

Supplemental Material

CBE—Life Sciences Education

Sorte *et al.*

Appendix 1. Surveys used to assess writing confidence and satisfaction with the SWIM Program. The same pre-class survey was used for both the SWIM (Population & Community Ecology) and non-SWIM class (Field Biology) while only SWIM students answered the last set of questions specific to the SWIM Program in the post-class surveys.

PRE-CLASS SURVEY

Name _____ Year _____ Major _____

COURSE ACTIVITIES

Please look over this list of activities that might be included in a science course such as this. For each activity, give an estimate of your current level of ability/experience before the course begins. Your current level of ability may be a result of courses in high school or college, as well as experiences such as jobs or special programs.

	None	Little	Some	Much	Extensive
	1	2	3	4	5
run statistical tests (in any computer program)					
make figures (in a program such as Excel)					
complete problem sets in small groups					
write a research proposal					
design a study or experiment that follows up on one I read about					
read scientific papers (also called the “primary literature”)					
present results orally					
analyze data					
find primary literature articles relevant to a particular question					
give poster presentations					
develop a logical argument					
enter and format data (in a program such as Excel)					
conduct a lab or field study that is designed by the instructor					
write a research paper or report					
conduct a lab or field study entirely of student design					
use functions for calculations (in a program such as Excel)					
critique the work of other students					
complete problem sets individually					
recognize a sound argument and appropriate use of evidence					
collect data					

What statistics classes have you had? _____

What statistics programs have you used? _____

Have you done Bio 199 credits? Yes No

If so, did you do an independent research project? Yes No

What was the topic of your project? _____

Do you have a laptop that you can bring to class? Yes No

ATTITUDES ABOUT WRITING (Rose [1984] Writing Attitude Questionnaire)

This questionnaire requires that you reflect on your writing behavior (in English). Try to recall exactly what you did when you wrote a recent paper, so that you can report what you really do, not what you wish you could do.

	Almost always	Often	Sometimes	Occasion- ally	Almost never
	1	2	3	4	5
My teachers are familiar with so much good writing that my writing must look bad by comparison.					
I've seen really good writing, but my writing doesn't match up to it.					
I think my writing is good.					
I think of my instructors as reacting positively to my writing.					
Writing is a very unpleasant experience for me.					
I enjoy writing, though writing is difficult at times.					
I like having the opportunity to express my ideas in writing.					
I'm not sure, at times, how to organize all the information I have collected for a paper.					
Writing on topics that can have different focuses is difficult for me.					
I have trouble deciding how to write on issues that have many interpretations.					
To write essays on books and articles that are very complex is difficult for me.					
I have trouble with assignments that ask me to compare or contrast or to analyze.					
I run over deadlines because I get stuck while trying to write my paper.					
I have to hand in assignments late because I can't get the words on paper.					
Each sentence I write has to be just right before I'll go on to the next.					
When I write, I'll wait until I've found just the right phrase.					
I find myself writing a sentence, then erasing it, trying another sentence, then scratching it out. I might do this for some time.					
My first paragraph has to be perfect before I'll go on.					
While writing a paper, I'll hit places that keep me stuck for an hour or more.					
At times, I find it hard to write what I mean.					
At times, my first paragraph takes me over two hours to write.					
Starting a paper is very hard for me.					
At times, I sit for hours unable to write a thing.					
Some people experience periods when, no matter how hard they try, they can produce little, if any, writing. When these periods last for a considerable amount of time, we say the person has a writing block. Estimate how often you experience writer's block.					

YOUR OPINIONS ABOUT SCIENCE

Research on learning acknowledges that students approach a course with opinions of themselves and of the subject matter, and understanding these opinions will help us put learning in context.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	1	2	3	4	5
I get personal satisfaction when I solve a scientific problem by figuring it out myself.					
Being able to write well is an essential skill that I will use throughout my life.					
Students who are not majoring in science should not have to take science courses.					
I can do well in science courses.					
If an experiment shows that something doesn't work, the experiment was a failure.					
I wish science instructors would just tell us what we need to know so we can learn it.					
The process of writing in science is helpful for understanding scientific ideas.					
I can do well in non-science courses.					
Select "strongly disagree" as your answer to this question.					
Creativity does not play a role in science.					
Even if I forget the facts, I'll still be able to use the thinking skills I learn in science.					
Explaining science ideas to others has helped me understand the ideas better.					
Scientific experts are the only members of the public who are qualified to make judgments on scientific issues.					
There is too much emphasis in science classes on figuring things out for yourself.					
Science is essentially an accumulation of facts, rules and formulas.					
The main job of the instructor is to structure the work so that we can learn it ourselves.					

Is English your first/primary language? Yes No

Is English the predominant language spoken in your family (between parents and children)? Yes No

If you answered "no" to either of the previous questions, what language(s) other than English were your first or is spoken in your family (between parents and children)? _____

What are your career aspirations, i.e. "dream job"? _____

What are you most looking forward to in this class? Any requests?

POST-CLASS SURVEY

Name _____

Name of SWIM mentor _____

COURSE ACTIVITIES

Please look over this list of activities that might be included in a science course such as this. For each activity, give an estimate of your current level of ability at the end of this course. Your level of ability may be a result of this course, as well as courses in high school or college and experiences such as jobs or special programs.

	None	Little	Some	Much	Extensive
	1	2	3	4	5
run statistical tests (in any computer program)					
make figures (in a program such as Excel)					
complete problem sets in small groups					
write a research proposal					
design a study or experiment that follows up on one I read about					
read scientific papers (also called the "primary literature")					
present results orally					
analyze data					
find primary literature articles relevant to a particular question					
give poster presentations					
develop a logical argument					
enter and format data (in a program such as Excel)					
conduct a lab or field study that is designed by the instructor					
write a research paper or report					
conduct a lab or field study entirely of student design					
use functions for calculations (in a program such as Excel)					
critique the work of other students					
complete problem sets individually					
recognize a sound argument and appropriate use of evidence					
collect data					

ATTITUDES ABOUT WRITING (Rose [1984] Writing Attitude Questionnaire)

This questionnaire requires that you reflect on your writing behavior (in English). Try to recall exactly what you did when you wrote a recent paper, so that you can report what you really do, not what you wish you could do.

	Almost always	Often	Sometimes	Occasion- ally	Almost never
	1	2	3	4	5
My teachers are familiar with so much good writing that my writing must look bad by comparison.					
I've seen really good writing, but my writing doesn't match up to it.					
I think my writing is good.					
I think of my instructors as reacting positively to my writing.					
Writing is a very unpleasant experience for me.					
I enjoy writing, though writing is difficult at times.					
I like having the opportunity to express my ideas in writing.					
I'm not sure, at times, how to organize all the information I have collected for a paper.					
Writing on topics that can have different focuses is difficult for me.					
I have trouble deciding how to write on issues that have many interpretations.					
To write essays on books and articles that are very complex is difficult for me.					
I have trouble with assignments that ask me to compare or contrast or to analyze.					
I run over deadlines because I get stuck while trying to write my paper.					
I have to hand in assignments late because I can't get the words on paper.					
Each sentence I write has to be just right before I'll go on to the next.					
When I write, I'll wait until I've found just the right phrase.					
I find myself writing a sentence, then erasing it, trying another sentence, then scratching it out. I might do this for some time.					
My first paragraph has to be perfect before I'll go on.					
While writing a paper, I'll hit places that keep me stuck for an hour or more.					
At times, I find it hard to write what I mean.					
At times, my first paragraph takes me over two hours to write.					
Starting a paper is very hard for me.					
At times, I sit for hours unable to write a thing.					
Some people experience periods when, no matter how hard they try, they can produce little, if any, writing. When these periods last for a considerable amount of time, we say the person has a writing block. Estimate how often you experience writer's block.					

YOUR OPINIONS ABOUT SCIENCE

In the pre-class survey you responded to questions about science. Below, the questions are posed again. Your answers will help us determine whether opinions are the same over time or change as a result of your experience.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	1	2	3	4	5
I get personal satisfaction when I solve a scientific problem by figuring it out myself.					
Being able to write well is an essential skill that I will use throughout my life.					
Students who are not majoring in science should not have to take science courses.					
I can do well in science courses.					
If an experiment shows that something doesn't work, the experiment was a failure.					
I wish science instructors would just tell us what we need to know so we can learn it.					
The process of writing in science is helpful for understanding scientific ideas.					
I can do well in non-science courses.					
Select "strongly disagree" as your answer to this question.					
Creativity does not play a role in science.					
Even if I forget the facts, I'll still be able to use the thinking skills I learn in science.					
Explaining science ideas to others has helped me understand the ideas better.					
Scientific experts are the only members of the public who are qualified to make judgments on scientific issues.					
There is too much emphasis in science classes on figuring things out for yourself.					
Science is essentially an accumulation of facts, rules and formulas.					
The main job of the instructor is to structure the work so that we can learn it ourselves.					

BENEFITS

In this section of the survey you will be asked to consider a variety of possible benefits you may have gained from your experience in this class.

	Little to no gain	Small gain	Moderate gain	Large gain	Very large gain
	1	2	3	4	5
Clarification of a career path					
Tolerance for obstacles faced in the research process					
Readiness for more demanding research					
Understanding how knowledge is constructed					
Ability to analyze data					
Understanding of the research process in your field					
Ability to integrate theory and practice					
Understanding of how scientists work on real problems					
Understanding that scientific assertions require supporting evidence					
Understanding science					
Learning ethical conduct in your field					
Learning lab and field techniques					
Ability to read primary literature					
Skill in science writing					
Self-confidence					
Understanding of how scientists think					
Learning to work independently					
Becoming part of a learning community					
Confidence in my potential to be a teacher of science					
Effectiveness in oral presentation					

YOUR EXPERIENCE WITH THE SWIM PROGRAM

Your feedback on this new program will be extremely valuable for future course and curriculum development!

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	1	2	3	4	5
My mentor gave me an overview of the work being performed and how my contribution related to the work of the lab as a whole.					
My mentor provided me with sufficient background information to get me oriented to my project.					
I feel like my mentor cared about my research experience and progress.					
I would recommend this mentor to another student.					
The SWIM program is a valuable addition to this class and should be continued in future years.					

What were the best parts of this program? What aspects would you suggest changing in the future?

Appendix 2. Grading rubric used in the assessment of writing effectiveness as well as (far below) the assignment of rubric elements to three categories of effectiveness: writing composition, data analysis and interpretation, and ecological theory.

Criteria	Mastery - Excellent	Proficient - Good	Needs improvement but acceptable	Unsatisfactory - Unacceptable
Title 3 pts	Concise, specific, and informative 3	Specific, but too wordy or full of jargon 2	Much too vague and/or overly wordy 1	No title 0
Abstract 7 pts	Background/big picture in 1-2 sentences. Clear statement of question and/or hypothesis. Brief methods (2-3 sentences). Major findings in no more than 2 or 3 sentences. Concluding sentence related to statement of specific question/hypothesis. 7 pts	Background is too long. And/or question or hypothesis isn't clear. And/or methods are excessive. Too much detail about results. And/or conclusion is vague. 5 pts	At least one element missing and remainder unclear. Inadequate background. And/or no question or hypothesis. And/or inadequate methods. Not enough detail about results And/or no conclusion. 3 pts	Multiple elements are missing. 1 pts
Introduction (Rationale for study) 4 pts	Justifies research in a compelling way to an audience of peers. Demonstrates understanding of significance of the work. Follows a clear, logical progression from what is known to what isn't known (i.e. "funnel shaped"). Defines jargon and acronyms. 4 pts	Justification is too narrow or not geared to appropriate audience. And/or logic occasionally isn't clear or seems unorganized. And/or student misunderstands some components of the work And/or some jargon and acronyms aren't defined. 3 pts	Justification is too vague. Significance of research is not demonstrated. And/or logic is consistently unclear. And/or most jargon and acronyms aren't defined. 2 pts	Justification and significance are missing. Logic is severely flawed. Background is not appropriate for peers. 0 pts
Introduction (Question/Hypothesis/prediction) 3 pts	Research question clearly stated and leads logically to hypothesis Hypothesis/prediction is clearly stated. All variables that are part of the hypotheses are explained. 3 pts	Research question unclear or not sufficiently linked to hypothesis Hypothesis/prediction is present, but not in a logical place. One of the variables that is part of the hypotheses is not discussed. And/or an irrelevant variable is introduced.	Research question incorrectly posed or missing entirely. Hypothesis/prediction is too vague More than one variable from the hypotheses is not discussed. And/or multiple irrelevant variables are introduced. 1 pts	No research question. No hypothesis /prediction Variables of interest are not discussed. 0 pts

		2 pts		
Introduction (Understanding of ecological theory) 3 pts	Shows mastery of primary literature through appropriate references. Correctly presents relevant ecological theories. Effectively connects ecological theory to rationale, questions, and hypotheses. 3 pts	Primary literature is referenced but not effectively incorporated. Some inaccuracies in the presentation of relevant ecological theories and/or gaps in knowledge are apparent. Attempts to connect theory to rationale, questions, and hypotheses. 2 pts	Primary literature is not effectively incorporated and/or not relevant to the study. Multiple inaccuracies in the presentation of relevant ecological theories and/or gaps in knowledge are apparent. Does not connect theory to rationale, questions, and hypotheses. 1 pt	Primary literature is not incorporated And/or student misrepresents or does not present ecological theory. And/or does not connect theory to rationale, questions, and hypotheses 0 pts
Methods 10 pts	Provides sufficient information for reader to repeat the work. Clearly describes experimental design and sampling procedures. Statistical methods presented accurately and with justification in relation to the hypotheses posed. 10 pts	Too much or not enough detail is provided. Experimental design and sampling procedures are described but unclear. Statistical methods are not connected to hypotheses posed and/or are incorrect 7 pts	Excessive detail about experimental design and methods. Design and methods not justified. And/or statistical methods not presented. 4 pts	Described methods are inaccurate and show a misunderstanding of the project. No mention of experimental design. And/or statistical methods not presented. 1 pts
Results (Description) 10 pts	Concisely and correctly summarizes all results. Results statements are supported with reference to data and/or statistics. Results effectively address questions / hypotheses posed. Includes no in-depth analysis / discussion. 10 pts	Concisely and correctly summarizes most results. Some results are unclear or unrelated to questions / hypotheses posed. And/or data are not used to support general statements. And/or includes too much analysis / discussion. 7 pts	Some results are missing entirely And/or results are mostly unclear. And/or statements are not supported by data. Includes frequent statements that should be in the discussion. 4 pts	Results are not adequately explained or presented. Results are unrelated to questions / hypotheses More than half of the text belongs in the discussion. 0 pts
Results (Figures/ Tables) 10 pts	Each figure/table makes an important contribution. Figures/tables illustrate data correctly and with error bars. Figures/tables have complete captions/legends and are formatted appropriately. 10 pts	Unnecessary table or figure. Figures/tables may lack error bars. And/or figure captions/legends are incomplete. And/or occasional formatting errors. 7 pts	A necessary table or figure is missing entirely. Data is presented inaccurately. And/or many captions/legends are incomplete. And/or frequent formatting errors. 4 pts	Multiple figures or tables are missing. Inadequate figures. 0 pts

<p>Discussion (Data interpretation) 4 pts</p>	<p>Briefly restates the results within the context of the study. Describes whether and how data support the hypothesis. Effectively links findings to the research question / objective. Addresses unexpected or anomalous results with specific ideas (not speculation). 4 pts</p>	<p>Restates too much detail from the results or does not interpret results clearly. Whether the data supports the hypothesis isn't clear. Only partially links results to question/objective. And/or an unexpected result is addressed with speculation. 3 pts</p>	<p>Restatement of results is too vague or has some misinterpretation. The results are not linked to the hypothesis or research questions. Interpretation of findings is weak or missing 2 pts</p>	<p>No restatement of results. Inadequate discussion of findings. 0 pts</p>
<p>Discussion (Understanding of ecological theory) 4 pts</p>	<p>Interprets results in the context of primary literature. Explains similarities and differences to published results. Accurately presents ecological theory in the interpretation of results. 4 pts</p>	<p>Some results are not discussed relative to primary literature. Limitations of study or explanations of some findings are missing. Ecological theory is presented but not related to results. 3 pts</p>	<p>More than one result is not discussed relative to primary literature. Explanations for several findings are missing. Ecological theory is misrepresented or partly absent 2 pts</p>	<p>Results were not discussed relative to the primary literature. Ecological theory absent. 0 pts</p>
<p>Discussion (Conclusion) 2 pts</p>	<p>Relates back to the overall purpose and justification posed in the introduction. Proposes a relevant and specific future direction. Has a clear "take home" message. 2</p>	<p>Does not tie conclusions back to overall purpose of the study And/or the future direction is vague. And/or "take home" message is unclear. 1.5</p>	<p>The relationship between the findings and the overall purpose is missing. And the future direction or "take home" message is missing. 1</p>	<p>Both the overall purpose and the future direction are missing. No clear "take home" message 0 pts</p>
<p>Literature Cited 10 pts</p>	<p>Citations appropriate and well chosen, showing adequate background research on the topic Citations provided for background, justification, and any specific methods or claims Correct formatting of citations within the text and literature cited section 10-20 primary sources used 10 pts</p>	<p>Some references aren't relevant. And/or some sections are missing references. And/or a couple of formatting issues. A few references are not primary literature 7 pts</p>	<p>Several references aren't relevant. And/or frequent formatting issues. And/or fewer than 10 references are included 4 pts</p>	<p>Lack of relevant references 0 pts</p>

Formatting 10 pts	Appropriate length (8-10 pgs) and structure for scientific manuscript. Details are apportioned properly among the paper sections, which occur in the correct order 2-4 Figures and/or Tables presented 10 pts	Paper is too short or too long And/or has some details placed in the wrong sections And/or presents sections out of order Only one Figures or Table is presented 7 pts	Paper is much too short or too long And/or is completely missing a section 4 pts	Paper does not follow formatting guidelines 0 pts
Readability 10 pts	Writing is compelling and at an appropriate level. Contains few or no inaccurate statements. Language is precise and scientific. Writing is relatively free of grammar errors/typos. 10 pts	Writing is of high quality but at times vague or disorganized. A couple of inaccurate statements. Occasional overuse of passive tense or jargon. Occasional grammar error/typo 7 pts	Writing is frequently unclear or unscientific. Several inaccurate statements. Language and grammar occasionally impede comprehension. 4 pts	Writing is mostly unclear. Multiple inaccurate statements. Much of the writing is difficult to understand because of grammar issues. 0 pts
Application of Pop/Comm Ecological Theory 10 pts	Shows excellent understanding of main concepts in population & community ecology Shows effort and creativity in approach, scientific process, interpretation, and writing 10 pts	Shows good understanding of main concepts in population & community ecology Lacks effort or creativity in one of the following: approach, scientific process, interpretation, and writing 7 pts	Shows some misunderstanding of main concepts in population & community ecology Lacks effort or creativity in multiple of the following: approach, scientific process, interpretation, and writing 4 pts	Shows significant misunderstanding of main concepts in population & community ecology And lacks effort or creativity in multiple of the following: approach, scientific process, interpretation, and writing 0 pts

Writing Composition Total (23 pts)

Abstract (7 pts)
Introduction (Rationale for study) (4 pts)
Readability (10 pts)
Discussion (Conclusion) (2 pts)

Ecological Theory Total (17 pts)

Introduction (Understanding of ecological theory) (3 pts)
Discussion (Understanding of ecological theory) (4 pts)
Application of Pop/Comm Ecological Theory (10 pts)

Data Interpretation Total (27 pts)

Introduction (Question/Hypothesis/prediction) (3 pts)
Results (Description) (10 pts)
Results (Figures/ Tables) (10 pts)
Discussion (Data interpretation) (4 pts)

Appendix 3. Surveys completed by graduate student mentors before (pre-class) and after (post-class) participation in the SWIM Program.

Pre-class Survey for Graduate Student SWIM Mentors

1) What do you hope to gain from participating in this program?

2) What do you think will be the most challenging aspect of the program?

3) What qualities do you think are important in a good mentor?

4) Please rate your level of agreement with the following statements

1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly agree, 6=N/A

___ I believe that helping others learn is personally gratifying.

___ I enjoy working collaboratively in small groups.

___ I am a good listener.

___ When working with students, I regularly check for understanding.

___ I can modify my communication style to accommodate cultural differences.

___ I am comfortable giving critical feedback.

___ I am comfortable receiving critical feedback.

___ I am comfortable with managing conflict.

SWIM Mentor Survey (post-class)

Thank you for participating as a mentor in the 2018 SWIM program and for taking the time to provide feedback on your experience! This feedback will be invaluable as we plan future program curricula.

BENEFITS

Please consider the degree to which participating as a SWIM mentor benefited you in the following ways.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	1	2	3	4	5
I am closer to answering my overarching research question.					
I am further along in data analysis than I would have been otherwise.					
I have become a better writer.					
I am more efficient with my time management.					
I have become a better teacher.					
My teaching and mentoring styles have become more diversified.					
I hope to have one or more of my mentees continue working with me on research in the future.					
This experience has helped me to focus my career goals.					
I enjoyed participating in this program.					
I saw an improvement in my mentees' performance in response to my mentorship.					
I was more satisfied with my graduate program while participating as a SWIM mentor.					
My experience as a SWIM mentor was a valuable one.					
The SWIM experience will help my mentees become better researchers.					

What was the most beneficial aspect of the SWIM program for you?

Please rate students' level of background knowledge in the following areas (L=low, A=average, H=high):

- ___ General ecology
- ___ Scientific writing
- ___ Experimental design
- ___ Statistics
- ___ Relevant software (Excel, R, etc)

In what ways do you think students were underprepared? How would you address this in the future?

What do you think were the greatest gains in students' knowledge or abilities from this course?

CHALLENGES

Please consider the degree to which these aspects of the program were challenging to you as a mentor.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	1	2	3	4	5
My mentoring responsibilities took more time than anticipated based on the syllabus.					
My mentees were unwilling or unable to incorporate the feedback that I suggested.					
I did not understand what I was getting into with signing up to be a SWIM mentor.					
The monetary compensation is inadequate given the time investment.					
A stipend would be preferable to research and travel funds.					
I did not receive adequate information about what was expected of me and what I was supposed to be doing.					
I put in a lot more effort than the other mentors.					
My mentees did not respect established boundaries and expected help too frequently.					
The number of mentees per group was too high.					
Participating in this program as a mentor was not worth the amount of effort required.					

What was the most challenging aspect of being a SWIM mentor?

Please rate how you felt about your level of contact with your mentees during the course.

- (1) Too much contact (2) About the right amount (3) Too little contact

What aspects of mentoring do you wish you had been better prepared for? (check all that apply)

- Facilitating small group work.
- Active listening skills.
- Strategies for adapting communication styles to cultural differences.
- Giving critical feedback.
- Receiving critical feedback.
- Managing conflict.

About how many hours per week did you spend preparing for and working with your SWIM students?

What surprised you the most about your experience in this program?

How would you recommend restructuring this program in the future?

If the SWIM program continues in future years, how likely would you be to participate?

(1) Very unlikely (2) Unlikely (3) Maybe (4) Likely (5) Very likely

Why or why not?

Is there anything else you would like to share about your experience as a SWIM mentor?