# Supplemental Material

*CBE—Life Sciences Education*

Aikens and Kulacki

**SUPPLEMENTAL MATERIALS**

Building Self-efficacy for Quantitative Biology Problems through Collaborative Group Work

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## TABLE OF CONTENTS

**Survey Items Analyzed**

Pre-Survey Items for Hardy-Weinberg Equilibrium…….....S2

Post-Survey Items for Hardy-Weinberg Equilibrium ……..S3

Pre-Survey Items for Population Growth…….....S4

Post-Survey Items for Population Growth……S5

**Table S1.** Pre- and Post-Survey Mean Self-efficacy Scores……S6

**Table S2.** Pre- and Post-Survey Mean Self-efficacy Scores by Gender/Sex.……..S6

**Table S3.** Output from Generalized Linear Models for *Accomplishing It*……...S7

**Table S4.** Output from Generalized Linear Models for *Getting Help from Peers*……...S9

**Table S5.** Output from Generalized Linear Models for *Confirming Their Answers*……..S11

*Hardy-Weinberg Equilibrium Pre-Survey Items*

Please consider the following problem about Hardy-Weinberg Equilibrium. **You <u>do not</u> have to solve it**.

A gene has two alleles: A and B. The number of individuals in a population with each genotype is shown in the table to the right.

| AA | AB | BB |
|---|---|---|
| 42 | 96 | 62 |

Please rate your confidence (circle the number) in your ability to successfully do the following:

| | Not at all confident | A little confident | Fairly confident | Very confident | Completely confident |
|---|---|---|---|---|---|
| Calculate the predicted number of individuals of each genotype under the conditions of Hardy-Weinberg Equilibrium. | **1** | **2** | **3** | **4** | **5** |
| Justify whether the population is evolving or not using the Hardy-Weinberg Equilibrium model. | **1** | **2** | **3** | **4** | **5** |

*Hardy-Weinberg Equilibrium Post-Survey Items*

Please consider the following problem about Hardy-Weinberg Equilibrium. **You <u>do not</u> have to solve it**.

A gene has two alleles: A and B. The number of individuals in a population with each genotype is shown in the table to the right.

| AA | AB | BB |
|---|---|---|
| 42 | 96 | 62 |

Please rate your confidence (circle the number) in your ability to successfully do the following:

| | Not at all confident | A little confident | Fairly confident | Very confident | Completely confident |
|---|---|---|---|---|---|
| Calculate the predicted number of individuals of each genotype under the conditions of Hardy-Weinberg Equilibrium. | **1** | **2** | **3** | **4** | **5** |
| Justify whether the population is evolving or not using the Hardy-Weinberg Equilibrium model. | **1** | **2** | **3** | **4** | **5** |

Describe any experiences and/or interactions during group work today that **<u>increased</u>** your confidence in your ability to calculate the predicted number of individuals of each genotype under the conditions of Hardy-Weinberg Equilibrium.

Describe any experiences and/or interactions during group work today that **<u>increased</u>** your confidence in your ability to justify whether the population is evolving or not using the Hardy-Weinberg Equilibrium model.

*Population Growth Pre-Survey Items*

Please consider the following problem about population growth. **You <u>do not</u> have to solve it**.

Cod is an economically important fish species in the fishing industry. Unfortunately, overfishing has depleted cod populations in some areas. A group of fisheries biologists is monitoring one particular cod population that is currently closed to fishing. The biologists estimated that the population size at the beginning of 2019 was 150 cod. Over the course of the year, they recorded 240 births and 60 deaths in the population. Assume the per capita population growth rate is the same every year, the carrying capacity of the population is 1000 cod, and the population can be modeled with the logistic growth model:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

The fisheries biologists have agreed to re-open the population for fishing once the population surpasses its maximum growth rate. Will the population size in 2022 be large enough to allow fishing?

Please rate your confidence (circle the number) in your ability to successfully do the following:

| | Not at all confident | A little confident | Fairly confident | Very confident | Completely confident |
|---|---|---|---|---|---|
| Predict the population size in the year 2022 | **1** | **2** | **3** | **4** | **5** |

*Population Growth Post-Survey Items*

Please consider the following problem about population growth. **You <u>do not</u> have to solve it**.

Cod is an economically important fish species in the fishing industry. Unfortunately, overfishing has depleted cod populations in some areas. A group of fisheries biologists is monitoring one particular cod population that is currently closed to fishing. The biologists estimated that the population size at the beginning of 2019 was 150 cod. Over the course of the year, they recorded 240 births and 60 deaths in the population. Assume the per capita population growth rate is the same every year, the carrying capacity of the population is 1000 cod, and the population can be modeled with the logistic growth model:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

The fisheries biologists have agreed to re-open the population for fishing once the population surpasses its maximum growth rate. Will the population size in 2022 be large enough to allow fishing?

Please rate your confidence (circle the number) in your ability to successfully do the following:

| | Not at all confident | A little confident | Fairly confident | Very confident | Completely confident |
|---|---|---|---|---|---|
| Predict the population size in the year 2022 | **1** | **2** | **3** | **4** | **5** |

Describe any experiences and/or interactions during group work today that **<u>increased</u>** your confidence in your ability to predict the population size in the year 2022.

**Table S1.** Means (± SD) for students' self-reported self-efficacy before (pre-survey) and after (post-survey) completing the quantitative biology group work assignment. The rating scales ranged from 1 (not at all confident) to 5 (completely confident).

| | Course Section A | | Course Section B | | Overall |
|---|---|---|---|---|---|
| | HWE | PG | HWE | PG | |
| Pre-Survey | 3.40 (1.07) | 2.99 (1.02) | 3.21 (1.10) | 2.72 (1.13) | 3.10 (1.11) |
| Post-Survey | 3.97 (0.92) | 3.40 (1.00) | 3.80 (0.87) | 3.25 (0.97) | 3.62 (1.00) |

**Table S2.** Means (± SD) by gender/sex for students' self-reported self-efficacy before (pre-survey) and after (post-survey) completing the quantitative biology group work assignment. The rating scales ranged from 1 (not at all confident) to 5 (completely confident). Means are not reported for students with other genders due to small sample sizes (< 10 students) which would impact the confidentiality of data.

| | Female Students | Male Students |
|---|---|---|
| Pre-Survey | 2.97 (1.06) | 3.40 (1.15) |
| Post-Survey | 3.50 (0.97) | 3.89 (1.01) |

**Table S3.** Output for the three generalized linear models with *accomplishing it* as the response variable: with gender/sex as the lone predictor, initial self-efficacy and gender/sex as predictors, and with an interaction term between initial self-efficacy and gender/sex as a predictor. Output includes unstandardized regression coefficients (*B*), standard error of the regression coefficient (SE), p-value, and odds-ratio.

| | ***B*** | **SE** | ***p*-value** | **Odds ratio ($e^B$)** |
|---|---|---|---|---|
| **Gender/Sex** | | | | |
| Intercept | -1.04 | 0.27 | <0.001 | 0.36 |
| Gender/Sex - Female | -0.30 | 0.26 | 0.25 | 0.74 |
| Question Type - PG | -0.02 | 0.24 | 0.93 | 0.98 |
| Course Section - B | 0.93 | 0.27 | <0.001 | 2.55 |
| Marginal $R^2$: 0.04<br>Conditional $R^2$: 0.15 | | | | |
| **Initial Self-efficacy + Gender/Sex** | | | | |
| Intercept | -2.48 | 0.55 | < 0.001 | 0.08 |
| Initial Self-efficacy | 0.39 | 0.12 | 0.001 | 1.48 |
| Gender/Sex - Female | -0.15 | 0.26 | 0.56 | 0.86 |
| Question Type - PG | 0.14 | 0.24 | 0.56 | 1.15 |
| Course Section - B | 1.03 | 0.27 | <0.001 | 2.81 |
| Marginal $R^2$: 0.07<br>Conditional $R^2$: 0.16 | | | | |
| **Initial Self-efficacy*Gender/Sex** | | | | |
| Intercept | -1.99 | 0.74 | 0.007 | 0.14 |
| Initial Self-efficacy | 0.25 | 0.19 | 0.20 | 1.28 |
| Gender/Sex - Female | -0.89 | 0.83 | 0.28 | 0.41 |
| Initial Self-efficacy*Gender/Sex | 0.22 | 0.24 | 0.35 | 1.25 |
| Question Type - PG | 0.16 | 0.25 | 0.52 | 1.17 |
| Course Section - B | 1.04 | 0.27 | <0.001 | 2.82 |

| | ***B*** | **SE** | ***p*-value** | **Odds ratio ($e^B$)** |
|---|---|---|---|---|
| Marginal $R^2$: 0.07 | | | | |
| Conditional $R^2$: 0.17 | | | | |

**Table S4.** Output for the three generalized linear models with *getting help from peers* as the response variable: with gender/sex as the lone predictor, with initial self-efficacy and gender/sex as predictors, and with an interaction term between initial self-efficacy and gender/sex as a predictor. Output includes unstandardized regression coefficients (*B*), standard error of the regression coefficient (SE), p-value, and odds-ratio.

| | ***B*** | **SE** | ***p*-value** | **Odds ratio ($e^B$)** |
|---|---|---|---|---|
| **Gender/Sex** | | | | |
| Intercept | -0.45 | 0.26 | 0.09 | 0.64 |
| Gender/Sex - Female | 0.62 | 0.28 | 0.03 | 1.87 |
| Question Type - PG | 0.42 | 0.24 | 0.08 | 1.52 |
| Course Section - B | -0.86 | 0.29 | 0.003 | 0.42 |
| Marginal $R^2$: 0.05<br>Conditional $R^2$: 0.24 | | | | |
| **Initial Self-efficacy + Gender/Sex** | | | | |
| Intercept | 1.18 | 0.52 | 0.02 | 3.27 |
| Initial Self-efficacy | -0.45 | 0.13 | <0.001 | 0.64 |
| Gender/Sex - Female | 0.47 | 0.28 | 0.10 | 1.59 |
| Question Type - PG | 0.23 | 0.24 | 0.34 | 1.26 |
| Course Section - B | -0.97 | 0.29 | <0.001 | 0.38 |
| Marginal $R^2$: 0.09<br>Conditional $R^2$: 0.26 | | | | |
| **Initial Self-efficacy*Gender/Sex** | | | | |
| Intercept | 2.23 | 0.82 | 0.007 | 9.27 |
| Initial Self-efficacy | -0.77 | 0.23 | <0.001 | 0.46 |
| Gender/Sex - Female | -1.00 | 0.89 | 0.26 | 0.37 |
| Initial Self-efficacy*Gender/Sex | 0.46 | 0.26 | 0.08 | 1.58 |
| Question Type - PG | 0.26 | 0.25 | 0.30 | 1.29 |
| Course Section - B | -0.98 | 0.29 | <0.001 | 0.37 |

| | $B$ | SE | $p$-value | Odds ratio ($e^B$) |
|---|---|---|---|---|
| Marginal $R^2$: 0.10 | | | | |
| Conditional $R^2$: 0.28 | | | | |

**Table S5.** Output for the two generalized linear models with *confirming their answers* as the response variable: with gender/sex as the lone predictor and with initial self-efficacy and gender/sex as predictors. The model with an interaction term between initial self-efficacy and gender/sex as a predictor did not converge. Output includes unstandardized regression coefficients (*B*), standard error of the regression coefficient (SE), p-value, and odds-ratio.

| | ***B*** | **SE** | ***p*-value** | **Odds ratio ($e^B$)** |
|---|---|---|---|---|
| **Gender/Sex** | | | | |
| Intercept | -7.98 | 1.04 | <0.001 | 0.0003 |
| Gender/Sex - Female | -0.40 | 1.17 | 0.74 | 0.67 |
| Question Type - PG | -6.05 | 0.98 | <0.001 | 0.002 |
| Course Section - B | -0.78 | 1.47 | 0.60 | 0.46 |
| Marginal $R^2$: $3.04 \times 10^{-9}$<br>Conditional $R^2$: $6.67 \times 10^{-8}$ | | | | |
| **Initial Self-efficacy + Gender/Sex** | | | | |
| Intercept | -11.48 | 2.45 | <0.001 | 0.00001 |
| Initial Self-efficacy | 0.85 | 0.51 | 0.10 | 2.33 |
| Gender/Sex - Female | -0.08 | 1.27 | 0.95 | 0.92 |
| Question Type - PG | -5.78 | 0.96 | < 0.001 | 0.003 |
| Course Section - B | -0.64 | 1.53 | 0.68 | 0.53 |
| Marginal $R^2$: $3.38 \times 10^{-9}$<br>Conditional $R^2$: $7.46 \times 10^{-8}$ | | | | |