Supplemental Materials

for

Students “Tackle” Quantitative Literacy in their Science Communication with Real-World Football Activity

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Appendix 1: Rubric used to evaluate scientific letters to a nonexpert, analysis of rubric-graded criteria for professional letter assessment for 2017 cohort (first submission and second submission after writing tutoring session), and examples of student work

Rubric Used to Evaluate Scientific Letters to a Non-expert:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight</th>
<th>Distinguished</th>
<th>Proficient</th>
<th>Introductory</th>
<th>Non-Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy of Calculations</td>
<td>25 %</td>
<td>All calculations are completed accurately given provided data.</td>
<td>2/3 of the calculations are completed accurately given provided data.</td>
<td>1/3 of the calculations are completed accurately given provided data.</td>
<td>No calculations are completed accurately.</td>
</tr>
<tr>
<td>Appropriate Research Evidence</td>
<td>25 %</td>
<td>All nutritional facts evidence is backed with appropriate scientific AND accurately cited sources.</td>
<td>2/3 of the nutritional facts evidence is backed with appropriate scientific AND accurately cited sources.</td>
<td>1/3 of the nutritional facts evidence is backed with appropriate scientific AND accurately cited sources.</td>
<td>No evidence is provided AND no accurately cited sources are presented.</td>
</tr>
<tr>
<td>Professionalism</td>
<td>25 %</td>
<td>Provides appropriate descriptions of evidence and prose for a letter, AND reads in complete sentences, AND reads with appropriate grammar.</td>
<td>Mostly provides appropriate descriptions of evidence and prose for a letter, AND reads in complete sentences, AND reads with appropriate grammar.</td>
<td>Letter contains several inappropriate descriptions of evidence, OR reads in incomplete sentences, OR reads with inappropriate grammar.</td>
<td>Letter contains several inappropriate descriptions of evidence AND reads in incomplete sentences AND reads with inappropriate grammar.</td>
</tr>
<tr>
<td>Readability for a Non-expert</td>
<td>25 %</td>
<td>Letter is jargon-free or effectively explains jargon AND effectively communicates the core scientific message.</td>
<td>Letter contains some jargon that is not explained OR sometimes ineffectively communicates the core scientific message.</td>
<td>Letter contains a lot of jargon that is not explained OR ineffectively communicates the core scientific message.</td>
<td>Letter contains a lot of jargon that is not explained AND ineffectively communicates the core scientific message.</td>
</tr>
</tbody>
</table>
Analysis of Rubric Graded Criteria for Professional Letter Assessment for 2017 Cohort First Submission and Second Submission after English Tutoring Session:

Analysis of First Submission 2017:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Distinguished</th>
<th>Proficient</th>
<th>Introductory</th>
<th>Non-Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy of Calculations</td>
<td>43%</td>
<td>14%</td>
<td>0%</td>
<td>43%</td>
</tr>
<tr>
<td>Appropriate Research Evidence</td>
<td>29%</td>
<td>14%</td>
<td>0%</td>
<td>57%</td>
</tr>
<tr>
<td>Professionalism</td>
<td>14%</td>
<td>14%</td>
<td>58%</td>
<td>14%</td>
</tr>
<tr>
<td>Readability for a Non-expert</td>
<td>0%</td>
<td>72%</td>
<td>14%</td>
<td>14%</td>
</tr>
</tbody>
</table>

Percentages describe fraction of groups that met the rubric requirements for a specific level of performance.

Analysis of Second Submission 2017:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Distinguished</th>
<th>Proficient</th>
<th>Introductory</th>
<th>Non-Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy of Calculations</td>
<td>43%</td>
<td>14%</td>
<td>0%</td>
<td>43%</td>
</tr>
<tr>
<td>Appropriate Research Evidence</td>
<td>57%</td>
<td>0%</td>
<td>0%</td>
<td>43%</td>
</tr>
<tr>
<td>Professionalism</td>
<td>72%</td>
<td>14%</td>
<td>14%</td>
<td>0%</td>
</tr>
<tr>
<td>Readability for a Non-expert</td>
<td>29%</td>
<td>71%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Percentages describe fraction of groups that met the rubric requirements for a specific level of performance.
Examples of Student Work:

Example 1:

August 30th, 2015

Dear [Name],

In your report, you stated that [Name] on average has 9000 calories a day in his diet, but to possibly achieve getting that number of calories he would have to eat 50 slices of bacon, 20 half chicken breasts and 13 Californian avocados. We have found a lot of inconsistencies in your work that will lead to a possible different number of calories consumed per day by this athlete if he were to eat as you state.

Your report leaves room for error. Nutrition and diets are specific. Serving size as well as portion size are not always universal, and different brands have different nutrition facts. There was never an instance in your report that designated the amount of calories to each product to total up to 6,000+ calories. You also did not specify how the food was prepared for the said diet or specify what kind of flavor add-ins could have been in the food. For example, say if the bacon was smoked or cured or what not, to be really nitpicky.

Our calculations contradict yours. Take the alone bacon for instance, according to Oscar Mayer the bacon would have contributed 1,100 calories alone. Then whenever the avocados and chicken breast are added in to the effect, the total calories consumed are less than 9000, to a grand total of 6,452 and ½ calories. Here is the math to prove so:

**Plain Uncooked Pork Bacon** (Oscar Mayer) – 4 Slices

- Fat (g) – 8 x 9kcal = 72 kcal
- Protein (g) – 4 x 4kcal = 16 kcal
- Carbohydrates (g) – 0 x 4 kcal = 0 kcal
- 88 kcal x 12.5 servings (4 slices per each serving) for 50 slices = 1,100 kcal

**Californian Avocado** (avacadocentral.com) - Per 1/5 an avocado

- 4.5 g fat 4.5g X 9kcal = 40.5 kcal
- 3g Carbohydrates 3g – 2g (grams of fiber) = 1gX4kcal = 4 kcal
- 0g Protein
- 40.5 + 4 = 44.5 kcal x 5 = 222.5 kcal per avocado
- 222.5x13 = 2,892.5 kcal for 13 avocados

½ **Plain Uncooked Chicken Breast**- (Tyson) – 4 oz

- Fat (g) – 3 x 9kcal = 27 kcal
- Protein (g) -24 x 4 kcal = 96 kcal
- Carbohydrates (g) - 0 x 4 kcal = 0 kcal
- 123 kcal x 20 half chicken breasts = 2,460 kcal for 20 half chicken breasts

1,100 + 2,892.5 + 2,460 = 6,452.5 kilo-calories

As you can see that after you add up each individual food item the amount of calories consumed are less than the reported number of 9,000 calories by 2,547.5 kilo calories. It would have been best to provide brand names and serving sizes in your report, to minimize the confusion in the athletes said diet.

Sincerely,

[Name]
Example 2:

Dear [Name],

As college students enrolled in a Human Nutrition class, my class and I have been learning over the past few weeks about Calories (or kilocalories) and how they are incorporated in foods. Your article, [article title], caught our attention because of the massive amount of energy one would get from eating that much. You also mentioned in your article that in order to consume that many calories, it would take 13 avocados, 50 slices of bacon, and 20 chicken breasts. As an assignment, we broke down each of these foods and determined the true amount of calories, and what we found may be surprising.

After breaking down each foods calories based on carbohydrate, protein, and fat content, we did not get an answer of anywhere close to 9000 calories.

Avocados (found from nutritiondata.self.com)

<table>
<thead>
<tr>
<th>Fat</th>
<th>Carbohydrates</th>
<th>Protein</th>
<th>Total Avocados</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 grams</td>
<td>4 grams</td>
<td>13</td>
<td>3809 kcal</td>
</tr>
</tbody>
</table>

Bacon (found at usda.gov)

<table>
<thead>
<tr>
<th>Fat</th>
<th>Protein</th>
<th>Carbohydrates</th>
<th>Total Bacon</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 grams</td>
<td>3 grams</td>
<td>0.1 grams</td>
<td>2105 kcal</td>
</tr>
</tbody>
</table>

Chicken Breast (found at myfitnesspal.com)

<table>
<thead>
<tr>
<th>Fat</th>
<th>Protein</th>
<th>Carbohydrates</th>
<th>Total Chicken Breast</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 gram</td>
<td>9 grams</td>
<td>4 grams</td>
<td>1220 kcal</td>
</tr>
</tbody>
</table>

Overall total of all foods = 7134 kcal

As you can see, these calculations provide evidence that [Name] would most likely need to eat 1866 more calories to reach his goal of a 9000 calorie day. We believe this discretion is due to a number of factors. The first is that there was no exact type of chicken, bacon, or avocados mentioned. There’s many types of all three of those foods and many ways it can be cooked or eaten that would change the amount of calories that would be in the item. The avocado could be smashed, pureed, or eaten in it’s entirely, depending on preference, for example. It’s also possible that things, such as condiments, were added to the food that would increase the calorie content. For example, if [Name] ate his chicken breast with a thin layer of barbeque sauce on it, that would add a significant number of calories. Other factors such as size and brand also would have an effect.

Of course, it would be difficult to get in to a lot of detail in a small article, especially since the readers probably wouldn’t be interested in the exact size of the avocado or the way in which a chicken should be cooked to get the most nutritional value of it, so it’s possible the article was precise after all under your calculations. The variation is just slightly confusing with so many possibilities out there.

Respectfully,

[Name]
Appendix 2: Cohort summative exam performance and examples of summative assessment questions

Cohort Summative Exam Performance:

<table>
<thead>
<tr>
<th></th>
<th>Cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative Problems Average % (Mean ± S.E.)</td>
<td>40.0 ± 8.7</td>
</tr>
<tr>
<td>Overall Exam Average % (Mean ± S.E.)</td>
<td>73.8 ± 2.4</td>
</tr>
<tr>
<td>Number of Students (N)</td>
<td>15</td>
</tr>
</tbody>
</table>

Sample Summative Exam Questions:

Question 1: A cheeseburger contains X kilocalories and Y grams of fat. Approximately what percentage of total energy is contributed by fat? (Where X and Y represent varied quantities.)

Students then calculate and select 1 from 4 Multiple Choice values which are provided as part of this question, one of which is the correct value.

Question 2: One cup of chocolate milk contains X grams of carbohydrate, Y grams of fat, and Z grams of protein. This cup of milk supplies ____________ kcal. (Where X, Y, and Z represent varied quantities.)

Students then calculate and submit their value in a free-response format.
Appendix 3: Survey questions and analysis, and student responses

Survey Questions and Analysis:

Appendix 3 Figure. Activity cohorts perceive value to activity. Post-summative assessment survey questions allowed students to reflect upon the perceived value of the described activity in preparation for the exam problems and in identification of the course learning outcomes. Respondents (N = 46) were given the above categories and asked to choose one that best fit their agreement with the question. Percentage of respondents for each category are presented.

Student Responses:

1. Students were asked to explain their response to “Would you agree that the ‘professional sports activity’ helped you prepare for the problem-based exam questions?”

Student Responses:

“It gave me practice and I was able to remember easily that way. I am a tactile learner so hands on learning is great for me.”

“It helped you learn about the nutrition labels.”

“The activities in class allowed me to apply my knowledge and practice.”
“I learn more with a variety of teaching techniques. All of us had to do it ourselves, but we were able to work together and figure out. It was more than just listening to a lecture.”

“The problems in class helped prepare me for the exam because I learn better by doing hands on. Being able to do the problems step by step and knowing the correct way helped me.”

“It gave me an example of the math problems on the test.”

“I believe it helped yes. More word problems like that would have helped as well.”

“It helped because we all had different perspectives, but after talking it through, we found the correct answers.”

“Yes, they did help because they made sure we knew what we were doing.”

“I think that this assignment works very well to help me how to calculate the amount of kcal.”

“It gave me more experience with calculating calories.”

“I definitely think that it helped me be able to understand how to calculate and read a nutrition label.”

“I think it was a good way to start learning the material and getting a feel for what the material was about through things we already knew a little about.”

“The group project made the kilocalorie calculations easier and was a great review for the test.”

“I never paid much attention to food labels before this class. It blows my mind as to some of the things that a food label actually tells you.”

“Yes because it gave me practice and an idea of how the test would be.”

“It helped me with the math portion of it.”

“It helped with destructing the food labels and calculating kcals.”

“It helped in some ways like the calculation side.”
2. Students were asked to explain their response to “Would you agree that the in class ‘professional sports activity’ helped you identify the major learning outcomes in the course?”

Student Responses:

“It allows me to have practice remembering things and memorizing information that might be important.”

“I wish we would've had more time with our groups.”

“The activity allowed me to understand what needed to be learned and receive direct feedback on how we were doing.”

“It gives me good examples of what the test will be like and gives me a better understanding of the material.”

“Especially with conversions on this test.”

“We had a better understanding of what the class was really about.”

“It always helps me to have peers and other people help me with assignments.”

“Yes, when I think back all activities I did that went along with the learning outcomes. I think I need to focus more in the learning outcomes for next exam.”

“I like working in groups and doing class work because it allows me to be able to ask questions that I might be confused about and learn things as I go along instead of just sitting on my computer and reading.”

“Yes I learn a lot better with interacting and group projects.”

“The in class activity also act as a refresher when it comes to things such as the tests and quizzes. I also believe that working hands on helps me learn the material more.”

“I like that in class we do many things in groups and things that help us get better understanding of the course.”

“The group activities I think help out more so than anything. Physically doing things and writing them out helps me remember the material better.”

“Personally I find group work helpful.”

“In groups you can share your ideas on something that is discussed in class.”