

## TEACHING TEACHERS STATISTICAL LITERACY ONLINE

Milo Schield, W. M. Keck Statistical Literacy Project

### Abstract

Teaching a course that combines critical thinking with quantitative literacy and statistical literacy is challenging. Teachers who want to teach such a course may need training to be most effective. Augsburg College offered teacher training on Statistical Literacy. The course was totally on-line in an accelerated six week format in summer 2011. The course used Moodle exercises and Odysseys2sense™: a revolutionary web forum that promotes civil discourse via anonymous peer review. Participants used Odyssey to discuss their analyses of statistics in graphs and short essays. This was a very intense course. During the 6 weeks they completed 730 problems, analyzed 14 news stories and gave weekly feedback on the course. These exercises included topics not generally encountered in QR/QL courses such as calculating the influence of different definitions on the size of a statistic, calculating the change in an association after taking into account the influence of a binary confounder and calculating the number of cases attributed to a given factor. This paper analyses the teacher evaluations of the textbook, the Moodle exercises, the use of "Odyssey" and the online course. Recommendations for improvement are presented.

**Keywords:** Odysseys2sense™, Moodle

### 1. TEACHING STATISTICAL LITERACY

Statistical literacy has been a full-semester catalog course (GST 200) at Augsburg College since 1998. The goal is for students to be able to read and interpret the statistics in the everyday media that are used as evidence for disputable claims. Schield (2004, 2008 and 2010). This means that students must have repeated practice with a variety of news stories, tables and graphs.

The goal is to teach Statistical Literacy entirely online in an accelerated six-week format to a large number of students (over 100) without TAs and without undue work for the teacher.

A secondary goal is to offer a training course for those teachers teaching a course to satisfy a Quantitative Reasoning (QR), Quantitative Literacy (QL) or Statistical Literacy (SL) requirement at their college or university.

Teaching critical thinking is difficult; teaching statistical inference and confounding is difficult; teaching statistical literacy – critical thinking about statistics – is at least as difficult as either one separately.

Teaching all this online is even more difficult. But if statistical literacy is going to be a course taught to large classes with minimal instructor involvement, all these problems must be addressed and solved.

### 2. STATISTICAL LITERACY GOALS

The goals of this course are in alignment with the goals from four sources:

- AACU Quantitative Literacy rubric (2010)
- ASA GAISE Guidelines for Colleges (2007)
- MAA Guidelines. Steen (2004)
- Academically Adrift (2011).

The AACU QL rubric (2010) states that “Individuals with strong QL skills”:

- *possess the ability to reason and solve quantitative problems from a wide array of authentic contexts and everyday life situations.*
- *understand and can create sophisticated arguments supported by quantitative evidence ...*
- *can clearly communicate those arguments in a variety of formats (using words, tables, graphs, mathematical equations, etc., as appropriate).*

Note the strong focus on understanding and communicating arguments supported by data. This focus on arguments – and thus on context – is what moves QL from calculation to critical thinking.

The ASA GAISE report defined statistical literacy as *understanding the basic language of statistics (e.g., knowing what statistical terms and symbols mean and being able to read statistical graphs), and understanding some fundamental ideas of statistics.*

This report noted that *students should develop statistical literacy and the ability to think statistically.* The college report suggests assessing statistical literacy by students *interpreting or critiquing articles in the news and graphs in media.*

The report stated that students should recognize:

- common sources of bias in surveys and experiments
- how to determine the population to which the results of statistical inference can be extended, if any, based on how the data were collected
- how to determine when a cause-and-effect inference can be drawn from an association based on how the data were collected (e.g., the design of the study).

The MAA document notes that “Quantitative literacy empowers people by giving them tools to think for themselves, to ask intelligent questions of experts, and to confront authority confidently. These are skills required to thrive in the modern world.”

Arum and Roksa (2011) note that “45 percent of students show no significant improvement in the key measures of critical thinking, complex reasoning and writing by the end of their sophomore years” Now that colleges have a way to measure these things, the pressure to show how they add intellectual value will increase.

Note that none of these sources specifies the kinds of critical thinking, mathematics or statistics that should be included. But they do specify that the focus or goal should involve arguments: arguments that involve critical thinking and complex reasoning.

### 3. STATISTICAL LITERACY COURSE

In order to meet these guidelines, a special Augsburg course was created: GST 200. This course has been taken by over a thousand Augsburg students. This statistical literacy course is based on four ideas:

1. *Association is not causation – but association typically signifies a causal connection somewhere.* Students should know the difference between association and causation in reality and in how language indicates this difference.
2. *Arguments are required in order to use associations as evidence for causation – especially when the data are obtained from observational studies.* This reasoning from effect to cause is a form of inductive reasoning. Mathematical induction and statistical induction (confidence intervals) are really mathematical deductions – their results are 100% certain. Students should be comfortable with both deductive and inductive arguments.
3. *Statistics are numbers in context.* Numbers without any relation to reality are just numbers. Students should be aware of how an observed association can be a result of confounding. In analyzing a statistic or a statistical association, students should look for the context: what is – and is not – taken into account.
4. *All statistics are socially constructed.* People select the question or outcome of interest, people decide how groups or measures are selected or defined; people decide how to summarize and present the results. These choices have a tremendous influence on the size of the resulting statistics and on the associated comparisons. Schield (2011c).

Some may argue that this emphasis on critical thinking, argumentation and causation takes away from the quantitative aspects of the problem or issue. But if “numbers in context” is an essential component of quantitative literacy, then critical thinking, argumentation and causation are absolutely necessary in order to set the appropriate context.

A unique textbook based on these key ideas has been generated. See Schield (2011b). Details on the approach in this textbook are available. Schield (2004, 2007, 2008 and 2010). This textbook is in its’ 5<sup>th</sup> edition, but is still in draft form.

More than 120 Moodle exercises have been generated and student-tested. Schield (2007) Of these more than a 100 are multiple choice exercises each involving a single topic. Most of these have 10 questions. The remainder of the exercises involve student writing that require manual grading.

In order to promote the critical thinking required by these guidelines, this course uses Odysseys2-sense(TM): a revolutionary web forum featuring anonymous peer review. Participants used Odyssey in two ways: (1) to discuss their analyses of statistics in graphs and short essays and (2) to discuss their reactions to the presentation of the materials. A poster by Schield and Copes (2011) illustrates some of the Odyssey features and benefits. Details of the program are reviewed by Schield (2011a).

### 4. STATISTICAL LITERACY ONLINE

In 2011, this full-semester course for students in non-quantitative majors was taught totally on-line in an accelerated six week format for the second time.

Materials were presented in three ways: (1) the textbook (Schield 2011b), (2) PowerPoint slides that summarized the high points of a given chapter, and (3) an mp3 audio that gave the teacher’s comments on the PowerPoint slides. This audio-PowerPoint combination resulted in a much smaller file size than having a 15-25 minute video. Some students said they loved the audio-format (it gave them a “relationship with the teacher) while others said they ignored the audio and focused on reading the textbook.

### 5. THE STUDENT-TEACHERS

Eight faculty from Keene College (VT) participated in the Augsburg’s first online teacher training course. The initial contact came from Michael Caulfield (instructional designer and QL instructor) and Sheri Bemis (QL Coordinator).

Michael and Sheri recruited six other Keene faculty: Elli Caldwell (QL instructor), Kenneth Gauvreau (QL instructor), Mike Goudzwaard (QL instructor), Becca

Hickam (Coordinator of Experiential Education and QL instructor), Ned Pokras (QL instructor) and Tamara Stenn (QL instructor).

Of the seven teachers, three have taken statistics, four have taught statistics and one has done both. Of the seven teachers, one has taken a QL course, three have taught a QL course and none have done both.

The fact that teachers may be teaching material they have not studied in a course is not surprising. Statistics is not a common undergraduate major and is seldom a required course for students majoring in Mathematics. Quantitative Literacy is a new subject with many different flavors.

## 6. THE COURSE WORKLOAD

This 2011 online course in Statistical Literacy for teachers included all the work assigned to students. These eight faculty signed on to a course designed for students. Thus, the faculty did the same work as did the five students enrolled in the course. This paper presents feedback from the faculty; feedback from the students will be presented in a separate paper.

This online summer course lasted six weeks: May 20 to June 30. The participants completed 73 Moodle exercises and answered 730 questions.

The Moodle exercises included problems that are not generally included in QR, QL or introductory statistics courses but are involved in reading and interpreting numbers in the everyday media. These problems included:

- calculating the influence of different definitions on the size of a statistic,
- calculating weighted averages using a graphical technique,
- calculating the change in an association after taking into account the influence of a binary confounder
- calculating the percentage and number of cases attributed to a given factor, and
- calculating the influence on statistical significance after controlling for (taking into account) a binary confounder.

The students and teachers participated in two Odysseys. In Odyssey 54 they analyzed 14 news stories (See Table 1). In Odyssey 55, they gave weekly evaluations of the materials they were being taught. This was an extremely demanding course.

Table 1 Challenges in Odyssey 54

#	Title
1	All statistics are facts
2	1 in 50 US Kids is homeless
3	Red Books Activity
4	Students: Prostitution to Pay for Education
5	Olympic Winner
6	Facebook Helps College Students Succeed
7	Per Person Spending: Married vs. Single
8	Spanking Lowers IQ
9	Bigger Tableware Helps Widen Waistlines
10	High gas prices drive down traffic fatalities
11	Stream Graph of Movie Revenues
12	College students: Later classes, lower grades
13	Giving Criminals Money After Release
14	TV Ownership Linked to Well-Being

In addition, the students and teachers evaluated the textbook, the Moodle exercises, the use of *Odyssey* and the online course as a package.

## 7. TEACHER EVALUATIONS: OVERVIEW

The appendices contain the final evaluation questions asked of each of the participants along with the counts for each of the answers. One participant sent in two copies of C3 at different times with different responses. The earlier (7/26) was used. The results are summarized by looking for those questions where the teachers had the most agreement. The following sections summarize the teacher's conclusions.

## 8. COURSE EVALUATIONS

The teachers agreed that the evaluation of news stories is *very effective* in promoting a deeper understanding of statistical literacy. They *strongly agreed* that Statistical Literacy should be required of all college students for graduation. They said that this course is *valuable or strongly valuable* in reading and interpreting statistics in the media.

However, the teachers said that the Moodle exercises are *somewhat* effective in promoting a deeper understanding of the material. They concluded that the use of and emphasis on math in this course is *somewhat adequate* relative to understanding numbers in the media.

## 9. TEXTBOOK EVALUATIONS

The textbook by Schield (2011b) uses a "Take CARE" approach where each letter identifies a family of influences on a statistic or on an association.

This group found the "Take CARE" approach (Context, Assembly, Randomness and Error/bias) had moderate to high value – with one exception.

In reviewing each of the four components, the teachers concluded that

- The focus on Context (choice in comparisons, ratios, study design) had *moderate to high* value.
- The focus on Assembly (choice in defining and presenting statistics) had *high* value.
- The focus on Randomness had *mixed* value.
- The focus on Error/bias had *high* value.

The teachers found the textbook hard and dense (not enjoyable), but found it was slightly more readable after doing the exercises than before.

### 10. MOODLE EVALUATIONS

The teachers found that in learning the material, the Moodle exercises had *moderate* value but the number of questions per exercise was *excessive* as was the number of exercises.

### 11. ODYSSEY EVALUATIONS

These teachers concluded they would recommend the use of the Odyssey forum over a regular online forum or written assignment. In evaluating whether using the Odyssey forum helped to improve their critical thinking, the teachers distributed equally between slightly/modestly, moderately, and considerably.

### 12. TEACHER EVALUATIONS

These teachers concluded that their students were *very likely* to need the skills from this course as citizens in a data-saturated world.

The teachers found the use of and emphasis on math in this course relative to understanding numbers in the media ranged from *somewhat* to *very adequate* even though they agreed that this course had *much less* math than a standard algebra course and had somewhat less – if not much less – math than a standard statistics course.

The teachers *agreed* or *strongly agreed* that this Statistical Literacy course covers most of the basic skills I want my students to have.

The teachers split evenly between Quantitative Reasoning and Statistical Literacy when asked which course is most useful to math-phobic students in understanding numbers in everyday media.

The teachers agreed that the Schield text is suitable as a reference text for a quantitative literacy course but were divided on whether the current version of the textbook should be the primary text for a QL course.

### 13. TEACHER COMMENTS

The following are some positive teacher comments.

“I loved how it started not with measurement but with ideas of inference and causality. The measurements make more sense if you start from why we measure in the first place, and this was the major revelation for me as a teacher -- work backwards, not forwards from the measurements.”

“The CARE acronym helped to organize it in a useful way, and it was easy to read.”

Liked: “the grammar of statistics, as well as the overall models through which to evaluate them in the media. I have already found myself using this material in my daily life, and plan to keep using it into the future.”

### 14. ANALYSIS

The survey questions had three major weaknesses.

1. There was no way for teachers to indicate the kind of QR/QL course they wanted to teach. Thus, it was difficult to evaluate negative comments about the textbook or the approach.
2. Most of the survey instruments were designed for students – not of teachers. So when a teacher was asked, “How helpful is X?” there is an ambiguity. Does it mean “helpful for future students,” “helpful for teaching future students” or “helpful for the teacher in learning the material”?
3. Some questions did not allow “Don’t know” as an answer. See C9, Q20 vs. Q17.

### 4. CONCLUSION

Although the Augsburg Statistical Literacy online course was not designed for teacher training, it seems to have been fairly successful.

While the teachers identified numerous opportunities for improvement in this course, they did agree that the following were valuable:

- The “Take CARE” approach
- Using Moodle for online exercises
- Using Odysseys for critical thinking.

They also agreed on some of the weaknesses of this course such as:

- The textbook is too dense and needs editing.
- The Moodle exercises are too long for teachers.
- Teachers need an opportunity to talk about how they would present some of these ideas.

This course demonstrates how critical thinking about statistics in the everyday media can be taught on-line at an accelerated pace in a way that encourages reflective dialog, is scalable for large classes and is manageable for the teacher.

### 5. RECOMMENDATIONS

Rewrite the textbook to be more structured, to be less dense and to include sample problems.

Improve the handling of Assembly with better structure. Improve the handling of Context by identifying the benefit of each way of controlling for a related factor. Improve the handling of Randomness by focusing first on survey margin of error.

Create a subset of the Moodle exercises for the teacher training course.

With a larger sample, it might be interesting to analyze the evaluations based on the teacher's statistics background, their QL background or both.

### REFERENCES

- AACU Quantitative Literacy Rubric (2010). At [www.aacu.org/value/rubrics/pdf/QuantitativeLiteracy.pdf](http://www.aacu.org/value/rubrics/pdf/QuantitativeLiteracy.pdf)
- Arum, Richard and Josipa Roksa (2011). *Academically Adrift: Limited Learning on College Campuses*. University of Chicago Press.
- GAISE Reports (2007). Guidelines for Assessment and Instruction in Statistics Education. ASA [www.amstat.org/education/gaise/](http://www.amstat.org/education/gaise/)
- Schild, Milo (2004). Statistical Literacy Curriculum Design. *IASE Curricular Development in Statistics Education Roundtable*, pp. 54-74. See [www.StatLit.org/pdf/2004SchildIASE.pdf](http://www.StatLit.org/pdf/2004SchildIASE.pdf). or
- Schild, Milo (2007). Statistical Literacy: Factual Assessment to Support Hypothetical Thinking, 2007 IASE, Guimarães, Portugal. [www.StatLit.org/pdf/2007SchildIASE.pdf](http://www.StatLit.org/pdf/2007SchildIASE.pdf).
- Schild, Milo (2008). Quantitative Literacy and School Mathematics: Percentages and Fractions, in *Calculation vs. Context: Quantitative Literacy And Its Implications for Teacher Education*. Edited by B. L. Madison and L. A. Steen. 2008 Mathematical Association of America. p.87-107 At [www.statlit.org/pdf/2008SchildMAA.pdf](http://www.statlit.org/pdf/2008SchildMAA.pdf) or [www.maa.org/QL/cvc/cvc-087-107.pdf](http://www.maa.org/QL/cvc/cvc-087-107.pdf).
- Schild, Milo (2010). Assessing Statistical Literacy: TAKE CARE in *Assessment Methods in Statistical Education: An International Perspective*. Edited by P. Bidgood, N. Hunt and F. Joliffe. Wiley Publishers, Ch. 11, p. 133-152.
- Schild, Milo (2011a) Teaching Statistical Literacy using Odyssey2Sense™: a Unique Web-Based

Forum. Mathematical Association of America. See [www.StatLit.org/pdf/2011SchildMAA.pdf](http://www.StatLit.org/pdf/2011SchildMAA.pdf)

Schild, Milo (2011b) *Statistical Literacy: Seeing Behind the Numbers*. 5<sup>th</sup> ed. Instant Publishers.

Schild, Milo (2011c). All Statistics are Socially Constructed. The International Association of Statistical Educators (IASE). See [www.StatLit.org/pdf/2011SchildIASE.pdf](http://www.StatLit.org/pdf/2011SchildIASE.pdf)

Schild, Milo and Larry Copes: Odysseys: Teach Critical Thinking. Augsburg poster presentation. [www.StatLit.org/pdf/2011SchildCopesPosterOdysseys.pdf](http://www.StatLit.org/pdf/2011SchildCopesPosterOdysseys.pdf)

Steen, Lynn (2004). *Achieving Quantitative Literacy: An Urgent Challenge for Higher Education*. MAA [www.maa.org/ql/mathanddemocracy.html](http://www.maa.org/ql/mathanddemocracy.html)

### Acknowledgments:

Thanks to Michael Caulfield of Keene College who first indicated an interest in using the materials developed at Augsburg. He, in turn, enlisted seven colleagues: Caldwell, Gauvreau, Michael Gudzward, Hickam, Edward Pokras and Tamara Stenn. The author is at [schild@augsborg.edu](mailto:schild@augsborg.edu). A copy is at [www.statlit.org/pdf/2011SchildNNN.pdf](http://www.statlit.org/pdf/2011SchildNNN.pdf)

### Appendix A: Textbook Survey (C2)

1. **Did you try reading all the assigned textbook material before doing the Moodle exercises?**  
a. Never b. one chapter 1 c. several chapters 2 d. Almost all the chapters 2 e. all the chapters 2
2. **How readable were those chapters you read before doing the Moodle exercises?**  
a. Not applicable 1 b. very hard/dense 2 c. hard/dense 1 d. readable/not enjoyable 2 e. enjoyable.
3. **How readable were the chapters after doing the Moodle exercises?**  
a. very hard/dense 0 b. hard/dense 1 c. **readable but not enjoyable** 3 e. easy/enjoyable 3

---

4. **How valuable is the material presented in the textbook?**  
a. Negative value (waste of time) b. Neutral c. modest value 1 **d. moderate value** 5 e. high value 1
5. **How valuable is chapter 1 on association and introducing Take CARE?**  
a. Negative value (waste of time) b. Neutral c. modest value 2 **d. moderate value** 3 e. high value 2
6. **How valuable is chapter 2 on making comparisons?**  
a. Negative value (waste of time) b. Neutral c. modest value 1 **d. moderate value** 5 e. high value 1
7. **How valuable is chapter 2 on the details of Take CARE?**  
a. Negative value (waste of time) b. Neutral c. modest value 2 d. moderate value 2 **e. high value** 3
8. **How valuable is chapter 3 on measurements?**  
a. Negative value (waste of time) b. Neutral **c. modest value** 3 d. moderate value 2 e. high value 2
9. **How valuable is chapter 4 on describing ratios (percent and percentage grammar)? (6)**  
a. Negative value (waste of time) b. Neutral 1 c. modest value 1 **d. moderate value** 3 e. high value 1
10. **How valuable is chapter 5 on comparing ratios (percentage and likely grammar)?**  
a. Negative value (waste of time) b. Neutral 1 c. modest value 2 **d. moderate value** 3 e. high value 1

---

11. **How valuable is the Take CARE approach: Context, Assembly, Randomness, Error/bias?**  
a. Negative value (waste of time) 1 b. Neutral c. modest value **d. moderate value** 3 **e. high value** 3
12. **How valuable is the focus on Context (choice in comparisons, ratios, study design)?**  
a. Negative value (waste of time) b. Neutral c. modest value d. moderate value 3 **e. high value** 4
13. **How valuable is the focus on Assembly (choice in defining and presenting statistics)?**  
a. Negative value (waste of time) b. Neutral c. modest value d. moderate value 3 **e. high value** 4
14. **How valuable is the focus on Randomness?**  
a. Negative value (waste of time) 2 b. Neutral c. modest value **d. moderate value** 3 e. high value 2
15. **How valuable is the focus on Error/bias?**  
a. Negative value (waste of time) b. Neutral c. modest value 1 d. moderate value 2 **e. high value** 4

---

16. **Of the chapters you read, which chapter was the most helpful/valuable? (5)**  
1 Intro 2 More intro 1 3 Measures (mean) 1 4 Describe ratios 5 Compare ratios 2 6 Interpret ratios 1
17. **Of the chapters you read, which chapter was the most readable? (5)**  
1 Intro 3 2 More intro 1 3 Measures (mean) 1 4 Describe ratios 5 Compare ratios 6 Interpret ratios
18. **Of the chapters you read, which chapter was the least helpful/valuable? (5)**  
1 Intro 2 More intro 3 Measures (mean) 1 4 Describe ratios 2 5 Compare ratios 2 6 Interpret ratios
19. **Of the chapters you read, which chapter was the least readable?(4)**  
1 Intro 2 More intro 1 3 Measures (mean) 4 Describe ratios 1 5 Compare ratios 6 Interpret ratios 2
20. **Status**  
a. Student b. college staff/teacher 7 c. high school staff/teacher d. Professional staff/trainer
- 21-26: **Essay response questions: Like most (2); Like least (2), Need improvement/how? (2).**

### Appendix B: Assess Teaching StatLit Online (C3) [Mode in bold if $k \geq 3$ ]

0. Status: a. Augsburg Student b. Keene College faculty/staff 7
1. **How many college courses have you done entirely online before this one?**  
 \_\_\_ a. **None** 6 b. One 1 c. Two d. Three e. Four or more
2. **On average, how much time did you spend on this course a week?**  
 \_\_\_ a. < 4 (1) b. 6 (3) c. 8 (2) d. 10 (1) e. > 12
3. **Would you have learned more if you had taken this as a regular face-to-face classroom?**  
 \_\_\_ a. Probably not 1 b. Don't know 2 c. Probably more 2 d. Definitely more 2
4. **How much more or less do you think you learned in this online class as compared to what you might have learned in a face-to-face classroom?**  
 \_\_\_ a. Much less 1 b. **little less** 4 c. **Same** 2 d. little more e. much more
5. **How valuable is this course in reading and interpreting statistics in the media?**  
 \_\_\_ a. No value b. barely valuable c. somewhat valuable 3 **d. Highly valuable** 4
6. **Would you recommend this course to a friend?**  
 a. Definitely not b. probably not 2 c. **maybe** 3 d. probably would e. definitely would 2
7. **Statistical Literacy should be required of all college students for graduation.**  
 \_\_\_ a. Strongly disagree b. disagree c. neutral d. agree 2 e. **strongly agree** 5
8. **How valuable is this course in improving your critical thinking?**  
 \_\_\_ a. No value 0 b. barely valuable 1 c. somewhat valuable 2 d. Highly valuable 3
9. **What did you dislike most (like least) about taking this class online?**  
 \_\_\_ a. Textbook 2 b. Quality of Moodle exercises c. **Quantity of Moodle exercises** 3  
 d. Quality of Odyssey program (anonymous, peer-grading) e. Quantity of Challenges assigned 2
10. **What did you like most (dislike least) about taking this class online?**  
 \_\_\_ a. Textbook 1 MOODLE: [b. Quality of exercises 0 c. # of exercises 2 d. # of questions/exercise] 1  
 \_\_\_ ODYSSEY [d. Program features (anonymous, peer-graded, power) 3 e. # challenges assigned/week]
11. **What topics/focus did you like most (consider strongest) about the textbook?**  
 \_\_\_ a. assoc. vs. cause.1 **b. Take CARE** 3 c. context/confound d. assembly e. randomness **f. error/bias**.3
12. **What topics/focus did you like the least (consider weakest) about the textbook?**  
 \_\_\_ a. assoc. vs cause 1 b. Take CARE 1 c. context/confound 2 d. assembly e. randomness 3 f. error/bias 0.
13. **Rate the effectiveness of the textbook in promoting a deeper understanding of the material.**  
 \_\_\_ a totally ineffective b Somewhat ineffective 1 c Neutral 0 **d. Somewhat effective** 5 e Very effective 1
14. **Rate the effectiveness of the Moodle exercises in promoting a deeper understanding of the material.**  
 \_\_\_ a totally ineffective b Somewhat ineffective c Neutral 0 d Somewhat effective 7 e Very effective 0
15. **Rate the effectiveness of the Odyssey program in promoting a deeper understanding of the material.**  
 \_\_\_ a totally ineffective b Somewhat ineffective c Neutral 1 d Somewhat effective 3 e Very effective 3
16. **Rate the effectiveness of evaluating news stories to promote a deeper understanding of the material.**  
 \_\_\_ a totally ineffective b Somewhat ineffective c Neutral 0 d Somewhat effective 2 e **Very effective** 5
17. **Compare the amount of mathematics in this course with that in a high school algebra course:**  
 \_\_\_ This course had: a **Much less** 4 b Somewhat less 1 c Same 0 d Somewhat more 1 e Much more 0
18. **Rate the use of and emphasis on math in this course relative to understanding numbers in the media.**  
 \_\_\_ a totally inadequate 0 b somewhat inadequate 1 e Neutral 0 d Somewhat adequate 4 e Very adequate 2
19. **Compare the amount of English grammar in this course with that in a high school English course:**  
 \_\_\_ This course had: a Much less 2 b Somewhat less 1 c Same 0 d Somewhat more 3 e Much more 1
20. **Rate the use of ordinary English grammar in this course relative to understanding numbers in the media.**  
 \_\_\_ a totally inadequate b somewhat inadequate c Neutral 1 d **Somewhat adequate** 3 e **Very adequate** 3

### Appendix C: Assess Moodle Exercises (C5)

In Moodle, there were a number of exercises (multiple choice and essay). Each on a specific topic; typically 5 or 10 questions each: two tries on exercises; one try on quizzes. Users received immediate feedback on exercises after their first try.

**1. How experienced were you in using Moodle before this class?**

\_\_\_ a. None 6 b. Very little (< 1 class) c. somewhat (1 class) d. fairly (2 classes) e. extremely (>2) 1

**2. How well did the chapter present the material needed to answer these Moodle exercises?**

\_\_\_ a. Poorly b. OK or so-so 1 c. somewhat adequate 1 d. fairly adequate 5 e. extremely adequate

**3. How helpful were the Moodle exercises in learning the material in the chapter?**

\_\_\_ a. Negative value (waste of time) b. Neutral c. modest value 1 d. **moderate value** 4 e. high value 2

**4. What is the main way these exercises could be improved?**

\_\_\_ a. More problems b. **More varied problems** 3 c. More difficult problems 2 d. Other (see below) 2

21. Essay: What did you **dislike most (like least)** about these web-based Moodle exercises?

22. Essay: What did you **like most (dislike least)** about the web-based Moodle exercises?

23. Essay: What parts of these Moodle exercises **need the most improvement?** How could they be improved?

24-25. Essay: Which two Moodle exercises were least helpful? [list on next page]

26-27. Essay: Which two Moodle exercises were most helpful? [list on next page]

### Appendix D: Odyssey Survey (C6)

**1. What is your academic status at this time?**

a. Student b. **College teacher/staff** 7 c. Other

**2. To improve students' critical thinking the most, which would you recommend?**

(a) **Odyssey challenges** 5, (b) regular online open forum discussion boards with instructor evaluations 2 or (c) standard written assignments that are turned in, graded by the instructor, and handed back later?

a. Odyssey challenges b. Regular online open forum discussions c. standard written assignments

**3. How difficult was the Odyssey system to use at first?**

a. Very easy 2 b. **OK** 3 c. somewhat difficult 2 d. very difficult e. extremely difficult

**4. Having completed several challenges, how difficult is the Odyssey system to use now? (6)**

a. **Very easy** 3 b. **OK** 3 c. somewhat difficult d. very difficult e. extremely difficult

**5. How useful, helpful or valuable did you see the Odyssey challenge system at first?**

a. Negative value (waste of time) b. Neutral c. modest value 1 d. **moderate value** 4 e. high value 2

**6. How useful, helpful or valuable did you see the Odyssey challenge system now (at this time)?**

a. Negative value (waste of time) b. Neutral c. modest value 1 d. moderate value 2 e. **high value** 4

**7. How enjoyable was the Odyssey approach to civilized discourse initially? (6)**

a. not very enjoyable b. OK c. **somewhat enjoyable** 3 d. **very enjoyable** 3 e. extremely enjoyable

**8. How enjoyable is the Odyssey approach to civilized discourse now?**

a. not very enjoyable b. OK c. **somewhat enjoyable** 3 d. very enjoyable 2 e. extremely enjoyable 1

**9. How objective do you see your Odyssey scores and power as being?**

a. Not at all objective b. **Neutral** 3 c. modestly 2 d. moderately 2 e. highly

**10. How valuable do you find the reviews of others to your responses?**

a. Negative value (waste of time) b. Neutral 3 c. modest value d. **moderate value** 4 e. high value

**11. Have you thought that others reviewed a response inappropriately?**

a. **Never** 3 b. Once c. Twice d. several times 3 e. many/most times

**12. Have you voiced your disagreements with inappropriate ratings of a response by critiquing?**

a. **Never** 5 b. Once c. Twice 1 d. several times 1 e. many/most times



13. **How relevant was the scoring (Power) in indicating the quantity (amount) of your comments?**  
a. Negative value (waste of time) b. Neutral 2 c. modest value 2 d. moderate value 2 e. high value 1
14. **How relevant was the scoring (Power) in indicating the quality of your comments?**  
a. Negative value (waste of time) b. Neutral 1 c. modest value 4 d. moderate value 1 e. high value 1
15. **How do you like the game aspects of the Odyssey program?**  
a. strongly dislike b. dislike c. neutral 2 d. like 4 e. strongly like 1
16. **How much do you think Odyssey helped to improve your critical thinking?**  
a. negative (waste of time) b. neutral 1 c. slightly/modestly 2 d. moderately 2 e. considerably 2
17. **The Odyssey program should be used as a central element in future statistical literacy classes.**  
a. strongly disagree b. disagree 1 c. neutral 3 d. agree 2 e. strongly agree 1
18. **Have you gotten better in making a stronger, cleaner argument in your initial reply than when you first used the Odyssey?**  
a. No, much worse b. No, a bit worse c. No change 3 d. Yes, somewhat better 3 e. Yes, much better 1
19. **What is your current Odyssey Power in evaluating Articles (Odyssey 54)? (0)**  
a. 1-999 b. 1,000-1,499 c. 1,500-1,999 d. 2,000-2,499 e. 2,500-2,999 f. 3,000-3,499  
g. 3,500-3,999 h. 4,000-4,999 i. 5,000-5,999 j. 6,000-6,999 h. More than 7,000.
20. **What did you like MOST about using Odyssey to improve your critical thinking? (4)**  
a. Can't see what other wrote until you've first submitted b. Anonymous c. Getting peer feedback  
d. Ability to critique your reviewers e. Having to rate the comments of your peers.
21. **What did you like the LEAST about using Odyssey to improve your critical thinking? (4)**  
a. Can't see what other wrote until you've first submitted b. Anonymous c. Getting peer feedback  
d. Ability to critique your reviewers e. Having to rate the comments of your peers.
22. **What kinds of challenges were most interesting?**
23. **Least interesting:**
24. **What kinds of challenges would you like (recommend for future classes)?**
25. **Critiques allow someone to contest a score they perceive as being unjust. Yet critiques are seldom used. What could be done to encourage their use in discussing such matters?**
26. **Most participants just do the minimum # of reviews required (2 reviews in this case). What could be done to encourage participants with low Odyssey power to submit additional reviews?**

---

### Appendix E: Teacher Assessment (C9)

1. **Have you taken a college statistics course?**  
\_\_\_ a. No (4) b. Yes (3)
  2. **Have you taught a college statistics course?**  
\_\_\_ a. No (3) b. Yes (4)
- Check the textbooks you have used: *None of the teachers had used any of these.*
3. \_\_\_ **Triola: Elementary Statistics or Essentials of Statistics.**
  4. \_\_\_ **Moore: The Basic Practice of Statistics, Introduction to the Basic Practice of Statistics.**
  5. \_\_\_ **Utts: Seeing Through Statistics or**
  6. \_\_\_ **Moore: Concepts and Controversies**
  7. \_\_\_ **Bennet, Briggs & Triola: Statistical Reasoning for Everyday Life**
8. **How different is this statistical literacy course from these college statistics courses?**  
\_\_\_ a. Don't know (1) b. no different b. slightly different (1) c. moderately different d. extremely different (5)
  9. **Have you taken a college quantitative reasoning or quantitative literacy course before?**  
\_\_\_ a. No (6) b. Yes (1)

10. **Have you taught a college quantitative reasoning (QR) or quantitative literacy (QL) course?**

\_\_\_ a. No (3) b. Yes (4)

Check the textbooks you have used: *None of the teachers had used any of these.*

11. \_\_\_ **Burger and Starbird: Heart of Mathematics**

12. \_\_\_ **Miller, Heeren and Hornsby: Mathematical Ideas**

13. \_\_\_ **COMAP: For All Practical Purposes: Mathematical Literacy**

14. \_\_\_ **Utts: Seeing Through Statistics or Mind on Statistics**

15. \_\_\_ **Bennet & Briggs: Using & Understanding Math: QR Approach**

16. \_\_\_ **Sevilla and Somers: QR: Tools for Today's Citizen**

17. **How different is this statistical literacy course from any of these college QR or QL courses?**

\_\_\_ a. Don't know (4) b. no different c. slightly different d. moderately different (1) e. extremely different (2)

**How important or valuable is taking this course for faculty intending to use this text?**

18. **What I thought before taking this course:**

\_\_\_ a. No value b. barely valuable c. somewhat valuable d. highly valuable (4) e. absolutely essential (3)

19. **What I think after taking this course:**

\_\_\_ a. No value b. barely valuable c. somewhat valuable (2) d. highly valuable (3) e. absolutely essential (2)

20. **This Statistical Literacy text covers important topics I haven't seen in other textbooks.**

\_\_\_ a. Strongly disagree (3) b. disagree (1) c. neutral (0) d. agree (2) e. strongly agree (1)

21. **How valuable is this statistical literacy course in improving students' critical thinking?**

\_\_\_ a. No value (0) b. barely valuable (1) c. somewhat valuable (4) d. Highly valuable (2)

22. **How likely are your students to need the skills from this course as citizens in a data world?**

\_\_\_ a. most unlikely b. somewhat unlikely c. Neutral d. Somewhat likely (2) e. Very likely (5)

23. **This Statistical Literacy course covers most of the basic skills I want my students to have.**

\_\_\_ a. Strongly disagree (1) b. disagree c. neutral (0) d. agree (3) e. strongly agree (3)

24. **Compare the amount of mathematics in this course with that in a college algebra course.**

\_\_\_ This course had: a. Much less (6) b. Somewhat less (1) c. Same d. Somewhat more e. Much more

25. **Compare the amount of mathematics in this course with that in a college statistics course.**

\_\_\_ This course had: a. Much less (4) b. Somewhat less (3) c. Same d. Somewhat more e. Much more

26. **Which course is most useful to math-phobic students in understanding numbers in everyday media?**

\_\_\_ a. high school algebra b. college algebra c. statistics d. Quantitative Reasoning (3) e. Statistical Literacy (3)

27. **Rate the use of and emphasis on math in this course relative to understanding numbers in the media.**

\_\_\_ a. totally inadequate b. somewhat inadequate c. Neutral d. Somewhat adequate (3) e. Very adequate (4)

28. **Compare the amount of English grammar in this course with that in a college English course:**

\_\_\_ This course had: a. Much less 1 b. Somewhat less 1 c. Same 1 d. Somewhat more (4) e. Much more (0)

29. **Rate the use of (emphasis on) ordinary English grammar in this course relative to understanding numbers in the media.**

\_\_\_ a. totally inadequate b. somewhat inadequate c. Neutral d. Somewhat adequate (3) e. Very adequate (4)

30. **This text is suitable as a reference text for a quantitative literacy course**

\_\_\_ a. Strongly disagree b. disagree (1) c. neutral d. agree (4) e. strongly agree (2)

31. **This text is suitable as the primary text for a quantitative literacy course**

\_\_\_ a. Strongly disagree (1) b. disagree (3) c. neutral (1) d. agree (2) e. strongly agree

32. **This text should definitely be considered as the primary text for a quantitative literacy course**

\_\_\_ a. Strongly disagree (1) b. disagree (2) c. neutral (2) d. agree (2) e. strongly agree

33. **Quotable recommendations on the textbook or the course.**

Here are introductions from the faculty who participated in the 2011 Online Statistical Literacy course. :

“My name is Sheri Bemis. I'm a Computer Science faculty member and the Quantitative Literacy Coordinator at Keene State College, in Keene, NH. I have taken and taught both summer and online courses. I'm taking this course so that I can improve my knowledge of quantitative literacy. I'm always excited and eager to share new information with both my colleagues and my students.”

“My name is Elli Caldwell and I am an instructor at Keene State College. I teach quantitative literacy through a course that looks at the impacts of humans on the environment. My interests include sustainability, group dynamics, leadership development and student empowerment. Through this course, I hope to gain a more nuanced understanding of statistical literacy (as opposed to simply statistics or math) and learn more effective ways of teaching this topic. I look forward to working with all of you!”

“I'm Mike Caulfield. I'm an instructional designer at Keene State College. I used to build online classes for a living, but this is the first one I've taken in a while. I taught a Quantitative Literacy class last semester, and will teach one this Fall.”

“[I am Kenneth Gauvreau.] I teach quantitative (statistical) literacy at Keene State College in Keene, NH, along with several others in this class. I teach a course in the summer (computer science) and up until last Thursday I thought it would not go since there was only one student enrolled. Much to my surprise as this week went on they trickled in one-by-one until I now have full enrollment (6), so I've been rather busy getting up to speed there. Therefore, I'm late to this party, but I will get caught up here also. I am taking this as I think it will help with my own instruction in the fall. I was a math major in college all those many, many years ago, but I have never been formerly taught how to think critically, and certainly have never been taught how to teach others to do it.”

“My name is Mike Goudzwaard and I teach a quantitative literacy course at Keene State College titled, Food Fight! In this course we explore the quantitative side of food on the systemic, community, and personal scales. I have used online learning platforms (Blackboard and Sakai) in courses I have taught and have taken full online courses myself. Through this course, I hope to gain a greater understanding of statistical literacy and learn new instruction methods to use in my own courses. I'm excited to work with you all this summer!”

“My name is Becca Hickam, and I am the Coordinator of Experiential Education at Keene State College. In addition, I am working on my PhD in Environmental Studies at Antioch University New England. I will be teaching a quantitative literacy course here at Keene State this fall on Health and Public Policy.”

“My name's Ned Pokras (pronounced rather like POKE russ), and I too am an IQL instructor at Keene State. Sorry I've been silent, but I've been a bit under the weather the past several days. Nothing serious, just seasonal allergies. I'm taking this course primarily as a refresher on some of the statistical concepts I deal with. Also, I've never been involved in online instruction before but am contemplating doing so online teaching, so this should help me see what it's like.”

“I'm Tamara Stenn a IQL adjunct professor at KSC. I teach from a journalism/critical thinking perspective with an emphasis on communications. I've done and taught online courses before. I hope to deepen the math proficiencies in my courses. I feel the students have a general overview of QL and data usage when they finish my course but do not have the depth in statistical analysis that I expect.”