated as a potential object of study for the purpose of reflection, but rather as a projection board for one’s own assumptions and investments: whether as a dirty national secret to be kept under wraps by recommending the study of more redeeming topics of which “we” can be proud;³⁵ or from another perspective as a historical stain safely belonging to an “other,” which we can condemn before returning to other more redeeming topics of which “we” can be

³⁴ cf. Peter Hays Gries, *China’s New Nationalism: Pride, Politics, and Diplomacy*, Berkeley: University of California Press, 2004.

³⁵ Similar processes occur in every society. James W. Loewen’s *Lies My Teacher Told Me: Everything Your American History Textbook Got Wrong* provides an eye-opening look at the self-redeeming representations in American history textbooks as well as the social context within which these narratives are perpetually reproduced.

proud. As should be obvious to anyone who has ever viewed a cable news show, the discussion of controversial topics, often structured around simplistic binaries and identities, primarily have the effect of reinforcing these binary identities.

In response to this tendency, throughout my teaching in this seminar, I attempted to implement an approach that I have now, in retrospect, labeled de-identification—the kind of fancy-sounding term that fits in well within an academic paper. But what exactly do I mean by this term in practice?

First, and most obviously, controversies are controversial precisely because they have the potential to shake us out of the complacency that surrounds our longstanding personal assumptions and sense of selfhood. Reflecting upon the most emotionally charged controversies in American culture today, one might note that they circulate around matters of life, death, sexuality, and national and racial identity—matters about which people have strong opinions, and thus in relation to which they develop a strong sense of identification. The Cultural Revolution and other examples of controversial historical moments similarly impinge upon the will to a positive national identity and related matters of national and imaginarily personal dignity.³⁶ As such, once a stance has been chosen, or a “team” selected (or more often designated by birth), immense resistance develops toward acknowledging other viewpoints, as well as the facts which support those viewpoints. And even in situations in which in-group favoritism and out-group bias are overcome, the end result is often a critical approach to one’s own in-group, and an unthinking romanticization of an out-group, which is presumed, again within a binary framework, to possess all of the strengths perceived to be lacking in one’s own in-group: to provide an example beyond the field of China Studies, Noam Chomsky’s now clearly misplaced enthusiasm for the Khmer Rouge in the 1970s³⁷ represents such a tendency, as does Michel Foucault’s incomprehensible celebration of the fundamentalist-theocratic 1979 rev-

³⁶ Jurgen Habermas, “Concerning the Public Use of History,” *New German Critique* 44 (Spring-Summer 1988), 40-50.

³⁷ Noam Chomsky and Edward Herman, *After the Cataclysm: The Political Economy of Human Rights, Vol. II* (Cambridge: South End Press, 1979).

olution in Iran as a correspondent for *Le Nouvel Observateur*.³⁸ This is thus a process which thrives upon identification, and through which identification thrives. A de-identifying approach as proposed herein, by contrast, seeks to move beyond such a self-affirming and thus self-reinforcing reification of history, considering the matters at hand rather than our pre-existing investments in these matters.

I attempted to model precisely such a de-identifying approach from the first day of classroom discussions. Recounting to my students the origins of my own interest in the Cultural Revolution and thus tracing the history of my own personal viewpoints on Maoism, I shared the somewhat embarrassing fact that, at their age, I had felt a certain degree of enthusiasm and optimism in relation to this movement. Convinced that education about communist countries in the United States concealed more than it revealed, I envisioned Maoism as an alternative to the path of governance and development currently implemented in what we term the “Western world”: a path seemingly more radical and thus potentially more liberating. Such thinking was the product of precisely the type of simple, identity-based binary described above: that which was seen to be lacking in our own political and economic experience was presumed to be automatically present in “the other.” Yet upon reading in more detail about the realities of the Cultural Revolution and people’s experiences in and memories of this period, I soon learned that despite the potential shortcomings of our own systems of governance and economic development, the model implemented in the Cultural Revolution, while undoubtedly different, was not a solution, and arguably posed an even larger and more burdensome problem.

Should I have laid my cards on the table like this? As noted above, recent studies in the pedagogy of controversy³⁹ have criticized the longstanding illusion of the detached teacher standing in an imag-

inary objective middle space beyond opinions, arguing instead for the importance of instructors being forthcoming about their own viewpoints. On the one hand, students who spend an entire semester discussing a particular topic with you as an instructor will undoubtedly be able to figure out your opinion over the course of the semester, no matter to what length you may go to disguise that opinion. On the other hand, as a “responsible authority figure,”⁴⁰ it is important to show one’s willingness to take a clear stand on the issues, and to avoid modeling an irresolute, wavering, and opaque approach to matters of fundamental human importance. These arguments are convincing, and I recognize the value and potential benefits of acknowledging one’s viewpoint. Nevertheless, while acknowledging the usefulness of such disclosure, it seems equally important in this process to avoid portraying one’s viewpoint as rigid and unchanging, as a firm identity that has remained fixed over the years or the sole correct perspective. Instead, by acknowledging one’s viewpoints and their transformations on the basis of learning,⁴¹ one can model a way of looking at difficult topics without simply clinging to one’s assumptions and opinions.

In my opinion, the transformation of thinking about the Cultural Revolution over the past decade, shared with my students on the first day of class, attempted to achieve precisely this by modeling de-identification in two primary senses. First, as mentioned above, my early assumptions about Maoist China and the Cultural Revolution had been based upon a simplistic and identity-based binary thinking: that which was lacking in our own political and economic experience was presumed to be automatically present in that of the Cultural Revolution. A more distanced and nuanced reflection that moves beyond simple binaries would acknowledge that in fact both models could be lacking to varying degrees. Second, in addition to moving beyond the type of simplistic binaries and accompanying assumptions that mapped the world throughout the Cold War, my tracing of my own opinion regarding the Cultural Revolution as an exploratory process rather than a firmly

³⁸ Janet Afary and Kevin B. Anderson, *Foucault and the Iranian Revolution: Gender and the Seductions of Islam* (Chicago: University of Chicago Press, 2005).

³⁹ cf. Hess, “How do teachers’ political views influence teaching about controversial issues?;” Barton and McCully, “Teaching Controversial Issues... Where Controversial Issues Really Matter.”

⁴⁰ O’Brien and Howard, “To Be or Not to Be: The Paradox of Value Neutrality and Responsible Authority.”

⁴¹ cf. Inna Semetsky, *Deleuze, Education, and Becoming* (Rotterdam: Sense Publishers, 2006).

consistent and unwavering identity provided a model of the type of de-identificatory learning that I aimed to promote in my course. I took a similar approach in classroom discussions throughout the semester, questioning stances in which I believed, raising unexpected questions, bringing opposing viewpoints into dialogue, and of course playing devil's advocate every once in a while to enact the goals of setting aside our assumptions, continually questioning our opinions, taking in and processing rather than simply categorizing and accepting or dismissing new information, and viewing knowledge as a process rather than a completed goal. Such an approach could help to ensure that our discussion of the topic of the Cultural Revolution would be a learning experience⁴² rather than a simplistic identification with opinions and subsequent opposition to others.

The arguably inherent human tendencies of in-group favoritism and out-group bias are magnified in the idea of the nation and the burdens of said nation's inevitably troubled history. The resulting simplistic binaries, such as those described at the beginning of this section, then hinder discussion by constructing an imagined opposition between "us" and "them" and viewing the discussion as a competition. Controversy, often structured around identities, then primarily has the effect of reinforcing these inherently false and problematic identities. The pedagogy of controversy within the field of national history should not only ensure exposure to the full range of viewpoints on any topic at hand, but also detach those viewpoints from any presumptive ties to identity, founded upon the appealing yet limiting notions of patriotism and national pride. De-identification is central to this process.

From Abstraction to Humanization

A controversy is, by definition, "a discussion marked especially by the expression of opposing views."⁴³ This concise definition revealingly focuses upon the opposing viewpoints that develop around the matter at hand, rather than the nature of the matter at hand itself: which is, one might argue, precisely what we as humans tend to do when we are faced with controversial top-

ics. This definition thus unintentionally highlights the re-identifying processes in the discussion of controversy, often founded upon the abstraction of the topics or events into objects of identification rather than actual events, reproducing identifications, as well as, by extension, the original controversies around which they are structured and abstracted. My original understanding of the Cultural Revolution, discussed in the previous section, was founded upon precisely such a binary. Yet the de-identifying processes noted above and the development of my understanding of the Cultural Revolution were not the product of a sudden and spontaneous change, but rather emerged over the years through exposure to a diverse array of viewpoints about and most importantly personal narratives of this event, which made it more than an abstract idea about which one has an opinion, but rather an actual concrete event which millions of human beings just like myself actually underwent over the span of a decade. This recognition of the reality and humanity of a historical event or other controversy is intertwined with the notion of de-identification noted above, and constitutes the second main approach applied in my teaching: humanization.

There is a vast array of media for introducing and discussing the Cultural Revolution: a diversity which, if handled properly, can greatly enrich not only discussion but also understanding of this moment in history. My seminar employed one conventional narrative history of the Cultural Revolution, *Mao's Last Revolution* by Roderick Farquhar and Michael Schoenhals, as a main textbook.⁴⁴ Although this work contains countless powerful stories alongside meticulous documentation of the details of politics and society in this tumultuous decade, the distance provided in such a straightforward narrative of history creates an atmosphere in which it is far too easy to maintain simplistic projections. As such, I also incorporated primary materials directly from this era featured in Michael Schoenhals' collection *China's Cultural Revolution: Not a Dinner Party*,⁴⁵ which brought the simultaneously surreal yet all-too-real discursive environment of the times to light for students through

⁴² Semetsky, *Deleuze, Education, and Becoming*.

⁴³ "Controversy." *Merriam-Webster.com*. Merriam-Webster, 2012.

⁴⁴ MacFarquhar and Schoenhals, *Mao's Last Revolution*.

⁴⁵ Schoenhals, *China's Cultural Revolution, 1966-1969: Not a Dinner Party*.

readings of media outlets and Red Guard journals from this period. Beyond these two primary texts, I further aimed within my course design to include the full range of analytical perspectives and viewpoints that have been aired on the topic, from philosophical treatises celebrating the Cultural Revolution as “an event” (e.g. Alain Badiou)⁴⁶ to state critiques of the movement as a decade of disaster (e.g. resolution on certain questions in the history of our party since the founding of the People’s Republic of China),⁴⁷ and of course every opinion in between.

Of course, one can present all of the opinions that one might like upon a historical event, but so long as this presentation is framed within a national viewpoint, binaries of “us” and “them” remain present, and the temptation to fall into the simple “expression of opposing views” from fixed positions is far too strong. As noted above, my students came from diverse backgrounds; yet no matter their background, in the discussion of these events and the opinions surrounding them, there always remained the risk of viewing the Cultural Revolution as a uniquely “Chinese” event: for some an object of embarrassment or defense as “us,” and for others an object of demonization and denunciation as “them.” In response to this potential pitfall, a tempting re-identification in the midst of my search for de-identification, I strove throughout the discussion of the Cultural Revolution to move beyond the portrayal of this event as a national issue, encouraging its interpretation instead as a fundamentally human issue. It is essential not only to move beyond a singular and simple narrative of what were inherently complex events through exposure and discussion of multiple perspectives, but also to break through the equally simplistic binary of “us” and “them” and “good” and “bad” that can often characterize thinking in China Studies and about historical controversies in general.

Modeling the breakdown of this binary, I included readings from Chinese authors celebrating the Cultural Revolution (certainly not difficult to find

in primary documents from this period), readings from Chinese authors which take a critical approach to the Cultural Revolution (Yan Jiaqi and Gao Gao’s *Turbulent Decade*),⁴⁸ readings from non-Chinese authors which also take a critical approach to the Cultural Revolution (Roderick Farquhar and Michael Schoenhals’ *Mao’s Last Revolution*),⁴⁹ and readings from non-Chinese authors that take a celebratory approach to the Cultural Revolution (such as Alain Badiou’s meditations on the Cultural Revolution as an “event,”⁵⁰ alongside Richard Wolin’s groundbreaking historical study on the aspiring Red Guards of Paris).⁵¹ This design broke through the ever resilient block of identity,⁵² demonstrating that not only was there a wide range of opinions on and assessments of the Cultural Revolution, but also that viewpoints could not be tied to nationality, that there was not, as is commonly presumed and even openly claimed, a uniquely “Chinese” or uniquely “Western” viewpoint on these events. In fact, some of the most thoughtful and engaging work on uncovering and thinking through the history of the Cultural Revolution in recent decades has been conducted by Chinese scholars and filmmakers, despite the ban on the topic. And some of the most unrealistically optimistic and fawning work on the history of the Cultural Revolution in recent decades has been conducted by “Western” authors, despite open discussion and widespread knowledge of the disastrous effects of this movement. By highlighting these inherently complex intellectual currents, my goal was to move beyond simplistic labels of “self/other” or “good/bad” so as to engage students in the real debates emerging about this historical event both within China and beyond, which are the types of debates that first caught my interest in this topic.

⁴⁶ Alain Badiou, *Ethics: An Essay on the Understanding of Evil* (London: Verso, 2001).

⁴⁷ Deng Xiaoping, “Resolution on Certain Questions in the History of Our Party Since the Founding of the People’s Republic.”

⁴⁸ Yan Jiaqi and Gao Gao, *Turbulent Decade: A History of the Cultural Revolution* (Honolulu: University of Hawaii Press, 1996).

⁴⁹ MacFarquhar and Schoenhals, *Mao’s Last Revolution*.

⁵⁰ Badiou, *Ethics*.

⁵¹ Richard Wolin, *The Wind from the East: French Intellectuals, the Cultural Revolution, and the Legacy of the 1960s* (Princeton: Princeton University Press, 2010).

⁵² Todd May and Inna Semestsky, “Deleuze, Ethical Education, and the Unconscious” in *Nomadic Education: Variations on a Theme by Deleuze and Guattari*, ed. Semestsky (Rotterdam: Sense Publishers, 2008).

Yet students were furthermore brought one step closer to the real issues and experiences surrounding this historical event through another diversification of sources, namely the diversification of media and the resulting humanization of the Cultural Revolution through exposure to the experiences of this period. Beyond the back-and-forth of textual sources which invariably, as detached black and white lines on pieces of paper, fail to fully represent the reality this event, I incorporated documentaries into our learning experience (*A Century of Revolution, Though I Am Gone, Morning Sun, Red Art, The Passion of the Mao, and Chung-Kuo*) as well as a number of photographic books. *A Century of Revolution* and *Morning Sun* are two Western-produced documentaries, composed primarily of archival images from the period and first-person interviews with participants, which colorfully narrate the history of this decade. *Though I Am Gone* and *Red Art* are two Chinese-produced underground documentaries, similarly relying on archival images and first-person interviews, which tell the stories of this era through two focal points: the widespread beating of teachers by their students and the mobilization of artists in this era to produce politically correct “art” for the revolution. *The Passion of the Mao* is a Western documentary which makes light of the standard portrayal of the Cultural Revolution in the West and attempts to place a far more positive spin on the events of this decade. *Chung-Kuo*, a four-hour documentary filmed by Michelangelo Antonioni in 1972 with the permission of the Chinese government, presents eerie snapshots of everyday life in China at the high point of Maoism. Although documentaries undoubtedly took away from class discussion time, their ability to humanize the events that we were discussing made this time commitment worthwhile. By presenting images directly from the era of the Cultural Revolution, these documentaries brought students perhaps as close as they could possibly come to the full and often horrible reality of these events, making the Cultural Revolution immediate as a personal experience⁵³ with deeper significance beyond one’s own personal investments and projections. Rather than identifying

with one side or another in a debate, or one side or another in the mythical showdown between capitalism and communism, viewers were exposed to images of humans, just like themselves, undergoing extreme and fundamentally incomprehensible experiences that stood above and beyond any sort of ideological proclivities.

The standard procedure in the handling of a controversial or sensitive subjects consists in the construction of an opposing binary around the topic, abstraction from the topic at hand toward a focus upon the two sides of the binary, and a resulting re-identification in pre-established sides of the binary. This formula was clearly demonstrated in my naïve attempts to discuss the Cultural Revolution with friends and acquaintances within China a decade ago. Yet, in the memorable quote by Chris Rock stated at the beginning of this section, it is also apparent in the standard handling of any form of controversy: binaries such as liberal/conservative, Democrat/Republican, pro-immigration/pro-borders, pro-choice/pro-life, gun control/gun rights, federalism/“state’s rights,” or, perhaps most relevantly for this project, cultural relativism and human rights are created. The notions of de-identification and humanization are designed to break through these binaries, abstractions, and re-identifications, seeking instead a de-identification from abstract national or ideological investments and recognition of the fundamental humanity and reality of the topics at hand. The following section examines two examples of these processes in practice from my seminar, for readers’ consideration and evaluation.

PRACTICE: A DOCUMENTARY AND A “DEBATE”

“Though I Am Gone”

For all of the talk about controversy above, my seminar actually began on a very quiet note, with a brief overview of the history of the Cultural Revolution excerpted from Maurice Meisner’s *Mao’s China and After*.⁵⁴ This excerpt served as the foundation for a first class discussion on the general history of this decade. Although the questions and concerns raised in this discussion were all relevant and provided an essential framework for thinking

53 Zelia Gregoriou, “Commencing the Rhizome: Towards a Minor Philosophy of Education,” in *Nomadic Education: Variations on a Theme by Deleuze and Guattari*, ed. Semetsky (Rotterdam: Sense Publishers, 2008).

54 Maurice Meisner, *Mao’s China and After, Third Edition* (New York: Free Press, 1999).

through this movement, they seemed markedly abstract, with topics such as Mao's political philosophy, the relationship between members of the senior leadership in the 1960s, and the eventual repercussions of the movement known as the Cultural Revolution for the power struggle between leaders. They were part of a macro-history restricting the event to a particular range that seemed rational and easy to discuss.

We took a far different approach in the next class meeting, in which we watched independent filmmaker Hu Jie's 2006 documentary *Though I Am Gone*.⁵⁵ This powerful film recounts the story of Bian Zhongyun, a longstanding Party member and teacher at a prestigious all-female high school tied to Beijing University, arguably the country's premier university. When the Cultural Revolution began and China's youth were instructed to rebel against all forms of supposedly "reactionary" authority, Bian's fate unpredictably took a turn for the worse. Arbitrarily targeted as a "counter-revolutionary," her house was ransacked by Red Guards, who pasted derogatory posters across the walls and doorway of her residence. She was removed from her post, and forced to clean the school's toilets. In between cleanings, she was repeatedly dragged out into the courtyard over a period of weeks to be publicly beaten by her own students. One day in the late spring of 1966, after her students added nails to the wooden clubs that they used to beat her, she passed away. Her husband's decision to use a camera to document their living environment at the time, as well as her deceased body, combined with his willingness to work with director Hu Jie forty years later in transforming these images into a documentary featuring extensive interviews with family and friends finally made this horrendous and once hidden story public.

Needless to say, the response to this film and its portrayal of one woman's experience of the Cultural Revolution was quite powerful. In a flurry of discussion after the closing credits, which memorably juxtapose radio broadcasts from the era heralding the creation of a new world with a seemingly unending list of documented victims of the Cultural Revolution in Beijing, my students

repeatedly asked why Bian's students had beaten her to death. Although this question was repeated, it did not appear to be a question to which there was a clear answer, and perhaps this was why it was being asked so compulsively. It was more of a question raised in perplexity and puzzlement, and that was precisely the response that I was seeking. Standard historical textbooks of course mention the widespread beating of teachers by students, yet such presentations often get lost in the abstraction of incomprehensible numbers; one might of course wonder, after seeing these figures, why so many students beat their teachers to death. Yet the in-depth presentation of this one particular case as representative of many thousands of other cases distributed across the country humanized the massive and massively distressing violence that characterized the Cultural Revolution. Not only did the film show the details of this innocent victim's daily life, including her family photos, class photos, and personal belongings, all highlighting her fundamental humanity, it also showed the details of her treatment at the hands of her captors and tormentors, thereby highlighting the fundamental inhumanity of her fate. The contrast generated between these two images, humanization in the face of dehumanization, left a powerful impression upon students—even three months later, while completing their course evaluations, students continued to refer back to this film as an important introduction to the Cultural Revolution.

Yet while humanization moves the experience of history beyond distanced words in books, and thus beyond comfortable generalizations, abstractions, and simplistic oppositions, it can also have emotional tolls. As Barton and McCully have noted in their discussion of teaching the Northern Ireland controversy in Northern Ireland, emotional reactions are inevitable.⁵⁶ Yet if this film made the experience of the Cultural Revolution personal, it was not intended to make the burdens of the Cultural Revolution personal. In the discussion after the showing, one student from China, clearly surprised by the film, observed that "for the first time" in her life she "felt ashamed to be Chinese." Other students disagreed with this emotional conclusion, and pointed out that everyone in the

⁵⁵ Hu Jie, "Although I am Gone," dGenerate Films, 2007.

⁵⁶ Barton and McCully, "Teaching Controversial Issues... Where Controversial Issues Really Matter."

film was Chinese—not only the perpetrators, but also the victims, as well as the interviewees and the director. There was indeed no singular role that a homogeneous “Chinese people” played in the decade of the Cultural Revolution, or in its handling as history. I added to this reassuring interjection by pointing out that if we had to divide the world into nations, as we all are accustomed to do also, no nation is immune from cruel historical tragedies and mishandling of memories. Simply considering the case of my own nation, the United States, widespread tragedy had occurred in the process which we call the “discovery of the new world.” Race and gender relations remained resiliently reactionary for many centuries despite beautiful rhetoric of equality and freedom, and a reliable tendency to become involved in at best ill-advised and at worst unnecessary wars promoted further instability in an unstable world. As such, to identify the problems raised by the Cultural Revolution and the handling of its history as uniquely Chinese would be to again alienate this event from its fundamentally human pathos. I suggested that my goal in showing this film, and in teaching this course, was to emphasize the humanity of victims as well as perpetrators, rather than their particular “Chineseness,” and to highlight the common challenges of national history and national identity. My goal in this film showing and discussion was then to at once humanize the events of the Cultural Revolution that my students would be examining over the course of the semester, as well as to humanize the group of people generally identified as related to the Cultural Revolution, namely “the Chinese,” an immensely abstract label that is far too casually tossed around by both insiders and outsiders to ascribe an illusory unity to over 1.3 billion people undergoing arguably unprecedentedly rapid sociocultural and economic change.

Does The Struggle for Tibet Have to Be A Struggle?

A second example highlighting de-identification was a discussion held on Tibet-China relations and the Cultural Revolution in the second half of this seminar. Scholars in the field of Asian Studies are undoubtedly aware of the challenges and risks involved in any attempt at discussion of Tibet, which often, despite everyone’s hopes, devolve into little more than a shouting match, or worse.⁵⁷ At Cornell

⁵⁷ On the politicization of Tibetan Studies and the

in the spring of 2008, a professor in the Anthropology Department received harassing emails and even death threats on the University’s Chinese Student and Scholar Association website, simply for organizing a film showing and discussion in light of the turmoil in Tibet that spring. But somehow, just three and a half years later, I gathered with my students one chilly November morning to have a surprisingly sane discussion on this still emotionally charged topic.

The reading in preparation for this discussion was the recently published *Struggle for Tibet*.⁵⁸ This volume features a series of essays constituting a dialogue between Chinese scholar Wang Lixiong and Tibetan scholar Tsering Shakya, examining the modern history of China-Tibet relations with particular reference to the destruction and violence implemented in the Cultural Revolution in Lhasa. The dialogue begins from Wang’s justifiable observation that many Tibetans actively joined in the destruction of their own culture in the Cultural Revolution, suggesting that Tibetans were not only victims, but were also intoxicated by Maoism. Shakya responds to this provocative thesis with an essay suggesting that Wang was promoting the standard colonialist mindset of implicating the colonized in their colonization, thereby rationalizing injustice. Beginning from these starkly opposed viewpoints, the authors engaged in a dialogue and eventually reached significant agreements on the status and future of both Tibet and China. This book, the last addition to my reading list, modeled the goals of de-identification that I sought to promote in my teaching, such as featuring alternating dialogic essays by two authors on either side of the immensely politically charged China-Tibet binary and the starting point of predictably opposing viewpoints, followed by dialogue and signs of changing and developing opinions which deconstruct the simplistic oppositions and identifications that are often both the foundation as well as the product of discussions of Tibet.

reductions that overlook the experiences and agency of Tibetans in favor of a simplistic narrative, see Emily Yeh, “Tibet and the Problem of Radical Reductionism,” *Antipode* 41, No. 5 (2009), 983-1010.

⁵⁸ Wang Lixiong and Tsering Shakya, *The Struggle for Tibet* (London: Verso, 2009).

Upon students' completion of this reading, I had scheduled a "debate," which, in retrospect, was an immensely poor choice of words in representing my goal of the activity. The readings themselves and their structure of engagement highlighted the pointlessness of dividing participants into opposing teams and determining any particular victor. Instead, I hoped that students would be familiar with the arguments presented by each side in the readings, and in turn go beyond these arguments and beyond sides. The results were pleasantly reassuring. Certainly, in the course of the debate, there were divergent opinions, with some students sympathizing with the past and current situation of Tibetans, and others empathizing with the Chinese government's stance, and quite a few others still in the process of deciding. There were students reciting standard lines from government discourses about a pre-1949 cannibalistic feudal aristocracy ruling over "simple" Tibetan people who lived in caves and were in desperate need of "modernization" to counter the "conspiracy" by the "Dalai clique" pleasantly combined with doubts and complications from the readings, just as there were students reciting another standard vision of Tibetans as fundamentally innocent and inevitably peaceful perpetual victims, also pleasantly combined with other doubts and complications from the readings. Yet beyond particular viewpoints, what was most important was that participants actually listened to one another, did not interrupt one another, and even occasionally acknowledged that those with whom they disagreed had made good points, rather than solely focusing upon arguing and dismissing opposing viewpoints. We had arguably descended into the ninth circle of controversy by compounding the Cultural Revolution and Tibet—a ninth circle whose residents are not trapped for eternity in ice kept frozen by the beating of Satan's wings, but rather trapped for eternity in a vicious and self-reproducing cycle of binary oppositions and reinforced identities. Instead of finding and supporting polarized and unyielding sides, students were really entering into dialogue and thinking about the topic at hand, which was far more than I had expected, having joined in a few less formal "debates" on this topic over the years.

The collection assigned as reading for this discussion, *The Struggle for Tibet*, highlighted the

shortcomings of the identity-based thinking that tends to abound in discussions of the Cultural Revolution, Tibet, and many other uncomfortable topics in Chinese history, such as thinking reinforced in the idea that "pro-Tibet" opinions are always "anti-China," and that "pro-China" opinions are always "anti-Tibet." Such simplistic thinking in fact produced the Cultural Revolution and brought it to its climax; as such, in discussing and thinking through the Cultural Revolution, another model is necessary. The readings in *The Struggle for Tibet* instead proposed a model of dialogue, learning, and de-identification from even the most rigidly opposed of binary positions. Students displayed the lessons of this approach in a surprisingly pleasant and thoughtful dialogue rather than a "debate," engaging with the controversial topic at hand, yet avoiding controversy, which is a hindrance to listening to and understanding one another. Of course, the adoption of such an approach one November morning does not guarantee the similar adoption of such an approach throughout life. Yet while this approach to thinking through topics and de-identifying from autopoeitic binaries will not likely be the guiding principle of students' subsequent lives, this exposure will at the very least provide a model for reflecting upon controversial and contentious issues in the future: issues that will of course be unavoidable in the course of their lives.

NON-CONCLUSIVE CONCLUSIONS

In the late 1960s, I admired Mao because I felt strongly about things like peace, freedom, justice, truth, and a fair chance for the little guy. Today I detest Mao and his legacy. Why? Because I am drawn to things like peace, freedom, justice, truth, and a fair chance for the little guy.

—Perry Link⁵⁹

My goal in this project was neither to prove anything decisively nor to provide a final answer—two objectives which, regardless, clearly have not been accomplished in the preceding text. Instead, my goal has been to produce new concepts and

⁵⁹ Perry Link, "Dawn in China," *Hong Kong Economic Journal* (February 19, 2011), accessed at http://www.hkej.com/template/blog/php/blog_details.php?blog_posts_id=62867.

thereby suggest potential new tools for educators interested in approaching controversial topics toward overcoming the simple binaries, abstraction, and identities that are too easily reproduced in the discussion of controversy. This project has thus proposed a dual methodology of humanization and de-identification in the teaching of controversial topics, suggesting that the pedagogy of controversy is best served by teaching against humans' instinctive reactions to controversy. This proposed methodology can be traced through the various classroom elements of instructors' stance, presentation, and topical debates noted in the review of the literature, as well as through the moments of implementation described and analyzed in the section on practice above. From the diversification of course materials and authors to the use of images and documentaries, and from an aversion to abstraction to the critique of "debate" as an approach to contentious subjects, this paper argues that a potentially effective way to handle controversies, which are based in and reproduced by binding binary identities, is to seek ways to move beyond said identities, highlighting both "internal" differences (e.g. multiple perspectives and approaches to the Cultural Revolution under the label "Chinese") and "external" similarities (e.g. common dilemmas of history). Only such an approach can avoid the stigma and finger-pointing usually associated with and reinforced by national historical controversies (as well as other forms of controversy), by underlining the common challenges faced by humanity, while at the same time continuing to recognize and account for the uniqueness of each individual historical tragedy.

Yet beyond the pedagogy of controversial topics in China Studies, my findings also arguably have significant repercussions for my home discipline of anthropology. The prevailing reaction against past colonial mistakes in the discipline has resulted in a relativistic culturalism that reliably steers away from engaging in any sort of controversy, which is promptly imagined away at even the slightest intimation. Yet such an approach is nothing but an inverse image of the past, continuing to imagine a monolithic other whose "value" has simply been inverted, thus providing the appearance of disciplinary progress yet in fact failing to move beyond this past. The anthropological obsession with finding an absolutely correct way to repre-

sent "the other" only reproduces the problem of representing the other; anthropology's frequent failure to address sensitive and controversial issues of human rights, inequality, oppression, and historical grievances and victimization in other cultures is not an example of redeeming culturalist sensitivity as many would argue, but rather an example of the most glaring disrespect, in that it denies "the other" the same degree of sophistication, complication, and contention that we immediately recognize as inherent to our own societies, and must realistically recognize everywhere that human society has reached. An anthropology that moves beyond identities and binaries to de-totalize "culture" and recognize the common challenges that we all face as humans, and recaptures the original meaning of anthropology as the "study of humankind," is then far more promising than a tautological anthropology that takes culture as both its object of analysis and means of explanation for "others."

The quotation above from renowned yet black-listed China scholar Perry Link captures such a coexistence of intellectual growth and reflection alongside a commitment to fundamental values and understanding of the common challenges facing humanity in an always complex world. What matters are not the labels and ideologies to which we become invested or attached, but rather the empathy, care, and growth that we embrace as teachers as well as researchers. This quotation served as a useful closing point of discussion in my course, as well as, now, for the non-conclusive musings above.

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Risk, Rehearsal, Reading, and Writing: Theatre Techniques in the Classroom

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INTRODUCTION

The title of my class always elicits giggles, or at least a smirk. I never know if it's out of discomfort or because it sounds so titillating, or maybe it sounds ridiculous to spend a semester on "The Drama of Sodomy and Incest on the Early Modern Stage." Titillating or not, I chose this First Year Writing Seminar title largely because that was literally the subject matter which I taught in the Spring of 2012: thinking about transgressive sexualities and how they were represented in the 16th and 17th century in the theatre. In a larger sense, however, my choice of title reflected some deeper questions and anxieties I had. How could I elicit student enthusiasm for a topic that I was passionate about (for example, does developing an edgy title work)? More importantly, I was concerned with how I could have students take the theme of sodomy and sexuality seriously, in two senses of "seriousness": in one sense, I needed the students not to treat it as mere kinkiness. In a second sense, however, it was important to me to elicit a type of seriousness, in the sense of respecting the term fully, by preserving the very qualities of Early Modern sodomy as a particular relation to social, hierarchical, and intimate norms, and the disruption of those norms. In a landmark essay, "Homosexuality and the Signs of Male Friendship in Elizabethan England," Alan Bray writes,

Elizabethan 'sodomy' differed from our contemporary idea of 'homosexuality' in a number of other ways also. It covered more hazily a whole range of sexual acts, of which sexual acts between people of the same sex were only a part. It was closer, rather, to an idea like debauchery. But it differed more fundamen-

tally in that it was not only a sexual crime. It was also a political and a religious crime and it was this that explains more clearly why it was regarded with such dread (41).

In a sense, if the course was about exploring a subject which embraced exploding or blurring strict lines of social control and intimate contact, I wondered what sort of ways this might be echoed in the classroom. Sodomizing the students was probably not a good option. But the idea of destabilizing the hierarchy of power, of the top-down hegemony of pedagogy, of exploring different ways of sharing and displaying knowledge—those were things I wanted to take seriously.

It was important to me to have these terms and ideas present in the course title, even in seed form, because most Cornell undergraduates are required to take two First Year Writing Seminars as part of their curriculum and I wanted to both "warn" and "entice" students to the explicit nature of the course material. The philosophy behind such a writing requirement is that Cornell graduates, regardless of their major or their professional career choices, need strong writing skills in order to communicate, to succeed, to exist as knowledgeable citizens of the world. Despite an extensive balloting system, the students end up choosing classes partly based on genuine interest in the course topic and partly for scheduling reasons. The courses, featuring six to nine short essay assignments in the semester and no more than 70 pages of reading per week, are often taught by graduate student instructors with varying levels of interest in pedagogy and varying levels of previous teaching training. In another sense, however, the nature of a

“requirement” often means that students view the course as a chore and limit themselves in terms of their creative risks and writing explorations, viewing “essay grades” as the final and only markers of their success.

While I had taught language (French and English) both in Paris and at Cornell for quite a few years, this course represented the first time that I could design and develop my own syllabus and structure from the ground up. In tandem with the extensive writing program, Cornell also featured a Walk-In Writing Service where students could drop in for individual tutoring; I had tutored with this center for so long that I had attained an Assistant Director position. All of these factors meant that I felt extra pressure to develop a truly spectacular course, or at least one which was deeply cognizant of certain types of pedagogic strategies to elicit strong writing. I believed in the importance of the writing program, and I wanted to design my course in such a way as to convince my students that they ought to explore and to engage in the study of writing; that this was a lifelong skill which they could cherish, develop, and depend upon; and that they needed not approach the course with their mere teleologic view of “checking off” the requirement and snagging a good grade.

OBJECTIVES

To complicate this unilateral approach to learning about writing, I wanted my students to explore risk-taking and celebration in the classroom. Fear of making a mistake and over-attention to “getting the right answer” means that students often try to “play it safe” and develop strategies like “teacher mind-reading” instead of allowing their own ideas to take root. For example, to my great chagrin, in one of my individual meetings with Russell (names have been changed), as I was gently pushing him to develop a stronger, more elaborate thesis, he threw down his pencil and said, “I don’t know what you want me to say,” as if he surmised that I had a secret “hidden” idea that I was trying to get him to guess. Another student, Corinne, would stare at me blankly while frantically typing every single word that came out of my mouth, as if she thought that by collecting all of my phrases, ideas, and questions verbatim, she could magically “see” what I was trying to have her say. These approaches to learning about writing frustrated me, obvi-

ously, and drove me to explore ways of exploring this notion that students had that the teacher had a single set answer and that their job, as the student, was to figure it out. I realized that half of the work of letting go of this phenomenon had to come from the students, not just from my approach to teaching. Encouraging risk-taking, in my opinion, can lead to beautiful unexpected insights, or new connections, or pushing oneself to reach a higher level of analysis or writing. To this end, offering non-traditional and creative theatre approaches to the text, showing that there are a variety of ways of engaging and responding to writing, could not only make it “come alive” for the students but also loosen their grasp on the idea that there is only “one” perfect formula for writing a strong paper.

My other objective was to complicate the notion of “celebration” or “accomplishment” in this project. Instead of inextricably tying together an “A” grade with “accomplishment” I wanted to challenge each of my students to think about micro-celebrations that happen throughout the day, including small things that they accomplish and do not fully give themselves credit for. In other words, instead of having a unilateral picture of what an “accomplished” goal looks like, I want to broaden and diversify this idea, for example, celebrating speaking up in class for a shy student, or celebrating “finally understanding why citing the text is important.” Kathryn Flannery proposes that the embodiment engendered by performance techniques creates a different level of accessing textual meaning and communication:

If all writing is in some sense disembodied, having the potential to erase the mode of its production by disconnecting itself from the hands that made it, performance restores the body to visibility. Whether composing scripts for performance or writing to make sense of what they have learned through performance, students tend to register this greater awareness of the human body in space and time, especially of the simultaneity of collective bodies in motion. Performance extends an understanding of literacy beyond the narrowly linguistic, emphasizing the extent to which the body itself serves as a signifying modality, a modality that can signify in ways that exceed the limits of print (44-45).

My thought was that by providing various levels of exploration of the text through performance, students might have a wide range of possibilities to demonstrate their textual comprehension, interact with the strangeness of Early Modern English, or decipher confusing character choices and actions outside of the normative way of merely approaching dramatic literature as a passive, textual object.

I developed a teaching-as-research project based on using theatre techniques in the classroom, incorporating a series of nine theatre-based activities throughout the semester, which I will discuss in the following section. My main objectives were twofold. I surmised that the value and importance of abstract concepts that are cherished in writing instruction, such as the use of strong evidence, reading for subtext, or the concept of editing vs. revision may actually best be instructed through exercises relating to body, voice, gesture, and tone. Secondly, to move to a more meta-analytic plane, my project wanted to explore something I called "teaching-as-directing."

While there is a decent amount of scholarship on teaching-and-acting, not much has been written on the role of the teacher as "theatre director" in the classroom. A good director approaches the play and the play's text, just as a teacher approaches the classroom and the text, with some "vision" of how the performance will ultimately go; it is only through her collaboration with the actors, set designers, costumers, etc. that this vision is actually enacted. Along the way, however, in rehearsal, a director has to walk a perfect balance between over-correcting (micro-managing), giving enough space for the actors to explore and express the text, and sharing the "vision" of the performance in a constructive, productive way. Flannery writes, citing Viola Spolin (one of the founders of improvisational theatre games):

The teacher is literally to the side: 'side coaching' is 'an assist given by [the] teacher-director to the student-actor during the solving of a problem to help him keep focus; a means of giving a student-actor self-identity within the theater environment' (392). Paradoxically, in this version of lay theatre, 'no one teaches anyone anything,' in the sense of direct or didactic instruction. This does not mean that the teacher is absent or withholding of her knowledge. Rather the teacher-director's approach

is remarkably relational. She is not divested of her expertise or her authority, but she is participating in the process without holding center stage and without controlling interpretive possibilities (51).

On opening night, a good performance will seem generated almost organically from the actors' expressions, intuitions, and gestures; a heavy-handed director will seem like an unfortunate invisible puppeteer stringing along his actors. Flannery's notion of the teacher-director was something that my project endeavored to embrace.

As appealing as this "remarkably relational" approach to teaching was, however, I wanted to make sure that investigating my role as a "director" instead of a "teacher" would help me critically reflect on my position in the classroom. That is to say, instead of taking on this positive, balancing approach to power and instruction, I couldn't assume that my position as an instructor was categorically neutral, or that I had an unquestioned superior understanding of the Early Modern dramas and of writing, I wanted to be able to use the analogic metaphor of director not only to re-craft my relation to power in the classroom but also in order to develop a critical self-awareness of this power, especially in regards to these moments of celebration and risk. How did my power suppress or control risk-taking, or predetermine sorts of celebration? As Stephen Brookfield writes,

Many of us would like to believe either that we have no special power over adult learners, or that any power mistakenly attributed to us by them is an illusion that can quickly be dissolved by our own refusal to dominate the group. But it is not that easy. No matter how much we protest our desire to be at one with a learner there is often a predictable flow of attention focused on us. While it is important to privilege learners' voices and to create multiple foci of attention in the classroom, it is disingenuous to pretend that as educators we are the same as students. Better to acknowledge publicly our position of power, to engage students in deconstructing that power, and to attempt to model a critical analysis of our own source of authority in front of them (130).

I hypothesized that positioning myself consciously as a director would not only allow me different kinds of pathways of instruction, but also enhance

my self-awareness of this position of power. It would also allow me new modes of imagining how to enact and embody this power.

In order to explore these two objectives, the pedagogy of writing through theatre and the notion of teaching-as-directing, I developed nine different theatre activities, which focused on creative approaches to costume, music, voice, bodies, gesture, and space. These activities were of three kinds: in-class activities, take-home activities, and a final project. Overall, in response to these activities, the students reflected on the theatre activities in freewrites, in-class discussion, presentations on their creative choices, and online postings to a discussion board.

In-Class Activities

The in-class activities included, for example, taking a phrase or one word and asking each student to say the phrase differently. The unpunctuated sentence "I did it" could be said as a proud declaration ("I did it!"), as an uncertain self-realization ("I did it?"—in the sense of "it was *me* who did it?"), as an admission of guilt, as a euphemism ("I did... 'it'"), etc. From there, I was able to talk about early modern textual practices and how the standards of punctuation and spelling during Shakespeare's time were not yet concretely anchored and how one mis-transcribed word could alter the entire meaning of a line.

Other activities had students improvise scenes where absences became more powerful than presence, or to dramatize the relationship between seduction and knowledge.

Take-Home Activities

The take-home activities gave students a greater amount of time to prepare their presentations, and I enjoyed devising activities that mimicked situations that real-life theatre professionals might be faced with. Students were challenged to come up with a costume for a modern-day production of Christopher Marlowe's *Edward II*, or to figure out what type of music would be playing during key moments during Jean Racine's *Phaedra* or Pierre Corneille's *Polyeucte*. For these, I asked students to read the text carefully and be able to justify their choices with textual evidence. My intention was to make sure that they knew how to refer back to the text constantly to support their choices, just as

they would need to rely on textual citations and evidence to support their thesis statements and arguments in their writing. Additionally, I wanted them to explore not just the obvious themes, or what was said, but also the unspoken and subtextual in their writing as well as in their performance choices.

Other than the visual and aural responses, however, I designed the activities to make sure that there was a good mix of group and solo performance responses. I also made sure that students had access to recordings, good YouTube clips of performances, and more.

Final Project

Students were divided into small groups and each group was assigned one of the five plays that we had read this semester. They were asked to choose a scene from the play and interpret it as they liked.

RESULTS

By and large, I found that seeing the theatre activities in class helped me as a teacher-director. When students' activities really demonstrated a concept clearly, I would be able to take that presentation as a jumping-off point for discussion. For example, I could have lectured on the doubleness of Othello's character—the fact that, at times, he feels equally torn between uncontrolled rage and irritation as well as his feelings of insecurity and neurosis. Having the students stage Othello two different ways, and precisely demonstrate this character split, not only illuminated it for the other students but also allowed me to confirm that they understood the text. Often, these exercises allowed me a way to gauge their level of textual comprehension and amend my lessons accordingly.

One aspect I did not anticipate was the development of interdependent learning. One student wrote in a freewrite: "I think the partner projects that require reading scenes in different tones and rhythms was [sic] my favorite, because I was able to understand the reading of the scene better and saw how other groups approached the scenes in different ways." This sentiment was echoed through many of the freewrites, and in the write-up of their final project, I could tell that the students had put a good deal of work into explaining the scene to each other, making sure all group

members were on the same page, etc. In my overhaste to analyze the power dynamics of the top-down teacher-director structure, I had completely forgotten about the fact that theatre was an entirely collaborative, joint experience. In the future, I would make sure to stress the interdependent learning aspect and see if there were certain activities I could design to make sure that they were able to take turns clearly teaching each other.

Of the fourteen enrolled in the course, thirteen provided freewrite responses. Five students (38%) thought the activities were both enjoyable *and* useful for their writing and reading comprehension. One student, Laura, summarized her favorite activities and described in detail the ways that opening up polyvalent avenues of analysis enriched her understanding of the text:

The use of drama in this course was integral to the analytic aspect of the writing seminar, as I found myself forgetting the performance of the works and focusing solely on the plays as text at times. It opened new doors to textual interpretation when truly thinking of the range of tone, emotion and wordplay possible in any given scene and what that could mean for a student's analysis. The "Othello Two-Ways" and "Pauses" exercises were especially telling for me, as I tended to pigeonhole some of the scenes into my own primary reading of it rather than explore the text as read aloud. They also reminded me how important it was to read said texts aloud when completing reading assignments, as well as occasionally seek out a YouTube clip or two when confused about how certain lines might be portrayed classically. The *Edward the Second* costume exercise gave way to thoughts about the extent of performance and adaptation, bringing to light the extensive thought and attention to detail the playwrights must have had when exporting their text to stage and what those details can mean to a production now, especially when adapted to modern-day contexts.

Three students (23%) thought it provided a creative outlet for textual exploration, but the value of the activities seemed to be ambiguously "useful." In these cases, I'm not sure if the students were just unable to articulate the ways that the activities were beneficial to them, or if they mostly appreciated the distraction. For example, one student

wrote: "It makes the writing seminar more unique and enjoyable because we are doing more than just writing. Plus we learn material in a more direct method which I really enjoy." Two (15%) thought it was enjoyable but not useful; one student, for example, said, "I don't have a problem with them, nor without them." Two (15%) found the activities to be not at all useful: "It may be that I'm too close[d]-minded and when I don't like something I don't pay attention or try to learn as much."

DISCUSSION

The students seemed to enjoy the final project the most. Randy wrote, "Because the play [*The Duchess of Malfi*] has so many themes and is so long, by focusing only on one scene, you really begin to understand in depth that one theme or issue you are focusing on. I better understand the rest of the play by exploring one theme, like filth and immoral characters. Having looked at one scene closely, iterations of that theme become clear throughout the rest of the play." Clearly the fact that I required the students to spend a great deal of time with the text, reading one scene closely and imagining how it would be staged—this meant that they would naturally "get more" out of the text, because they had paid a certain kind of closely attentive and interpretive time with the text in preparation for their projects.

On the other hand, while the students appreciated the final project, I realized that they didn't quite understand its placement in the sequence of theatre activities and its relation to the other written work that they were being graded on. As one student noted in an anonymous freewrite response: "I think that the final project was the most helpful because we had more time to prepare our thoughts and focus. The rest of the theatre exercises in class were very last second type of exercises and thus didn't allow you to fully develop your ideas which caused them to be less helpful". At the same time, however, I specifically designed the other theatre activities (playing with pauses, extremes of voice, highs and lows, costuming, etc.) so that they would be prepared or somewhat familiar with the different avenues of creative expression, in anticipation of this final project. I would, in the future, make it clear that all of the in-class activities, while they might feel "last second," also engender a certain type of spontaneous engagement with the

text, certain kinds of insights and inspirations. Furthermore, while the assignments that required more at-home preparation had clearer, more direct “payoff” in terms of their comprehension, the other in-class assignments fed into the larger structure.

Students were also confused about being evaluated for different forms of response, other than writing, to the text. Another student, Paul, said, “One of the most helpful activities, in my opinion, was the latest theatre activity. The modern adaptation of the different groups allowed me to relate to some of the plays. This assignment should be done as the class goes on rather than at the end, when being able to relate to the assignment does not really help.” Interestingly enough, for Paul, the “helpfulness” of the theatre assignment is gauged by how it can help clarify a text in order to write about it. Since the final projects presenting the plays came at the end of the semester, after students had already written essays on those texts, Paul felt that the assignment was not useful. He read the use-value of the exercise in terms of its ability to help him produce a written assignment, without considering that the performance itself, and his reflection on the performance, was also still a response and a demonstration of his mastery of the text in some way. In the future, if I were to do the course again, I would definitely make it clear that all of the smaller theatre assignments, including improvisation, help textual comprehension, and that the final assignment is still a type of performance-based assessment of his engagement with the text.

Another aspect I hope to work on in the future for the class is the nature of inclusion. One student, Rina, wrote:

Having done four years of children’s community theatre, four years of high school drama club, and four years of high school musical theatre, I intentionally chose writing seminars both semesters that involved theatre. [...] I really enjoyed the assignment where we had to present the same scene in two different ways, with different emotions, personalities, reactions, etc. I thought that really highlighted the importance of an actor’s interpretation of a character. When you’re reading the lines, your mind usually jumps to one way of interpreting them, and one way of imagining what a char-

acter is feeling at that moment, and how they are acting. But when you have to take a scene and decide what meaning you want to put behind every single word, it becomes much more clear just how open to interpretation plays and characters can be. I really enjoyed all the theatre assignments we did for this class; I felt that the plays we read necessitated a little acting and a little creativity, in order to truly comprehend and grasp all of the potential meanings and messages to be found.

I felt that students who were naturally extroverted or who felt comfortable and enjoyed performing got the most out of these activities. Another student, Lily, said that the projects required “a bold sense of self to perform; thus, it can be a little embarrassing.”

In the future, I believe I need to make sure that students don’t feel “pushed” into performing or uncomfortable. Risk-taking does require a certain level of discomfort, but I wonder if it is within the bounds of my prerogative as an instructor to push students to a certain kind of risk or self-exposure. While on the one hand, “theatre activities” can seem like an unambiguously positive way of rendering the classroom more dynamic, engaging, or enriching, sometimes such activities also need to be critically analyzed as well. In a parallel privileged classroom structure, the “circle” of chairs (as opposed to rows of desks), Brookfield complicates the notion of the circle as “unsullied democratic purity” by arguing that

[B]eneath the circle’s democratic veneer there may exist a much more troubling and ambivalent reality. For learners who are confident, loquacious, and used to academic culture, the circle holds relatively few terrors. But for students who are shy, aware of their different skin colour, physical appearance or form of dress, unused to intellectual discourse, intimidated by disciplinary jargon and the culture of academe, or conscious of their lack of education, the circle can be a painful and humiliating experience. These learners have been stripped of their right to privacy (134).

In the future, as I try to explore and extend these theatre activity projects, I would want to ensure that there are mechanisms of “opting out” available to students who do experience those “painful and humiliating” experiences. Halfway through

the course, I decided to change the nature of the theatre assignments and ask for volunteers who wanted and did not want to perform—the non-performers shared their musical choices for a character's imaginary iPod, for example, and many of the other students enjoyed these non-performing activities because they were still able to think about the text in a very enriched, dynamic way without putting someone on the spot. I think that I would re-structure the activities in such a way in the future.

A final point of consideration is to consider the classroom as "rehearsal" time. I had some thoughts about the nature of direction before I started teaching—about the ways that a director had to come with a "plan" or a vision for the script, etc. After reading Robert Gross's article, "Rehearsal as Interpretive Technique," I think that I would reformat my approach to classroom time. The technique he proposes is to not go into rehearsal (or classroom time) completely ignorant of some themes, nor to approach it with an overly fixed vision of how the play "should be," nor to be overly weighted down by literary-tropic analysis. Rather, one should approach classroom time (or rehearsal time) with a type of radical openness to an ever-evolving appreciation of the text:

Making rehearsals interpretively productive requires pre-rehearsal interpretations that ask "why" over and over again until every perceivable moment of the script has been fully rationalized and reconciled with every other moment into a coherent "action to be communicated," not merely an action to be executed before an audience. The most useful way for the director to formulate this action is in terms of final cause; that is, as a web of understandings of the communicative job to be done, of the impact performance that they should have on the audience moment by moment. During rehearsal, this sketchy cognitive structure of how the play should be communicated should be tested, revised, and fleshed out (1).

I really appreciated the last line ("tested, revised, and fleshed out"), and I would restructure my class in such a way to make sure that students are all on board with being cooperators in this explorative endeavor—to be testing, revising, and fleshing out with me (as the director?) through activities, through writing, and through interdependent learning.

While this project was a first exploration and a first attempt in sketching out an approach to teaching writing through the theatre, I feel like I gained a lot, even through some flubbed activities or some mis-organized structures. Although the theme of my project was encouraging my students to take risks, I ended up taking risks myself in teaching this first course in such a way that defied the "safe" structure of merely having students read and write. I feel like there is so much that has been explored but still so much to perfect and hone as I continue to develop this project.

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PART III: TEACHING STUDENTS TO BECOME CRITICAL CONSUMERS OF INFORMATION

Explicit Instruction in Primary Literature to Foster Scientific Knowledge and Writing Skills in First and Second Year Students

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ABSTRACT

Primary scientific literature is a crucial part of scientific dialogue, but reading it and using it effectively in writing can pose real challenges for most first and second year undergraduate students. For this study, I created a series of primary literature workshops embedded in two writing-intensive courses at a large private university. Students were primarily first and second year students from a wide variety of majors. An important note for this study is that, in the spring class, most of the 11 students were science majors, but this was not the case for the Fall class, in which most students were not science majors.) A student-chosen term paper—including a literature review—was the culminating project for the fall class, and a formal proposal was assigned as a final project for the spring class. At the end of both terms, qualitative and quantitative analyses showed significant gains in the quality with which students used primary scientific literature in their writing. However, these gains were more pronounced in the class with science majors. In addition, while both groups of students reported feeling challenged by the primary literature, students in science majors were more likely to feel that reading the literature was valuable, despite its perceived

difficulties. Students from many majors can learn to use primary literature effectively in writing, but those interested in science or those who are more invested in it, seem to reap the greatest benefits from it. In addition, embedding primary scientific literature instruction in a class that builds up to a culminating project in which students are asked to pose new questions appears to be quite effective. If these conditions are met, first-year students can do an excellent job reading and writing with primary literature.

INTRODUCTION

One of the exciting challenges of being a science instructor at a university is sharing the culture and practice of science with a broad variety of students, from future doctors, research scientists, and engineers, to the next generation of lawyers, poets, and English professors. The challenge for science educators, then, is to balance the needs of this diverse student body and provide a level of scientific literacy to all students, while providing the explicit instruction and introduction to scientific practice needed by those whose future careers are in the sciences. In a traditional college of sufficient size, this is done by separating

courses into two classifications: for “majors” and “non-majors,” with the understood difference being that the courses for “non-majors” involve less methodological and technical detail. Nevertheless, promoting scientific literacy for all students includes helping them to develop an appreciation for the methods and culture of science (Glynn and Muth, 1994; Holliday et al., 1994 ; Hand et al., 1999; Yore, 2000). Two important tools for the promotion of scientific literacy are the use of primary scientific literature and scientific writing tasks.

Scientific Literacy

Scientific literacy is generally defined relative to the portion of the population that is not actively engaged in science. It includes both the understanding of basic scientific concepts and scientific habits of mind—that is, an understanding of the nature of science, the roles that evidence plays in science, and the ability of a person to evaluate the quality of evidence and use that evidence to support a conclusion (Hand et al., 1999; Yore, 2000; Gunel et al., 2009). It has also been extended to deciphering and delivering clear communications about scientific ideas with others (Holliday et al., 1994; Hand et al., 1999). It thus promotes intellectual benefits for all educated people, regardless of their primary field. At the college level, scientific literacy should be a basic outcome for all graduates. Methods that promote scientific literacy are especially important in the content of non-majors courses, as such courses will be the primary—and perhaps the only—method of obtaining scientific literacy for non-majors, while majors in a scientific field will have additional methods of developing scientific literacy through the practice of science. Scientific literacy has become of increasing importance to students, as scientific topics are becoming increasingly prominent in everyday life. It will be essential for all people to be able to understand and evaluate the issues presented to them, as climate change, energy policy, and health issues are increasingly part of the daily news cycle, and citizens will be part of important public policy debates on issues of scientific importance.

Use of Writing Tasks to Promote Scientific Literacy

Several studies have shown that well-designed writing tasks are particularly useful in cultivating scientific literacy for a wide variety of grade levels (Holliday et al., 1994; Gunel et al., 1999; Hand et

al., 1999; Yore, 2000). A well-designed science-related writing task engages students in clarifying and evaluating their own thought processes and allows the integration of new facts with previous knowledge characteristics to turn into a successful social constructivist learning of science ((Glynn and Muth, 1994; Hand et al., 1999, Gunel et al., 1999; Yore, 2000). Explicit instruction in writing teaches students the tenets of a well-reasoned, clearly expressed approach to a scientific problem (Yore, 2000). Considering how to express scientific ideas in writing for a well-defined purpose and audience encourage not only good writing but good science, as students are provided opportunities to reflect productively on their own understanding and reasoning (Gunel et al., 1999). Indeed, the act of scientific writing specifically for non-technical or younger audiences increases student comprehension of subject matter because it requires students to work with the material more deeply in order to construct it and express it in a form younger readers can understand (Gunel et al., 1999). Writing itself, therefore, is not only an important part of the scientific process for all practicing scientists, but it also promotes a depth of scientific understanding crucial for both science literacy and science practice (Yore et al., 2002; Phillips and Norris, 2009).

Importance of Primary Literature as an Inquiry Tool

In addition to scientific writing tasks, readings from the primary scientific literature have also proven a fruitful gateway into the understanding of science. Many college science classes have currently incorporated primary literature (in this discipline, reports of original scholarly research, generally an experiment or observational study) though these classes have primarily been directed toward science majors and have therefore had science practice as well as scientific literacy as their primary goal (e.g. Janis-Buckner, 1997; Herms, 1999; Smith, 2001; Hoskins, Lopatto and Stevens, 2011). Such courses have overwhelmingly reported numerous benefits of using primary literature when used as part of a carefully structured course. Students exposed to intensive primary literature instruction report greater confidence in their understanding of science (Janis-Buckner, 1997; Herman, 1999; Houde , 2000) of scientific techniques (Herman, 1999), improved skill in experimental design and data analysis (Janis-Buckner, 1997; Herman, 1999; Houde 2000; Smith, 2001), and

perceptions of themselves as part of the scientific community (Smith, 2001; Houde, 2000; Hoskins et al., 2011).

In addition, because writing and reading primary literature articles are part of the process of developing knowledge in the scientific field, literature can be used to introduce students not only to scientific concepts, but also to many aspects of the nature of science. Because the structure of scientific papers detail the end results, provide discussion points to take home, and discuss the methods used and questions posed to generate those results, this can prove to be a window into scientific thought for students (Rybarczyk, 2006; Phillips and Norris, 2009). Hoskins, Lopatto, and Stevens (2011) have developed a particularly fruitful model of using primary literature in which they track the course of a research project using a series of papers on the same topic from the same lab, and even correspond with the authors to illuminate the research project. The model showed that this method increases students' understanding of the processes of science and the role of inspiration and creativity in developing scientific theories (Hoskins et al., 2011). This is particularly important in classes that are too large to permit intensive laboratory study (e.g. Hoskins et al., 2011) or in which study is intractable because of the delicacy and expense of research materials needed. One example is in ecosystem level science, an area in which projects often require vast datasets which span many years, are expensive to perform, and may require statistical and mathematical modeling skills beyond the experience of most first year students. Using the primary literature is a way to add both nature of science and inquiry based tasks to a curriculum in which experimentation is not feasible (Phillips and Norris, 2009).

Scientific literature can also be used to demonstrate the tentative, theory-laden, and debated nature of science if articles with opposing viewpoints are chosen (Rybarczyk, 2006), or if students use primary literature as a window on a case study in which multiple stakeholders—e.g. landowners, the EPA, environmental activists, etc.—have a voice in an environmental controversy (Camill, 2000). In addition, the kind of persuasive writing undertaken in science (Yore, 2000; Yore et al., 2002) in which scientists present evidence for their conclusions and differentiate between alternative hypotheses

also can serve as an antidote to the view of science in textbooks, which overwhelmingly present science as a collection of certain facts (Phillips and Norris, 2009).

Despite the overwhelming evidence for the utility of a carefully structured use of primary literature, it is still challenging to use primary literature in an undergraduate class. One problem is that teaching students explicitly how to use primary literature is time consuming and may result in reduced time for coverage of course content (Rybarczyk, 2006; Wenk and Tronsky, 2011). In addition, primary literature is often densely written and full of complex terminology (Herman, 1999), which makes it difficult for early-career students to comprehend. Indeed, in the absence of focused instruction in the use of primary literature, most instructors report that students find the literature "intimidating" and difficult to follow (Smith, 2001). However, this difficulty can be largely obviated, even with first year students if a progressive approach is followed (Wenk and Tronsky, 2011; Rybarczyk, 2006; Hoskins et al., 2011). In such an approach, students are introduced to literature in stages, often first reading only a section of the paper (e.g. introduction, methods) and are asked to answer basic questions "What is the question this paper is trying to answer?" or "What are the authors' hypotheses?" before tackling a full paper. Frequently instructors will prepare an overview of the information of what students should find in each section of a paper (e.g. Wenk and Tronsky, 2011; Janis-Buckner, 1997) as a guide for students when they are reading, and students are then asked to summarize the article before discussion. This type of basic summarizing, i.e. "putting it in your own words," can lead to the kinds of information restructuring and prior knowledge integration which are essential in creating good reading skills (Yore, 2000; Glynn and Muth, 1994). Secondary steps involve critique and analysis of the articles (e.g. Wenk and Tronsky, 2011; Janis-Buckner, 1997; Hoskins et al., 2011) which then leads to the kinds of mental activities that promote integration of new information with previous information and activation of reasoning skills (Yore, 2000; Glynn and Muth, 1994).

Despite the progress made in teaching undergraduates to read primary literature, more work is still needed on two major fronts. First, we need more information on techniques to teach non-majors

how to use scientific literature. Currently, despite the power of primary literature in illuminating the scientific process, few or no studies focused on teaching primary literature to non-majors have been completed, and only one (Tronsky and Wenk, 2011) focuses on first and second year students. In addition, when measuring the effects of primary literature, using pre-and post-test scores, authors must measure effects with the same rigor they would use in a scientific experiment. Most authors (e.g. Smith, 2001; Houde 2000; Herman, 1999) perform excellent matched-pairs tests to determine the effects of explicit instruction in primary literature on student understanding of concepts and scientific process. However, in most of the studies, it is not clear how the tests were done and what corrections for multiple comparisons were performed. A notable exception is Hoskins et al. (2011), who used Principal Components Analysis to increase the statistical rigor of their tests.

Secondly, we must increase the focus on the connection between reading primary literature and writing. Most of the research on the use of primary literature in college classes, however, has not focused on its ability to assist students with their use of it in writing. Despite the overwhelming utility of primary literature and writing exercises separately, so far no study has attempted to study the effect of reading primary literature on the quality of student writing in a writing-intensive course. This may in fact be because scientists judge the quality of papers primarily on the scientific content rather than particular aspects of literary style, and emphasize the content of science writing rather than literary qualities when teaching (Yore et al., 2002). However, though scientists are mostly focused on the content of papers, they do also report suspicion of the quality of science in poorly written papers (Yore et al., 2002). It is therefore important for scientists to write well, for themselves, for other scientists, and for the wider public to whom their research will apply. Moreover, primary literature is a critical part not only of the scientific process, but also of the science writing process, as the primary scientific literature is the gold standard for quality of evidence among scientists (Yore et al., 2002). Furthermore, science papers can serve as models for the types and tones of writing in science. In fact, understanding the language of science arises naturally from immersion in such language, rather

like immersion in a foreign language aids in its comprehension (Holliday et al., 1994). Engagement with the reading and writing of and about primary research articles helps students to become familiar with the sounds and methods of scientific discourse (Holliday et al., 1994; Houde, 2000; Phillips and Norris, 2009).

In my own classroom, I have experienced the challenges of teaching students to read and write with primary literature. Over the years in a variety of institutions, from a small liberal arts college to a large research university, I have been given and have myself assigned lab reports and other writing projects in which students are required to cite at least one primary source. However, I have noticed that students struggle to find good sources, to comprehend them, and to use them effectively in their writing. For this reason, I developed a series of workshops designed to help students read primary literature more effectively, find it more easily, and use it more appropriately in their writing. This study examines the effect of those workshops on scientific literacy, subject comprehension, and increases in writing skill in two writing-intensive courses for different audiences. I hoped that by critically reading examples of good scientific writing, students would increase the clarity of their writing, the quality of their thesis developments, and the sophistication with which they can appeal to evidence.

METHODS

Students and Classes

I integrated explicit instruction in reading and using primary literature into two writing intensive courses intended for quite different audiences—a freshman writing seminar and a writing-intensive upper-level ecology class. The first course was a Freshman Writing Seminar (FWS) entitled “Sustainable Earth, Energy, and Environmental Systems.” All students at the university are required to take an FWS, though they have a choice of many different writing seminars in a variety of departments. This FWS, offered in the Fall of 2011, served 17 students: twelve male and five female; two seniors, three sophomores, and twelve first years. The students ranged in majors from engineering (5) to biology (1) to anthropology (1), economics (1) and the remainder undecided/unknown. This course was intended as a “non-majors” course, that is, it was

intended to promote scientific literacy on the topic of climate change. Explicit overall learning goals for the course were: 1) Students will understand the nature of science and the methods of climate change science, including how information is gathered and evaluated, where this science is powerful, and where it is limited, 2) Students will learn to read and evaluate scientific literature as a means of investigating a question of importance to them, 3) Students will develop writing skills of conciseness, clarity, argumentative rigor, and language selection used to communicate with both scientific and non-scientific audiences, and 4) Students will understand the basic principles of climate change and the implications of climate change for sustainable ecosystems and human society, including effects of these changes on food security, water, human health, and conservation.

The second course was a “Writing in the Majors” course (WIM) in ecology. Students attended the regularly scheduled ecology lecture, but had two additional hours a week of discussion to perform enrichment activities and writing tasks. This class, taught Spring 2012, had eleven students—five male and six female. It had seven first-year students, three sophomores, and one junior, and students had to apply to be in this specific, writing-intensive section. Unlike the first-year writing seminar, this writing in the majors course was specifically designed for future scientists (and doctors), and thus enculturation into scientific methods and literature could proceed more explicitly. The overall learning goals of this course were similar to the other in that both emphasized writing as well as scientific content. The primary difference was the content-related goal, states as: Students will understand the basic principles of ecology, its fundamental connection to evolutionary biology, and its basic implications for conservation, health, and human services. For both courses, choice of primary literature and writing tasks were chosen to complement each week’s themes of the course (Wenk and Tronsky, 2011).

Workshops

Students in both classes were led through a progressive series of primary literature workshops, ranging from once a week to once every three weeks. The primary literature selected for each workshop was chosen to match with the weekly topics of the class discussion. Supporting review

articles, book chapters, and news items were assigned to give students overviews of the topics, comprehensive background knowledge, and a window on the multiple perspectives brought to the issue.

Introduction of primary literature into the curriculum followed a progressive model based on Wenk and Tronsky’s (2011) work on primary literature (Rybarczyk, 2006). The primary literature assignments began with a brief introduction to primary literature in excerpts.

- *Workshop 1:* Students were given excerpted data from the 2007 IPCC report and asked to write a figure caption and summary about the piece.
- *Workshop 2:* Students read a full article using a series of guided questions to tease out the implications, and then wrote a summary of the article. In the FWS class, this took the form of an abstract of the article. However, students struggled to produce an abstract different from the published abstract. Therefore, in the writing in the majors class, the students wrote an annotation for the article, comprised of a summary and an evaluation explaining why the article was useful.
- *Workshop 3:* Students looked more closely at the articles, and analytically laid out the argument and evidence for it from a particular paragraph. They then generated a question that the article raised for them, and wrote about what in the article led them to the question. Students in the FWS class had trouble defining what I refer to as “the scientific context of a question”—the background from which it sprang and what makes it interesting. Therefore, in Workshop 3 in WIM, we spent much more time examining the introductions to scientific articles to identify scientific context. This was designed to help students identify scientific context in their own proposals.
- *Workshop 4:* Students looked more critically at the primary research papers, evaluated assumptions and critiqued the arguments. In this workshop, they also examined closely how the authors of the piece used evidence and referred to previous literature to support their claims.

Journaling

Students were encouraged to read all sources, both primary and secondary, critically and reflectively, and write informally about them in journal assignments. This process proved difficult to monitor in the first-year writing seminar. Therefore, during the WIM class, students posted a “reflection piece” each week with three main goals:

1. to briefly summarize the reading
2. to critique the assumptions or conclusions of the piece
3. to generate at least one question for class discussion and explain what led them to this question (Yore, 2000; Glynn and Muth, 1994)

Such reflection pieces have been shown to increase student comprehension of reading material, and enrich the quality of further discussion of literature (Glynn and Muth, 1994; Yore, 2000; Janis-Buckner, 1997). My goal was that explaining what prompted their questions will also promote students’ metacognitive awareness of their own ability to ask good questions, and lead to richer, more integrative, or deeper questions about the topics.

Writing Assignments

In the FWS, students wrote six total papers of increasing length, for a variety of audiences. Though they used different sources, students generally used an increasing amount of information gathered from primary literature. Shorter assignments included a popular science piece, an annotated bibliography, and, as a culminating experience, a literature exploration paper in which they identified a problem of interest to them in sustainability or ecology and used literature to support an answer to it. This final assignment gave students a chance to research an area of interest to them within the broader context of the course.

In the WIM course, one of the goals for the students was to produce a proposal for a scientific topic, grounded in the appropriate scientific literature. They produced this proposal in stages, including a pre-proposal defining their topic, an annotated bibliography, and several drafts of the proposal itself.

Evaluation of Course and Workshops

Each workshop was evaluated in the following ways:

1. *Subjective student evaluations of the workshop series:* At the beginning and at the end of the series, students were asked to fill out a workshop questionnaire for the overall primary literature workshop series, in which they rated their comfort with writing, science, and primary literature on a scale of 1-5 (Appendix A, modeled on Smith, 2001; Houde, 2000). These surveys examined students’ perceptions of their own scientific competence, writing skill, and scientific engagement. Because each student had a unique identifier, it was possible to use a matched pairs design to analyze the pre-survey and post-survey data for each student on each question. Questions were analyzed with matched-pairs t-tests. Surveys were recoded so that 5 = strongly agree and 1 = strongly disagree. In addition, anonymous mid-term and end of year evaluations were analyzed to determine students’ response to the course, including items that the students felt were most helpful.
2. *Student Draft Comparisons:* Pre-class reflections, cover letters, drafts, and assignments produced by the same student were evaluated for increase in sophistication of writing and sophistication of use in primary literature. The instructor noted patterns of improved sophistication.

RESULTS

Challenges of Primary Literature

Student reflections in surveys and cover letters in both sections indicated struggles with the primary literature—specifically, difficulty finding primary literature (or other peer reviewed literature) and reading or understanding it. Navigating databases is still difficult for many of my students, and some of them reported using Google or Google Scholar, even after the intensive library session about scientific databases. Similarly, the technical terms, in-text citation, and density of the text posed challenges. In her cover letter to her proposal, one WIM student wrote:

While reading the scientific articles was one of the most eye opening parts of this project, it was at times, the most difficult. Sometimes I felt like if I wanted to understand what the authors were saying, I would have to learn some other language. There were definitely some

times when I had to read and reread sentences or even entire paragraphs.

The students' response to challenges varied between the two classes. The FWS students were more likely to report frustration with primary literature, with one student even referring to the primary literature as "boring" during a class discussion. Interestingly, this student, despite being bored, was quite adept at critiquing it. For example, when we read a paper including a model forecasting malaria, this student was able to point out with no prompting from me some of the pitfalls that beset all modeling studies. Similarly, in the mid-term evaluations, when asked for suggestions for the remainder of the class, students wrote "more interesting readings" and "less primary literature." In general, one of the senior science majors did appreciate the primary literature, probably because she knew its value.

In contrast to the dissatisfaction with primary literature of the FWS students, students in the WIM class were more likely to find reading the primary literature articles useful. For example, on the mid-term evaluations, several of the students mentioned reading and discussing primary research articles in response to the question, "What activities have been most helpful and why?" These differences between the classes may arise from several causes. First, many of the FWS students were not science majors, and they were less invested in becoming part of the scientific community. They may have had less experience with scientific language and less motivation to use it. In contrast, most of the WIM students planned on practicing some type of science, and may have found it more useful. Secondly, the type of final paper produced by the FWS students was a review article, and I suspect many of the students did not fully see the need to read original sources to write a good review. In contrast, the final project of the WIM students was a proposal for a scientific question that had never before been researched. Since the first two sections of a proposal (introduction and methods) and the first two sections of a primary literature article are very similar, the primary literature served as an effective model for the students, which may have increased their appreciation of it. Finally, there was a lecture course associated with the WIM class, and the lecturer mentioned by name several articles we read in detail, so students may have

felt that reading the articles assisted their preparation for lecture. At the end of the class, the WIM students seemed to feel more confident than FWS students about their approach to primary literature. For example, one WIM student proclaimed her progress with primary literature when she wrote: "All in all, I think I handled [the difficulty with primary literature] very well and that I drew a lot from my sources."

Instructor Evaluations of Student Writing

The difference between the two sections' student comfort with primary literature was evident in student writing as well. Nonetheless, students in both sections were able to make important gains in the sophistication with which they used primary literature. Examples of what constituted an increase in sophistication varied between students, partially because some students had much more trouble using primary literature effectively at the outset. Below are some examples of ways students used primary literature more effectively in secondary drafts than in early drafts, that is, how they showed greater sophistication in their use of primary literature in their writing.

Paraphrasing rather than quoting. In formal scientific writing, quoting is rare and stylistically eccentric. Students would be encouraged to paraphrase and cite, rather than quoting directly. This represents a challenge, however, as effective paraphrasing requires a solid understanding of the technical work one is paraphrasing. Students who were able to effectively paraphrase demonstrated their ability to summarize the important points of an article in their own words.

Amassing a greater amount of primary evidence. Some of the student gains in writing sophistication simply meant delving deeper into the body of knowledge on a particular topic, in other words, finding and citing a wider variety of literature on a particular subject. While this seems like a simple task, realizing the need for more information and additional research is actually a challenging skill for some undergraduates and willingness to do this represents an increase in skill for some students (Sommers, 1980).

Organizing more proficiently the evidence used. Many students struggled with the organization of the piece, and were citing similar information

in several paragraphs. Through discussions, in-class writing responses, and comments, several students were able to re-organize information to group themes and improve the flow of their argument.

Synthesizing articles rather than simply listing their information. Several students, distributed across the two classes, struggled to put their articles together into a coherent argument. Their papers read like a series of summaries on the previous literature on their topic. Through repeated drafting, one of these students did an excellent job at pruning the summaries and integrating the information in them into his own argument. The other student who struggled with this also made some progress, including more of his own analysis, though there were still many “summary paragraphs” in his final report.

Using a broad range of primary scholarship including non-science (e.g. anthropology, economics, ethics). Many of the students were studying topics that had a social, ethical, or economic component. These students were able to locate primary sources from the appropriate discipline and cite these studies. While this does not indicate greater comfort with primary scientific literature, it does suggest a respect for primary intellectual scholarship-- the source of original scholarship that is a crucial part of any field.

While the previous types of gains in student writing and primary literature use were distributed across both classes, certain types of sophistication gains (described below) were only seen in the WIM class:

- *Using papers as models for technique as well as sources of background information.* Several students realized that they could bolster their proposals by citing methods that other people had successfully used to answer related questions. This type of citation moves past using scientific articles merely for background information to realizing that scientific articles can contain models for how to practice science.
- *Including a wider variety of justifications for studies.* Most students’ work was very application focused. When asked to explain why their proposed research was important, most students discussed things that their research

would help make or build. For example, my student studying genes conferring salt tolerance discussed the possibility of genetically engineering salt tolerant plants. Through discussion, students broadened the focus of their justification to include the joy of knowing the answer. Students began to realize that for the scientific community, answering a question that has never been asked is justification itself.

- *Pointing out articles that disagreed with each other and proposing research to resolve the dispute.* One student noticed inconsistencies in the published literature on the effect of wild dog pack size on prey capture efficiency. She therefore proposed her study to (among other things) resolve this dispute in the literature. Identifying scientific debates from reading and synthesizing a body of literature is a crucial skill, one practiced by many scientists looking for their next project.
- *Disagreeing with published articles’ methods.* Several students criticized the methods of published studies, either in their writing or in class. Willingness to disagree in this way represents a major intellectual gain for students, as most students see themselves as novices and are reluctant to criticize published works. This type of robust critique is an important part of scientific dialogue (it happens at every journal club I’ve been in), and becoming familiar with it helps students to practice a key part of scientific thinking.

Students’ Perceptions of Efficacy

While I perceived important progress on student writing, I wanted to understand how students perceived their comfort with writing, primary literature, and the scientific community. One of the goals of this project was to help students become more confident in their abilities to locate and use primary literature, and to help them feel more a part of the scientific community. To measure their feelings on these topics, students were given a survey before most of the primary literature workshops and at the end of the course. Care must be taken when interpreting the results of these surveys, as I performed a large number of paired t-tests, which could increase the probability of finding an erroneously significant result. On the other hand, the low sample sizes in each class did

limit statistical power. Nonetheless, these surveys do provide an additional window into student attitudes about science, primary literature, and writing.

Comfort with Primary Literature

In WIM, students showed trends toward increasing comfort with primary literature. WIM students reported a marginally significant increase in their comfort in identifying primary literature articles ($t=-2.20564$, $n=11$, $p=.0519$, Figure 1b), and awareness of how primary literature is used as evidence in a scientific article ($t=-2.20564$, $n=11$, $p=.0519$ Figure 1b). However, they did not show significant improvement in comfort with using primary

literature to verify information for a non-scientific audience ($t=-0.93761$, $n=10$, $p= 0.3705$, Figure 1b). This may be because this class did not focus as much on writing for non-scientific audiences as the FWS class did. Interestingly, despite writing proposals on novel topics, they did not report a significantly greater awareness of current research topics in the area of ecology ($t=1$, $n=10$, $p=0.3409$, Figure 1b), though there was a trend toward greater awareness.

The FWS students struggled considerably more with primary literature, and this is reflected in their survey responses. Students showed a non-significant increase in their comfort in identifying primary

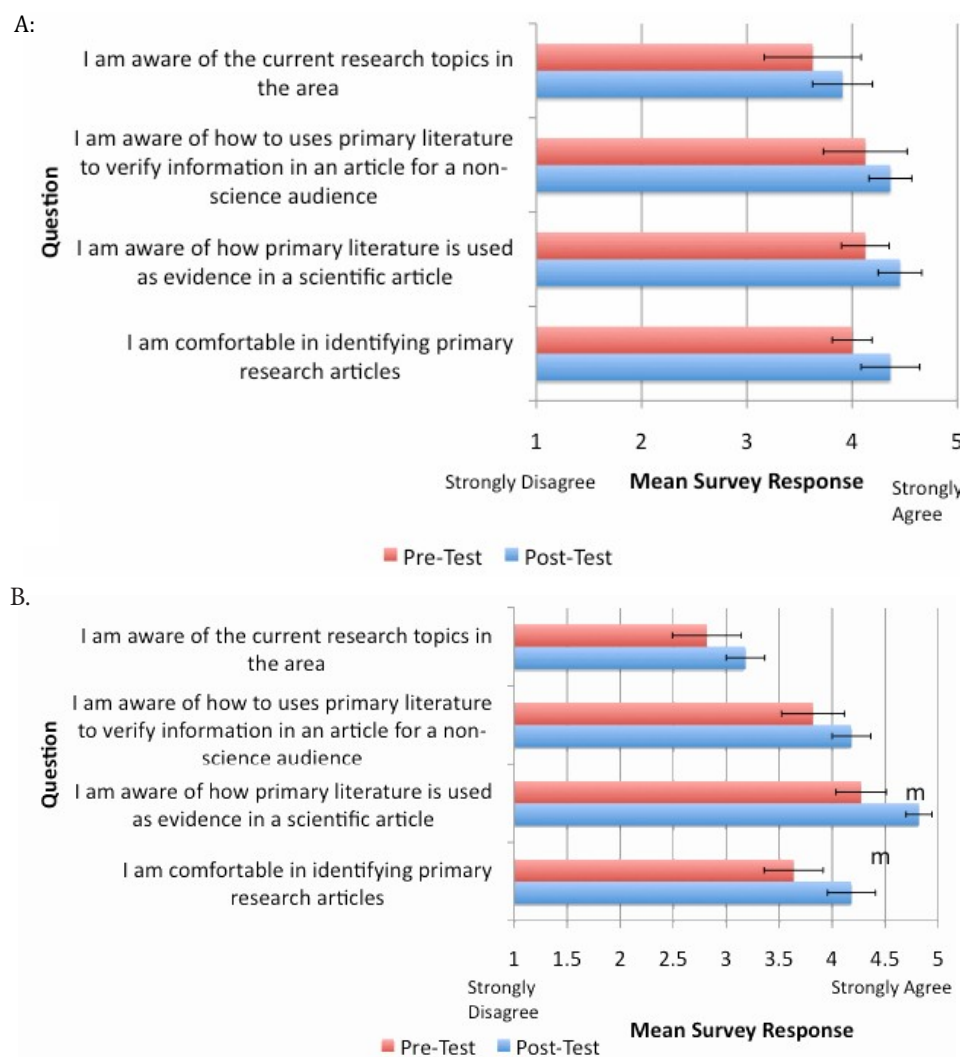
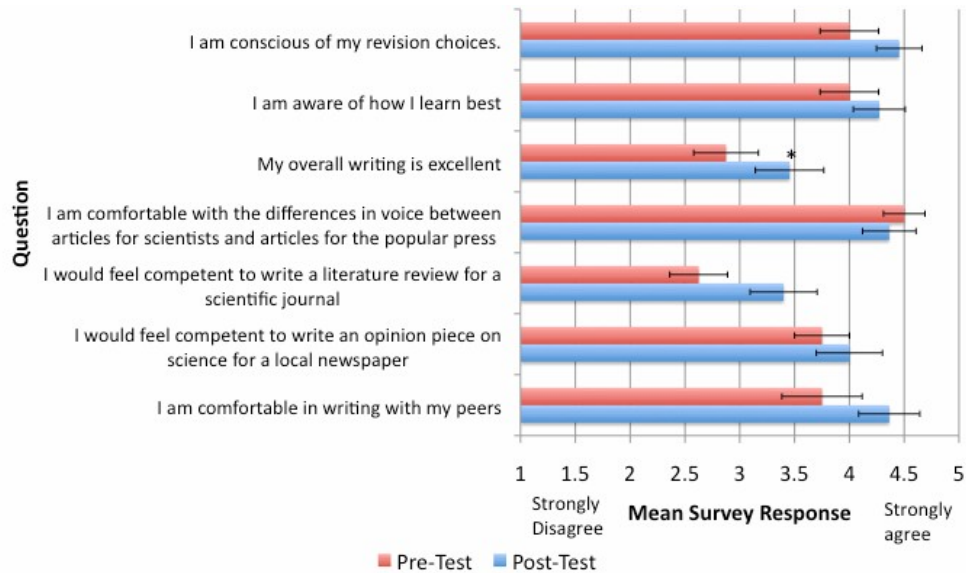


Figure 1 Student Comfort with Primary Literature. A, top: Results from surveys of FWS students ($n=7$). B, bottom: Results from WIM students ($n=11$). Error bars represent ± 1 standard error. * Represents pairs of means that are significantly different at $p=.05$, while m = pairs of means that are different at $p < .07$. Overall, while both groups showed trends toward increasing comfort with primary literature, those trends were most pronounced in the WIM class.

ry literature articles ($t = -1.92154$, $n = 7$, $p = 0.1030$, Figure 1a), and awareness of how primary literature is used as evidence in a scientific article ($t = -2.12132$, $n = 7$, $p = 0.0781$, Figure 1a). However, given the low sample size of this study, the fact that we were able to detect this trend toward increasing comfort in using primary literature for a scientific

audience is perhaps encouraging. However, like their WIM counterparts, they did not show an increase in comfort with using primary literature to verify information for a non-scientific audience ($t = 0.67937$, $n = 10$, $p = 0.5222$, Figure 1a) or greater knowledge of current topics ($t = -0.67937$, $n = 7$, $p = 0.5222$, Figure 1a).

A:



B:

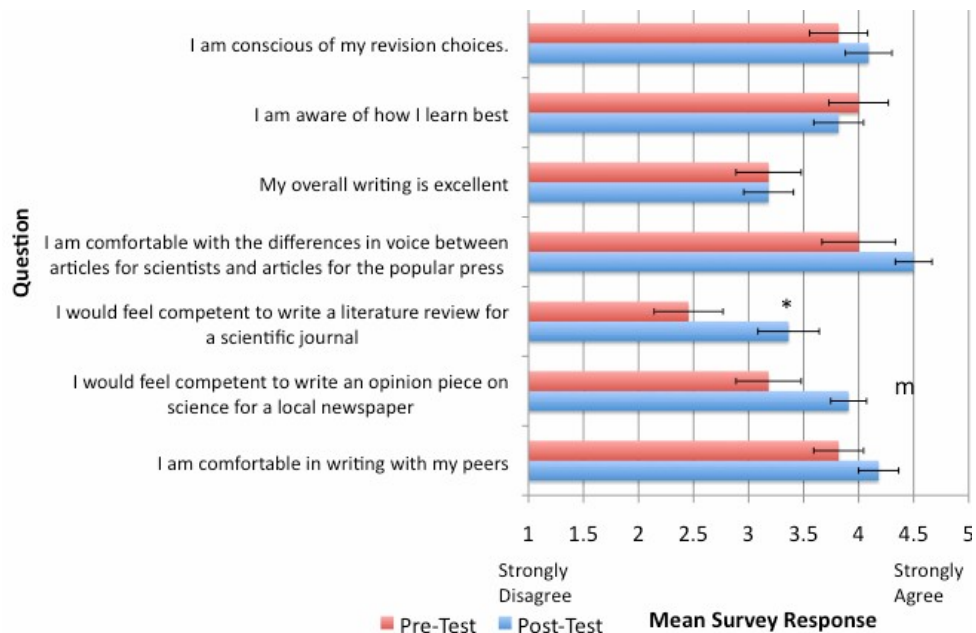


Figure 2 Student Comfort with Writing. A, top: Results from surveys of FWS students ($n = 7$). B, bottom: Results from WIM students ($n = 11$). Error bars represent ± 1 standard error. * Represents pairs of means that are significantly different at $p = .05$, while $m =$ pairs of means that are different at $p < .07$. Overall, FWS students reported greater gains in confidence in their writing, and in writing with peers. WIM students reported more significant gains in confidence in technical writing.

They, do, however, report more confidence in writing for a scientific audience. They show a significant increase in the number agreeing that they felt comfortable writing a literature review ($t = -3.62738$, $n = 10$, $p = 0.0046$, Figure 2a), a marginally significant trend toward being more comfortable writing an opinion piece for a newspaper ($t = -2.18543$, $n = 10$, $p = 0.0537$, Figure 2a), and a non-significant trend toward being more comfortable choosing an appropriate voice for their audience (Figure 2a).

Comfort in Writing

FWS students made some important gains in their comfort with writing. FWS students reported significantly more comfort when writing with peers at the end of the semester ($t = -2.5$, $n = 7$, $p = .0465$, Figure 2a). They also reported non-significant trends toward greater comfort in writing an opinion piece for a local newspaper ($t = -0.6793$, $n = 7$, $p = 0.5222$, Figure 2a) and a scientific literature review ($t = -1.74608$, $n = 6$, $p = 0.1412$, Figure 2a). Interestingly, despite these trends in comfort with these two very different types of audiences, when surveyed directly about their comfort with audience, they reported no significant difference in comfort writing for a particular audience ($t = 0$, $n = 6$, $p = 1.0$, Figure 2a).

However, the class did seem to increase their self-confidence in their writing, and possibly their meta-analytic skills. Students were significantly more likely to agree that their writing was excellent at the end of the course ($t = -4.58258$, $n = 6$, $p = 0.0038$, Figure 2a), and they reported non-significant increase in awareness of how they learn best ($t = -1.54919$, $n = 6$, $p = 0.1723$, Figure 2a) and their revision choices ($t = -2.12132$, $n = 6$, $p = 0.0781$, Figure 2a). In contrast, WIM students did not show such dramatic gains in confidence in their writing, despite my perception of their writing as good, and often excellent. They were not significantly more comfortable writing with peers at the end of the semester ($t = -1.17444$, $n = 10$, $p = 0.2674$, Figure 2b), though this is likely because FWS students spent much more time writing with peers than did WIM students. In addition, they did not report more confidence in the excellence of their writing overall ($t = 0$, $n = 10$, $p = 1.0$, Figure 2b), or greater meta-awareness of their learning styles ($t = 1.0$, $n = 10$, $p = 0.3409$, Figure 2b) or their revision choices ($t = -0.75955$, $n = 10$, $p = 0.4650$, Figure 2b).

Comfort with the Nature of Science

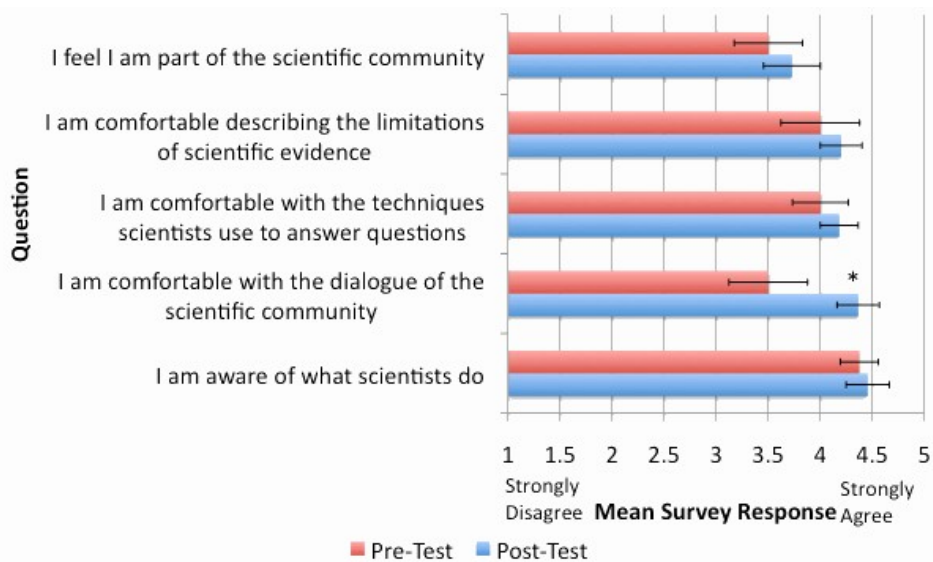
These workshops as reported, helped students to read and write effectively with primary literature. Sadly, the evidence for their efficacy in improving awareness of the nature of science is by no means as conclusive. Neither the FWS students nor the WIM students reported a significant increase in awareness of what scientists do at the end of the course (FWS: Figure 3a, $t = -1.54919$, $n = 7$, $p = 0.1723$; WIM: Figure 3b, $t = 0$, $n = 10$, $p = 1.0$.) Similarly, neither reported additional awareness of the limitations of scientific evidence (FWS: Figure 3a, $t = 0$, $n = 6$, $p = 1.0$; WIM: Figure 3b, $t = 0.288675$, $n = 10$, $p = 0.7787$), or of feeling like part of the scientific community (FWS: Figure 3a, $t = -0.42008$, $n = 7$, $p = 0.1723$; WIM: Figure 3b, $t = 0$, $n = 10$, $p = 0.6891$).

However, both groups did report a non-significant trend toward a greater awareness of scientific techniques (FWS: Figure 3a, $t = -1$, $n = 7$, $p = 0.3559$; WIM: Figure 3b, $t = -1.45556$, $n = 10$, $p = 0.1762$). And the FWS students reported a significant increase in comfort with the dialogue of the scientific community (Figure 3a, $t = -2.5205$, $n = 6$, $p = .0453$), though the WIM students did not report such an increase (Figure 3b, $t = -0.24693$, $n = 10$, $p = 0.8100$).

DISCUSSION AND CONCLUSIONS

The overall goal of this study was to create a series of primary literature workshops that would help students comprehend primary literature and use it effectively in their writing. In class, we made some strides toward this goal. However, after this study, I now believe that the overall course design in which primary literature instruction is embedded makes a great deal of difference in its success. In particular, the endpoint to which students are working is extremely important. I had two culminating activities for the different classes—a proposal and a literature review. I believe that the proposal activity was more successful than the literature review activity, both in terms of the sophistication with which students were able to use primary literature in writing and in terms of student willingness to engage with primary literature. This result must be interpreted cautiously because there were several differences between the students in the two classes, including the fact that while only some of those who wrote literature reviews were science majors, all of those who

A:



B:

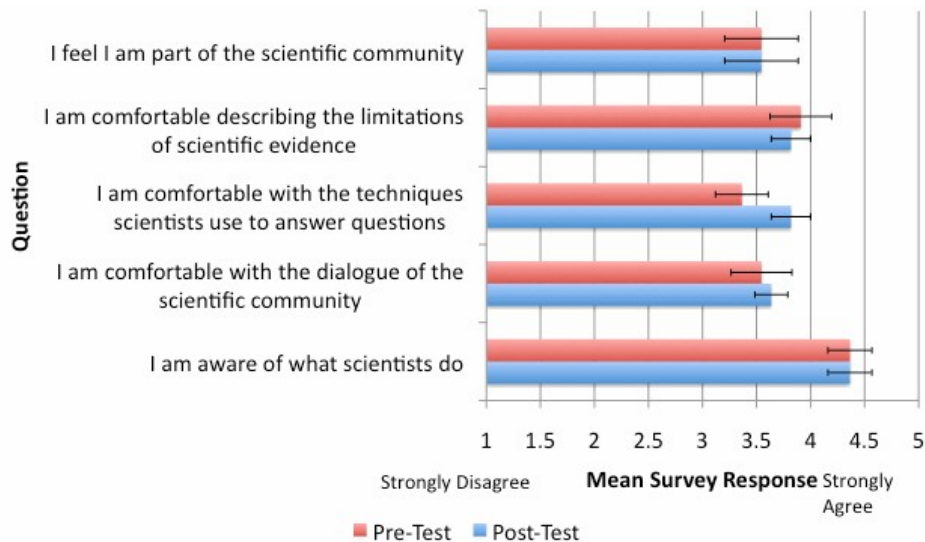


Figure 3 Student Comfort with Nature of Science. A, top: Results from surveys of FWS students (n=7). B, bottom: Results from WIM students (n=11). Error bars represent +/- 1 standard error. * Represents pairs of means that are significantly different at $p=.05$, while $m=$ pairs of means that are different at $p < .07$. FWS students showed the greatest gains in confidence in scientific dialogue, but neither group reported more confidence in evaluating scientific evidence.

wrote proposals were science majors. In addition, the proposal-writing class was taught in the spring, when students had more college writing experience. However, I do still think that proposals may have been more effective as an organizing project for the term. In particular, because the students who wrote proposals could use primary literature as models, they were likely more invested in reading it and learning from it. In addition, writing proposals is an authentic scientific activity

(Crawford, 2000) and will likely help students engage with science in the future.

Originally, I had thought of the primary literature workshops as self-contained—and able to be inserted into a variety of courses. At the end of this study, I appreciate how important it is to integrate these workshops into the goal of the course. Indeed, I cannot say for certain that the gains I saw in student writing were attributable to the explicit

instruction in primary literature. Some of them are likely due to other activities, for example, peer review and comments on drafts. However, the whole course of activities did allow students in these classes to read and write more effectively with primary literature.

As Wenk and Tronsky (2011) so astutely pointed out, first-year students can do extremely well with primary literature if guided appropriately, and my students certainly did become significantly more confident in synthesizing scientific literature over time, and this corresponded with greater effectiveness and sophistication in their writing.

As I revise my classes, I am more likely to require a final proposal of some type for students, as this seemed to be more effective as an endpoint. Moreover, creating proposals involves tasks that practicing scientists perform, and they may help students think about the integration of the known and the unknown in science. While I am cautious about generalizing these results to students in other classes, I do hope that these workshop details will provide ideas for others to use in their classrooms.

In the future, I will continue to use formal instruction in primary literature with gradually increasing complexity. I do think, however, that I will need to include critique skills earlier in the semester, as many students need practice with scientific critique. I hope this modification of my syllabi may help students become more confident in describing the limit of scientific evidence, a subject no students reported gains in. I also must remember to plan class activities that allow enough time for a full discussion and debriefing after primary literature workshops, which I hope will increase self-efficacy and student use of primary literature.

A secondary goal of these workshops was to help students become more integrated into the scientific community, to have a better sense of themselves as scientists, to be more aware of the limits of scientific evidence, and to understand how science is done. I think that these workshops will require revision in order to meet those goals. Though this did help my non-major students to become more comfortable with scientific dialogue, these primary literature workshops did not increase students' sense of themselves as part of the scientific community or their awareness of

what scientists do. My sense is that my students still think of science as something done by experts, rather than by regular people or students, such as themselves. In the future, I want to consider other ways to use literature to empower students to think of themselves as part of the scientific community and to understand how science is done, and to use writing to help students become aware of their own learning styles.

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Improving Undergraduates' Critical Thinking Skills through Peer-Learning Workshops

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INTRODUCTION

In the 2011-2012 academic year, I became a Graduate Research and Teaching Fellow (GRTF) at Cornell's Center for Teaching Excellence. One component of the fellowship was a "100-hour" Scholarship of Teaching and Learning (SOTL) research project. Inspired by my frustration with the low level of discourse about information, not only in the sciences but elsewhere in American society, and particularly that of the news media, I developed and implemented a series of four Critical Thinking Workshops designed to explicitly teach students information literacy, critical reading, and information filtering skills in the everyday context of mainstream internet, news, and advertisement media. The workshop materials are easily adaptable to any undergraduate, and perhaps an 11th and 12th grade classroom as well.

The typical college student is of an excellent age to focus on and develop critical thinking skills. Brain development is ongoing through adolescence and young adulthood, particularly in the regions associated with higher cognitive tasks, with "synaptic pruning" progressing from the back of the brain to the front (Powell, 2006). The brain matures considerably but non-uniformly during adolescence: different lobes mature at different rates, and maturation peaks at different ages for different lobes (Giedd et al 1999). At the ages of 18–22, the "emerging adult" brain is still maturing: the frontal lobes of the brain, which are associated with "response inhibition, emotional regulation, planning

and organization," mature considerably between adolescence and the mid-to-late-20s (Sowell et al. 1999). This has been observed *in vivo*: in a longitudinal MRI study, Bennett and Baird (2006) observed an increase in white matter relative to grey matter during the freshman year of college, consistent with an increase in myelination, which increases the speed and strength of processing within the brain. Teaching critical thinking skills to undergraduate emerging adults may help reinforce connections within their brains that are associated with the cognitive skills.

MOTIVATION

My ultimate purpose in establishing critical thinking workshops is to make the world a better place by raising the level of discourse in American society. A recent analysis by the Sunlight Foundation indicates that the complexity of Congressional speech, as measured by a Flesch-Kincaid test applied to the Congressional Record, has dropped from 11.5 in 2005 to 10.6 today (Drutman, Lee 2012). The lack of critical thinking in everyday life in current American society bothers me greatly. The news media now aims for entertainment, attention, and ratings over information and education, and if reports are to be believed, the American public doesn't question the legitimacy of the information provided to them by the media. This lack of critical thinking in everyday life, this acceptance of the information provided without ques-

tion, and certainly without deep questioning, leads to societal issues such as choosing a president based on sentiments like, "He seems like a good guy to have a beer with," or based on a president's attendance at superior schools for his or her undergraduate, graduate, and professional degrees. This is not right.

Secondarily, today's young people have grown up with literally a world of information at their fingertips. Much of that information, however, is unfiltered. Without explicit instruction, young children do not have the ability to determine what is correct/legitimate/evidence-based versus what is simply an uninformed person's opinion, or worse yet, deliberate misinformation. Teenagers and emerging adults are *expected* to be able to distinguish between these varying sources of data, but who trains them? Do we expect their parents, many of whom are information illiterate themselves, to help them? Or their schoolteachers, who are given more and more requirements with no increase in the amount of instruction time and no training on how to do so?

I hope to bridge the gap for educators to improve students' critical thinking and higher-order thinking and reasoning skills, and the classroom teacher. My goal for designing critical thinking workshops is to create a stand-alone classroom activity that can be simply and easily incorporated into as many institutions and classrooms as possible. The teacher will need some instruction on how to conduct the workshops, but other than that, teachers should be able to incorporate the activities into their classrooms as-is, or easily adapt them to their preferred topic(s). I hope that the workshops will ultimately be considered a standard part of introductory science curricula. One way that I will encourage this is to stress how the workshops fit in with universities' and departments' learning outcomes. They should also be able to be used in junior and senior high school classrooms.

My workshop format is based on the Workshop Tutorials developed by the Sydney University Physics Education Research Group (SUPER; Sharma *et al.* 1999, Sharma *et al.* 2005, Sharma and McShane 2008). The workshops are weekly non-compulsory peer-learning workshop-style tutorials, rather than the sage-on-a-stage tutorials typical in this field. Students work in groups of three or four, facing

each other around tables covered by a sheet of butcher paper for scratch work. They complete worksheets composed of qualitative, quantitative, and demonstrative questions designed to challenge the students conceptually. Tutors circulate around the classroom, asking probing questions, guiding students through toward solutions, and encouraging groups who have figured out solutions to explain their solutions when other groups have the same questions.

I was a research assistant and graduate/postgraduate student in the University of Sydney's School of Physics from 2001 to 2007. Throughout this time, I was a tutor for First-Year Physics Workshop Tutorials. The Workshop Tutorials were developed over several years by SUPER, the Sydney University Physics Education Research Group (Sharma *et al.* 1999, Sharma *et al.* 2005, Sharma and McShane 2008). Over 1,000 students annually enroll in first-year physics courses at the University of Sydney. In the 1990s, SUPER teacher-scholars undertook an endeavor to improve learning and exam results in these classes. The result was weekly non-compulsory peer-learning workshop-style tutorials, which are like the tutorials described in the preceding paragraph. Students receive solution sheets at the end of the Workshop Tutorial and employ similar workshops, termed "lecture tutorials," in introductory astronomy courses.

Having been immersed in Workshop Tutorials as a teaching environment for many years, it seemed natural to me to implement this teaching methodology in my own classes. As a TA in the Astronomy Department at Cornell University, I often included mini-workshops, in which, for half of the class meeting period, I divided the class into groups of 3-4 students, and the students worked through one or two qualitative questions in a manner analogous to Workshop Tutorials.

METHODS

Recruitment

I piloted my workshops with students from a non-majors planetary science survey class. This course's enrollment is typically 20-25 students from a variety of majors and class years (see Table 1); course evaluation and assessments this semester were administered as four essays and a PowerPoint presentation. The teaching staff consisted of

a professor, who presented lectures twice a week and gave assignments, and a TA, whose primary duty was grading the students' papers. I had no official association with the course. The professor graciously and enthusiastically allowed me access to his students for the purpose of this study, and encouraged his students to participate in my workshops.

Table 1. Enrollment breakdown of the planetary science for non-majors class from which I recruited my students

Category	Number of Students
Full course	23
Class year	
Freshmen	8
Sophomores	6
Juniors	3
Seniors	6
College or School	
Agriculture and Life Sciences	3
Arts and Sciences	10
Engineering	1
Hotel Administration	5
Human Ecology	2
Industrial and Labor Relations	2

On the first day of class, the professor introduced me as “a wonderful person who has volunteered to help us through the process of the first assignment.” I explained the project to the students, telling them that this was part of a research project to improve teaching at the university and in the department; that the workshops were designed to teach them skills that would help them improve their grades in this class and their other classes; and that the workshops would be aligned with the topics of their essay assignments. Attendance at the workshops would not be mandatory, and there would be no credit, nor any other compensation, given for participating in the workshops. There would be no time commitment other than the workshops themselves. Participation would be considered informed consent. In the last 15 minutes of the class meeting, I conducted a 15-minute teaser “mini-workshop” on the theme of information literacy, and handed out a sign-in sheet. Three students chose to participate, and continued with the project through the end of the semester.

I encouraged the students to attend the workshops through individual communication (emailing each student individually rather than the three as

a group), meeting in “fun” locations (often the Mars Rovers conference room next door to my office), and by providing snacks (generally cookies or brownies) at each workshop. On one occasion when the workshop began at 5pm, I provided pizza. This was particularly valuable for Matthew, a student in the course. As a freshman, he had limited opportunities to obtain meals. Because of his meal plan, his dinners were dominated by “all you care to eat” meals in his dorm. As an athlete, he needed to eat by around 6:30pm in order to have digested his dinner before track practice, which ran from 8 till 10pm.

I received access to the bibliographies of all students' first and final essays, and access to the full essays of the students who participated in the workshops.

Bibliographic Analysis

I conducted a textual analysis of the class's bibliographies. After reading through the bibliographies of the first assignment, I developed a set of themes, and re-read these bibliographies, coding them for these themes. New themes appeared; ultimately, I combined some themes into categories.

As I did not have access to most students' writing, I cannot comment on the way in which students used their sources.

Design of the Critical Thinking Workshops

I developed a series of four peer-learning workshops to teach students how to purposefully employ critical thinking skills in their everyday lives. The workshops' learning objectives are to enable students to:

- *Workshop 1:* Discriminate between inappropriate and potentially useful sources in search engine results pages;
- *Workshop 2:* Identify articles' claims, and evaluate the evidence presented in support of those claims;
- *Workshop 3:* Differentiate between causal relationships and non-causal correlations; and
- *Workshop 4:* Appraise claims made and evidence presented in advertisements.

Students sit around a table, facing each other, and complete worksheets that lead students step-by-step through

- a) verbalizing their preconceptions of the workshop theme,
- b) dissecting instructional materials to discover the cognitive processes they already use,
- c) applying skills step-by-step in real-world situations (search engine results, news articles, ads), and
- d) using metacognitive strategies of questioning and reflection.

I did not develop the “instructional materials” myself. As Macdonald & Bykerk-Kauffman (1995) said, “Designing successful small group activities is an intellectually demanding and time-consuming process that occurs behind the scenes.” Other practitioners have devoted time to creating these; my innovation was the creation of peer-learning workshops to accomplish my learning objectives in a format that I can make widely applicable. I found instructional materials suitable for each workshop (see Table 2) and wrote worksheets that required students to actively *work through* the material, answering questions about the material itself and the students’ reflections about it, rather than simply asking them to passively read the material. The workshops are easily adaptable to any college classroom; teachers can either use my material as-is, or substitute media examples that are relevant to their course content.

As an example, the first workshop was designed to help students with information literacy—specifically, how to determine if a website presents legitimate information. The everyday task was a Google search results page (I had entered a search term from their assignment and saved the resulting search page as a pdf, which was included in the handouts). I wrote a worksheet to accompany “Evaluating Web Pages: Techniques to Apply & Questions to Ask,” a web literacy tutorial from the UC Berkeley Library* (The worksheet required the students to read the document and hand-write the steps and reasoning described by the document, and to comment on these justifications and whether they tended to follow these steps already. On the last page of the worksheet, the students applied the steps to the pdf Google search results. This pdf was the only information the students had about the websites.

* <http://www.lib.berkeley.edu/TeachingLib/Guides/Internet/Evaluate.html>.

Essentially, the students first learned what steps one might take to evaluate a website, and then applied those steps to the context of their essays. All the while, they were discussing the steps with each other, justifying the reasoning behind the steps through conversation and writing, and answering questions regarding whether or not they already used these steps. Then, they individually conducted their own very similar web searches while researching their papers for their class.

The reasoning behind this limitation of available data was that it is often possible to evaluate the legitimacy of a website given the URL and a short blurb, at least to first order, and doing so can save hours of time when doing research for a college essay. I purposefully decided to have the students work with a printout of the search results rather than using a more authentic experience of an on-line search. I chose to do this for several reasons: 1) I wanted to ensure that the results in question contained a mixture of reasonable, questionable, and decidedly unsuitable results; 2) I wanted to make sure that all students examined the same set of search results; 3) I wanted to remove the distraction that access to the internet inevitably is; 4) I wanted to force the students to look only at the results themselves rather than taking the easy way out of clicking on the link and accessing the site.

RESULTS

Bibliographic Analysis

I coded the bibliographies with the following categories:

- *Journal Articles.* Novice students lack the vocabulary needed to comprehend scientific literature. Undergraduates are capable of understanding journal articles, but only after they have gained vocabulary in the field and have been explicitly taught how to read the articles. “Reading” does not lead to learning. Additionally, non-majors can misunderstand what they find in articles and state facts incorrectly in their essays, which leads to grading penalties.
- *High-level News.* Press releases, and sites such as www.sciencedaily.com and www.phys.org that aggregate them, bridge the gap between journals and news outlets. Their language is academic yet accessible to novices. They

Table 2. Summary of the workshops

	Workshop 1	Workshop 2	Workshop 3	Workshop 4
Title	“Information Literacy, or, Is it reasonable to use this website as a resource for my essay?”	“Reading Critically, or, Understanding information and making it your own”	“Correlation is not necessarily causation”	“Putting it all together”
Learning Objective	Discriminate between inappropriate and potentially useful links in search engine results pages	Identify articles’ claims, and evaluate the evidence presented	Differentiate between causal relationships and non-causal correlations	Appraise claims made and evidence presented in advertisements
Instructional Materials	Evaluating Web Pages: Techniques to Apply & Questions to Ask (UC Berkeley – Teaching Library Internet Workshops) ¹	Excerpt from Chapter 3 of <i>Introduction to Critical Thinking</i> by Bruce R. Reichenbach (2001); associated Chapter 3 Study Guide ²	“Did the disappearance of pirates cause global warming? Probably not...” ⁵ and Scientific Reasoning module from the Hong Kong University OpenCourseWare on critical thinking, logic, and creativity ⁶	Critical Thinking Workshops Summary: What you’ve learned
Media Examples	Google search results page: “What killed the dinosaurs theory”	“Global Warming Likely To Increase Stormy Weather, Especially In Certain US Locations” (ScienceDaily) ³ and “Group warns global warming promotes severe weather” (Dover Post) ⁴	“Central Heating May Be Making Us Fat” (<i>New York Times</i>) ⁷	Ace Magnetics Copper Magnetic Bracelets site ⁸ and SkyMall ads

1. Available at <http://www.lib.berkeley.edu/TeachingLib/Guides/InternetEvaluate.html>

2. Study guide available at http://www.mhhe.com/soc-science/philosophy/reichenbach/m2_chap03studyguide.html

3. Available at <http://www.sciencedaily.com/releases/2007/12/071204121949.htm#>

4. Available at <http://www.doverpost.com/communities/x907383491/Group-warns-global-warming-promotes-severe-weather>

5. Available at <http://www.ionpsych.com/2011/05/01/did-the-disappearance-of-pirates-cause-global-warming-probably-not../>

6. Available at <http://philosophy.hku.hk/think/sci/>

7. Available at <http://well.blogs.nytimes.com/2011/01/26/central-heating-may-be-making-us-fat/>

8. Available at <http://www.acemagnetics.com/copper-bracelets.html>

provide detailed, accurate information, often including quotes from principle investigators of the studies being described. They often link to the journal articles they discuss.

- *Informative Websites*

These are websites from research groups, educational organizations, government sites (e.g., NASA), museums, and public media (e.g., PBS, Australian Broadcasting Corporation). They are comprehensible and often comprehensive.

- *Traditional Sources*

Textbooks and lecture notes provide reasonable background reading. The bibliographic entries indicate that the students access traditional media in nontraditional ways; one book was cited as coming from WorldCat, (the university library catalog). The catalog entry for this item includes an Amazon.com-like "Preview this item" feature, which provides access to limited pages from the book. Students were able to read books as online excerpts.

- *News Articles*

While news articles would be reasonable sources for certain assignments, particularly as historical resources, they are not prime resources for topics such as the extinction of the dinosaurs. Their factual and writing quality varies, and Google levels this playing field by interspersing local, national, and international sources. Students assume that these articles are credible because they are "published."

- *"True on Review" Websites*

"True on Review" websites are sites which I, with my expert knowledge, could confirm had correct information. Novices, however, do not have the knowledge to judge the sites' validity. As one of my students put it, "If I'm somewhat familiar with the topic and I could analyze other potential factors myself, then I will do that, but if we're in astronomy and I'm way over my head, then I will just accept what they say." Examples are www.extremescience.com and Donald L. Blanchard's Earth Sciences Website <http://webspinners.com/dlblanc/paleo/dinocolo/extinction/index.php>.

- *Inappropriate Websites*

This category includes sites such as www.answersingenesis.com and nature.factoidz.com.

They range from factually confused to creation "science." The best I can say about them is that since I didn't have access to the students' essays, it is possible that www.answersingenesis.com was used as a counter example.

Reference Category	# of students citing this category	# of citations
Journal Articles	11	16
Traditional (book, textbook, lecture notes, encyclopedia)	11	13
High-level news	11	12
Informational website	18	39
News	12	17
"True-on-review" website	4	5
Inappropriate website	8	13

Critical Thinking Workshops

- *Observations*

I had intended for the workshops to be able to be completed within a standard class meeting. While some courses meet for 80 minutes, many, particularly sections and tutorials, are 50 minutes long. In this pilot study, most workshops ran closer to 90 minutes than 50.

- *Student Surveys*

I assessed the students' learning through mixed qualitative and quantitative surveys at the end of each workshop, and approximately 2 weeks after each workshop.

CONCLUSIONS AND DISCUSSION

The findings of the bibliographic analysis indicates that we must either *tell* students what types of resources are appropriate for college-level research, or *teach* them cognitive skills that enable them to appraise information themselves.

In their current incarnation, each workshop runs about 1.5 hours. This is longer than many tutorials/sections. I am working on reducing the length of the workshops, based on student feedback about the most and least valuable questions.

To say that scheduling the workshops was difficult is quite an understatement. The three students in this pilot study had various weekly and pop-up commitments, including: athletic practice, job in-

interviews, class meetings, class assignments, work commitments, hosting prospective students, and family visits. Despite signing up students on the first day of class and only having three students plus myself, we were not able to conduct the 4th workshop until the study period between the last day of classes and the first day of exams. The fact that the students stuck with it and completed all 4 workshops (one student was unable to attend the final workshop due to illness) is a testament to its perceived importance amongst the students. When one of the three students was suddenly unable to attend Workshop 2, he convinced a friend to participate on the following day, and one of the other students volunteered to attend it twice in order to enable that student to attend. Attempting to coordinate my and three students' schedules took much more time than I had expected. My recommendation is that the workshops be used in-class during scheduled class meetings such as tutorials or recitation sections.

SUPER recommends that peer-learning groups should have 3-4 members. In this pilot study, conducting workshops with the three student volunteers worked well. The students worked well together, respectfully questioning each other and engaging with each other in meaningful discussion. All three students, at one time or another, questioned the others' statements. On two occasions (Workshop 2 and Workshop 4), however, only two students attended. For Workshop 2, Louis cancelled at the last minute. We decided to run the workshop with just Matthew and Cody. Louis enlisted a friend to attend the workshop the following day, and Cody volunteered to attend the workshop a second time if it would enable Louis to participate. For Workshop 4, Matthew text-messaged me a few minutes before the session began, saying that he was on his way back from the health center and would not be able to attend. On most occasions, the workshops "ran themselves": the students completed the tasks themselves, and I was primarily an observer, asking occasional questions in response to their dialogu and clarifying questions that they approached differently to how I had intended. I found myself participating more actively during the two-student workshops, as there weren't enough voices for enough views to be expressed.

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Close Reading and Metacognition

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GOALS

This paper has two goals: the first is theoretical, the second practical. For theoretical purposes, I will survey research in education and developmental psychology in order to better understand a common pedagogical tool in the literature and writing classroom: close reading. For practical purposes, knowing more about this research will aid in developing more effective close reading assignments in the classroom.

DEFINING TERMS: CLOSE READING

Close reading is one of the most widely used pedagogical tools in the literature and writing classroom. Developed from the 1920s to 1950s by a set of thinkers known collectively as the “New Critics,” close reading reacted against older forms of criticism: philology (which concentrated on word origin, meaning); historicism (which focused on biographical or historical facts of text); and belle-lettrism (which judged the relative worth of a text) (Eagleton 1996).

In general, close readings pay attention to the *form* rather than the *content* of the text. One way to think of this distinction is to think of a close reading as being interested in not what the author says but how the author says it. In order to have students focus directly on a text, for example, Richards gave his students poems that did not include any information about the author (or sometimes even the title of the poem) (Richards 1929). By doing so, Richards encouraged his students to focus on things like figurative language, imagery, and syntax in the text. Richards also famously claimed that by focusing on these aspects of the text students would develop an “organized response” to

the text, the sort of response that developed from students’ first impressions of the text, to a greater understanding, to—eventually—a fully fleshed out critical response to the text in question.

Close reading (in the sense that Richards intended it) could best be illustrated by a brief example. Consider the first four lines of Shakespeare’s Sonnet 73:

*That time of year thou mayst in me behold,
When yellow leaves, or none, or few, do hang
Upon those boughs which shake against the
cold,
Bare ruined choirs, where late the sweet birds
sang.*

A basic summary of these lines might suggest that Shakespeare is essentially saying something like: “I am getting old.” But if Shakespeare only wanted to say that, then why write a complicated sonnet? In order to complicate this summary, a close reading will look beyond the content (“I’m getting old”) to the form (the meter, images, syntax, etc.) of the poem. A close reading might note that Shakespeare uses a metaphor to explain that he is getting old: the old Shakespeare is like the autumn (the time of year when only a few leaves are left on the trees and “shake” in the cold).

This kind of reading, if Richards is right, will lead to a sort of “organized response” to the poem. Indeed, the benefits of this kind of reading are that they embrace a number of cognitive skills that the student can monitor and control. For instance, the close reading aids in basic comprehension: for difficult poems—like Shakespeare’s—close reading is necessary for basic comprehension. It can also

aid in writing since paying attention to the formal qualities of prose and poems will help students develop their own writing. Students can “copy” and adapt these formal effects in their own prose. Most important of all, close reading develops thinking more generally since close reading models “good” thinking: students recognize ambiguity, complexity, etc.

DEFINING TERMS: METACOGNITION

Metacognition was defined most simply by its earliest proponent—John Flavell—as “knowledge and cognition about cognitive phenomena” (Flavell 1979, 906; qtd. in Hacker 1998). Flavell went on to note that, by thinking about one’s own thinking, we can learn to better track and improve upon certain kinds of goals we have set out. As we develop this ability further, we can consciously control our thinking about thinking and improve upon it (Flavell 1979, esp. 252). Building on Flavell’s work, Kluwe (1982) describes metacognition as a *process* that monitors and can eventually control lower-level thoughts.

In writing and literacy pedagogy, metacognition has been advocated most prominently by Hayes and Flower (1980). Hayes and Flower argued that students improve most in their writing when they understand this activity as a metacognitive process. More specifically, Hayes and Flower developed a three-tier model of the writing process based on Flavell’s theories. They explained that good writing evinces stages of planning, translating, and reviewing. Furthermore, they emphasized that these stages lend themselves to an active self-monitoring process that can control and improve them.

In developing this model, Hayes and Flower made use of expert-novice studies. Further research in writing pedagogy and metacognition has followed a similar path. Peskin (1998) showed that expert writers and readers can more easily draw on past knowledge to understand a difficult text, while Earthman (1992) demonstrated that expert readers tend to focus on ambiguity and difficulty in their initial readings of a text. Both writers stressed that these “expert” readings could be achieved by novice readers through practice of metacognitive skills.

WHY LINK METACOGNITION AND CLOSE READING?

At the moment almost no research in education explicitly links the process of metacognition with close reading skills that are more evidently articulated in the literature classroom. Nevertheless, both activities bear a remarkable resemblance that is worth attending to. For instance, close reading compels students not just to read a poem (the content; what it’s about) but to reflect on *how* they’re reading and what images or language they’re paying attention to—a process that is remarkably similar to the one sketched out in Flower and Hayes.

Furthermore, close reading was first developed in conjunction with new ideas in developmental psychology—a connection that was since lost but can be renewed again (Gang 2011). Specifically, Richards developed early “practical criticism” from new ideas in behaviorist psychology. And yet while research in education has advanced beyond early work in simple stimulus-response behaviorist models in order to embrace a more dynamic picture of the human mind, close reading assignments and pedagogy have essentially remained unchanged since Richards’s advances.

Problems and Solutions

While most literature teachers think close reading will improve reading, writing, and thinking, the fact that the methods and grounding of close reading has not changed since I.A. Richards work in the 1920s means that many literary studies teachers remain unclear about exactly how close reading works. Indeed, most close reading assignments are either inherited (“This is the way it was taught to me, so this is how I’ll teach it”) or idiosyncratic (“This is how I teach it, and it works”). It follows from this that by not knowing why or how close reading works, we may be neglecting more effective methods. Some of my task is translating more general metacognitive ideas into lessons that could work for close reading. In other words, looking at research on metacognition helps us better understand how close reading works, and in the process improves our close reading pedagogy.

Close Reading in My Classroom

Seeking to understand more about research on close reading and metacognition was borne out of dissatisfaction with close reading assignments in

my own classroom. I've taught four First Year Writing Seminars at Cornell, and I began each seminar with a close reading assignment (see attached documents). This initial close reading essay is then followed by assignments that ask students to focus on a specific writing skill: thesis statement/argument; paragraph structure/topic sentences; style/sentence flow. In addition to the aforementioned essay assignments, I also provided students with two close reading handouts.

In addition to these students, I often encounter a second group—perhaps larger in number than the first. This second group of students do well on an initial close reading assignment but fail to carry over these close reading skills into later work. While I know that these students can close read—as evident in their work on the first essay—I found myself continually reminding them to integrate their close reading skills into later essay assignments. Indeed, even after I would comment on student papers reminding them to close read, their revised essays (i.e., essays that were rewritten after I had graded/commented on them) would include “close reading” simply by quoting a few lines of text—a practice that left out analysis and interpretation entirely. Furthermore, my sense that both groups of students did not fully understand or appreciate the close reading essays/assignments was frequently confirmed by past post-class surveys—surveys that frequently indicated that students did not think highly of their work in interpretation and analysis.

SURVEY AND ANALYSIS

With these issues in mind, I gave students in my current First Year Writing Seminar a post-class survey that would (ideally) help me understand what my students thought about their close reading assignments.

1) Close Reading Prior to My Course

The first question on the survey was designed in order to understand whether students had been exposed to close reading prior to taking the course and, if so, what they thought of this skill. Of the sixteen students who took the in-class survey, eleven students responded that they had been exposed to close reading in the past (though their past teachers did not necessarily use this word to describe the activity); four students responded that

they had never used close reading before; and one student did not answer the question.

Of the eleven students who had been exposed to close reading the past, all eleven explained that they found the exercise valuable. Precisely *why* the students found close reading valuable ranged in some respects: three students explained that they thought close reading made them better writers, while two others explained that close reading helped them locate evidence for their argument (more on this aspect below). More important for my purposes, though, was that seven students explained that close reading helped them develop their thinking skills. These students explained that close reading could aid in “logic,” “reasoning,” and “critical thinking.” Even more importantly, two students who expanded on precisely what they meant by critical (or logical) reasoning in their responses explained that the kind of thinking close reading helped them develop was the sort where one could more easily “make connections” between ideas or think with “stepping stones.”

This idea that close reading developed not just thinking generally but a kind of thinking that served as a *process* was confirmed elsewhere in the survey (see below). Prior to taking the course, then, many of these students were already convinced that close reading was an important educational activity. Moreover, many of these students described the sort of thinking that close reading fostered in metacognitive terms. Indeed, the language of process and connection they continually refer to nicely parallels the way in which researchers in metacognition describe that process.

2) Close Reading in My Course Generally

After establishing precisely what students thought about close reading prior to taking the course, the remainder of the survey (other than the last question) asked students what they thought of close reading within the course. Since close reading is taught first in a sequence of essay assignments, the survey asked students whether or not they thought learning close reading before other sorts of skills was valuable. Fourteen students responded that learning close reading first was helpful; one student responded simply with “maybe”; and one other student responded that learning close reading first was not helpful. This student explained that it would have been more effective

had thesis statements been taught before close reading, though the student did not elaborate on why they thought this was the case. The student who responded with “maybe,” explained that it was difficult writing a paper “where all the close reading relates back to the thesis.” I analyze this response—the disconnect between close reading and argument—below.

The students who responded positively to this question gave two kinds of answers as to why they thought close reading should be taught before other kinds of skills. The first group felt that close reading was fundamental toward understanding the text they were reading. Without close reading, these students felt that they would have not understood the reading without more extensive analysis. Interestingly, many students also argued that close reading helped them appreciate ambiguities and “subtler interpretations of words they may have missed” without close reading. These responses—even those that stress more complex reading skills like identifying ambiguities, etc.—imply that students view close reading as a minimal requirement in understanding how a text works.

A second positive group of answers to this question resonates with the sense (prior to the course) that close reading helps develop metacognitive abilities. This second kind of response argued that close reading was an important first assignment for the course because it helps “organize thoughts”; indeed, insofar as it organizes thoughts, students claimed that close reading was “fundamental” in critical writing.

These responses once again show that students understand – presumably intuitively –that close reading is an exercise that lends itself naturally to metacognitive thinking. However, the lone student who responded that he or she had difficulty connecting close reading to a larger thesis or argument is not exactly an outlier – this response, and the sense that there’s a breakdown in thinking of close reading as a process, will become more prominent.

3) Close Reading as Process

Two later questions in the survey confirmed that, despite prior answers, many students were having a difficult time using close reading as process. One question asked students to explain whether or

not they had a clear idea of what sort of qualities an “A” close reading had; while another question asked students if they integrated close reading into later assignments.

All of the students surveyed responded that they did have a clear idea of what constituted an “A” close reading. However, their answers continually evinced hesitation (“Initially, I had trouble [...] but I found out later[...]”; “I had a vague idea”; “For the most part”). These notes of hesitation imply that, while students began to understand what constituted an “A” close reading over time, initially, at least, students did not quite understand the criteria (an issue with the close reading handouts that I discuss at greater length below).

More interesting, though, was that in explaining *what* qualities an “A” close reading possessed, students continually noted that these sorts of readings 1) focus on specific details; and 2) connect these details back to an overarching argument. Close readings, according to these students, “look at specifics,” at “details,” at “direct quotes from texts,” at “specific words.” They “point out something new to reader”; they “identify key words and [show] how they relate to text as a whole.” Evident in these phrases is a rhetoric of identification and “pointing”; close reading is a method that allows the author to point to evidence or details that the reader would have otherwise missed. While students have a lot to say about how close readings “point” to evidence, they are curiously silent about exactly how this evidence gathering process allows them to strengthen their argument. In other words, these students claim that close reading helps them both gather evidence *and* connect these details back to a larger argument. However, when they detail exactly how this works they do not explain how pointing leads to a better argument. All the talk of process, logic, and stepping stones evident in above questions suddenly drops out here.

The latter was evident through a slightly different question. When asked if their close reading skills improved while writing the first essay, students responded in decidedly ambivalent ways. While only one student explicitly answered the question in the negative, other students were unclear as to whether or not their skills had improved. Two students explained that their close reading skills

improved as other kinds of writing skills were developed; these students noted that their writing skills “complemented” one another and “grew together.” Such phrases point us once again to the fact that students view close reading as a kind of process when they view it positively. Unfortunately, most students responded with ambivalence; in particular, they noted that they lost track of the close reading skills as we moved on to new assignments. These responses demonstrate that, as with the above question, students have lost track of close reading as a way of managing a larger thought process.

My contention is that, after completing the close reading assignments in my course, students begin to think of close reading as an activity that fosters mere evidence gathering rather than metacognition. This difference is evident in the ways students describe how close reading works in the course. Describing close reading as essentially a “pointing” activity became most evident when students were asked if they continued to use close reading in later essays. One student replied that he or she did not use close reading in later assignments, but the other fifteen students explained that they did. Eight of these students used “pointing” language to describe how close reading helped them in later essays. Specifically, they mentioned that close reading helped them “hone in” on specific words or phrases that they could then use to support their thesis statement. Once again students mentioned these “pointing” words without making reference to the “process” words.

4) Translating Close Reading

By thinking of close reading as an activity that points to evidence rather than as a method that aids in metacognition more generally, students have a difficult time understanding how close reading is important for their education more generally. When asked if students would use close reading in other courses, responses were ambivalent. To be sure, a few students explained that close reading would be useful, though mainly for better understanding a text: in these responses, close reading serves as something that can hone in on “finer” details, something that will help students note a “particular pattern or theme.” Other students, though, responded that close reading would not help, mainly because the other sorts of

courses they would be taking would not require this kind of writing. In their responses, the science or business courses they would enroll in require only “data and statistics” for an effective paper. Such responses demonstrate that, rather than seeing close reading as an activity that develops more general metacognitive skills, many students view it basically as a means of gathering evidence for literature papers.

SURVEY SUMMARY

Thinking about the results of the survey as a whole reveal a few telling trends that, in general, tend to confirm my sense of what is going wrong with close reading assignments in my own First Year Writing Seminar. First, those students who come into class already having been exposed to close reading suspect that close reading develops “higher” skills like critical thinking (i.e., it’s not just about reading poems, etc.). Indeed, many of these students describe this sort of thinking in terms that already links it to metacognition. In a sense, these students have been prepared to talk about what close reading *should* be doing for them. However, by the end of my class, most students view close reading only as a means to an end: close reading means quoting but not analyzing. This becomes evident as the language in which they describe close reading shifts from the rhetoric of “process” (making connections, thinking through things logically) to “pointing” (focusing or honing in on specific details).

Precisely why this shift occurs is harder to pin down, but the responses to the survey provide a few hints. Students remain adamant that close reading helps them both gather evidence and use that evidence to support a thesis statement in a paper. However, while students are voluble about *how* gathering evidence works in close reading, they are curiously silent about how to use that evidence to support their work. In other words, these responses demonstrate that students remain unclear about how the process of close reading works, i.e., how analyzing a metaphor in Shakespeare’s poem will lead to better argument, better understanding of poem; how pointing to specific metaphors in Shakespeare’s work will lead to a more general analysis in Shakespeare’s writing. This interpretation is confirmed by student responses to the question of whether or not they will

use close reading outside the writing classroom: most students say “no,” mainly because they see close reading solely as a means to gather evidence for literature papers, rather than as a more general activity that can help with textual analysis in any kind of work.

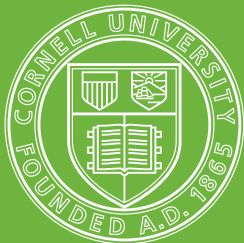
IMPROVING CLOSE READING AND CONCLUSIONS

By drawing on the literature of metacognition and by thinking through the summary of these student surveys, there are a few things that I think will improve close reading in the writing classroom. Flower and Hayes agree that two things that aid metacognition in the writing classroom are exposing students to “expert” and “novice” versions of an assignment, and asking them to “externalize” their self-reflection process in journals or group activities. With this in mind, I would suggest some changes to the handouts I give students in class.

First, in order to stress the difference between expert and novice readings, the “Good-Better-Best Handout” should be given to students *after* we’ve discussed an “expert” close reading of the text in question. Doing so will allow students to develop their own criteria for an “expert” close reading and then compare this criteria against the handout I’ve given them.

Students should also compare the first draft of their essay against the handout. All of this will help students reflect on the *process* by which “expert” readings develop from “novice” ones.

Second, in order to better externalize the process of self-reflection, I suggest that just after handing in their first draft, students should write a short explanation of their thought process when composing that essay. Having done that, students can then discuss common mistakes in close readings, a discussion which will then lead to the more formal “mistakes” on the second handout.



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