Facilitating Experiential Learning in a Large Introductory Food Science Course
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ABSTRACT
Experiential learning activities are often viewed as impractical, and potentially unfeasible, instructional tools to use in a large class. Research has shown, though, that the metacognitive skills that students utilize while participating in experiential learning activities enable students to assess their true level of understanding and mastery for the subject matter. The objective of this study was to evaluate whether students in a large (643 person) Introduction to Food Science and Human Nutrition (FSHN 101) course improved their understanding of dietary intake and food safety after participating in two experiential learning activities developed for these course topics. The first activity, completed during class, asked students to select one day’s worth of food from a list of menu choices, calculate the nutritional value of their food choices, and then compare their daily nutritional intake to the dietary reference intakes for their gender, age category and health status. The second activity, completed via the course website, asked students to complete a food safety survey prior to the commencement of the course’s food microbiology section to assess the students personal food safety behaviors and a second survey upon completion of the section to assess students knowledge of recommended food safety practices. Students were asked to evaluate both the cognitive and affective aspects of the experiential learning activities by completing a reflective questionnaire after participating in each activity. Overall, students’ responses revealed that the activities were effective learning tools and that the students liked engaging with the material on a personal application level.

INTRODUCTION
Experiential learning can be broadly defined as the process by which a learner creates meaning from direct experience. David Kolb’s (Kolb and Fry 1975; Kolb 1984) experiential learning model suggests that most adults utilize a four stage cyclical process to learn new information (e.g., about new subject matter). Though Kolb and Fry (1975) suggest that the cyclical learning process can begin at any one of the four stages, the learning process often begins with the “Concrete Experience” stage, followed by the “Reflective Observation” stage, and then finally the “Abstract Conceptualization” stage. By including experiential learning activities in the classroom and curriculum, students are able to participate in the stages outlined by Kolb, solidifying their comprehension of the subject matter (Cano, 2005).

Thus, the objectives of this study were to: 1) create and implement two experiential learning activities in our introductory, large enrollment course, Introduction to Food Science and Human Nutrition (FSHN 101), for dietary intake and food safety course topics and 2) to evaluate their cognitive and affective impact on student learning. The first activity, completed during class, asked students to select one day’s worth of food from a list of menu choices, calculate the nutritional value of their food choices, and then compare their daily nutritional intake to the dietary reference intakes for their gender, age category and health status. The second activity, completed via the course website, asked students to complete a food safety survey that assessed the students personal food safety behaviors prior to the commencement of the course’s food microbiology section. After completing both activities, the students were asked to evaluate both the cognitive (did it help students learn) and affective (did they like it) aspects of the experiential learning activities by completing a reflective questionnaire after participating in each activity.

MATERIALS AND METHODS
FSHN 101 is a large (643 student) lecture course that introduces students to the basic concepts of food science and human nutrition. The course is divided into four sections throughout the semester: nutrition and health; food composition and chemistry; food microbiology and processing; and food laws, quality, and the consumer. Experiential learning activities were created for the first (nutrition and health) and the third (food microbiology and processing) sections. Both experiential learning activities were approved by the University of Illinois, Urbana-Champaign Institutional Review Board (IRB). Students were required to complete the assignment to earn credit, however, participation in the study was voluntary and their grade was not impacted if they chose not to participate in the study.

Table 1. The meal choice worksheet.

<table>
<thead>
<tr>
<th>CHOICE 1</th>
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<tbody>
<tr>
<td>1.5C raisin bran 6oz. cottage cheese with fruit</td>
<td>1C steamed brown rice garden salad (with shredded cheese, croutons, clementine, Fuji apple)</td>
<td>16 oz. apple juice fuji apple 1C 1% milk</td>
<td>1/2C fudgy brownie 1/2C milk water roll and low-cal dressing</td>
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<tr>
<td>2 oz. bagel 1.5C cream cheese</td>
<td>1.5C frosted flakes 6 oz yogurt steamed vegetable medley</td>
<td>1.5C frosted flakes 6 oz yogurt</td>
<td>1.5C frosted flakes 6 oz yogurt 1C 1% milk 1% fat cheese peanut butter 1C apple 1C milk 1/2C fresh fruit 1/2C milk</td>
</tr>
<tr>
<td>Dinner</td>
<td>Dinner</td>
<td>Dinner</td>
<td>Dinner</td>
</tr>
<tr>
<td>1C tomato soup with shrimp</td>
<td>6 oz. apple juice 1C milk</td>
<td>1C tomato soup with shrimp</td>
<td>1C tomato soup with shrimp</td>
</tr>
<tr>
<td>2 oz. cheddar cheese 1C garden salad (with shredded cheese, croutons, clementine, Fuji apple) 2 oz. whole grain bread</td>
<td>1C soy milk 1C vanilla instant pudding 1/2C milk</td>
<td>1C soy milk 1C vanilla instant pudding 1/2C milk 1/2C french dressing</td>
<td>1C soy milk 1C vanilla instant pudding 1/2C milk 1/2C french dressing</td>
</tr>
<tr>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
</tr>
<tr>
<td>6 oz. beef pot roast 1/2C mashed potatoes 1C mixed vegetables</td>
<td>6 oz. beef pot roast 1/2C mashed potatoes 1C mixed vegetables</td>
<td>6 oz. beef pot roast 1/2C mashed potatoes 1C mixed vegetables</td>
<td>6 oz. beef pot roast 1/2C mashed potatoes 1C mixed vegetables</td>
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<tr>
<td>Snack</td>
<td>Snack</td>
<td>Snack</td>
<td>Snack</td>
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<tr>
<td>1 C Wonder bread, 3 oz deli turkey, 1 oz topped with 6 oz of grilled chicken and low-cal dressing</td>
<td>1C Wonder bread, 3 oz deli turkey, 1 oz topped with 6 oz of grilled chicken and low-cal dressing</td>
<td>1C Wonder bread, 3 oz deli turkey, 1 oz topped with 6 oz of grilled chicken and low-cal dressing</td>
<td>1C Wonder bread, 3 oz deli turkey, 1 oz topped with 6 oz of grilled chicken and low-cal dressing</td>
</tr>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Students were instructed to print off the worksheet prior to this class period. At the start of the class, students were instructed to complete a table which highlighted the kcals, fat (g), carbohydrates (g), and full calorie dressing information and cost for each meal (Table 2). They were then asked to reflect on their notes that covered nutritional adequacy, macronutrient requirements, Food Guide Pyramid, and the food label, and identify what their nutritional needs were for their age, gender, and health status. Once they had identified their nutritional needs from the Dietary Reference Intake Tables and their notes, they began to fill in a second table (Table 3). After completing Table 3, the students were asked to consider their meal choices that most closely resembled their own daily meal choices (from any of the categories). They were then given a packet questionnaire. On the first page, the nutritional information and cost for each breakfast, lunch, dinner, and snack was provided. On the second page, students were first instructed to complete a table which highlighted the kcals, fat (g), carbohydrates (g) protein (g) cholesterol (mg) sodium (mg) fiber (g) and cost of each meal (Table 2). They were then asked to reflect on their notes that covered nutritional adequacy, macronutrient requirements, macronutrients requirements, nutrients digestion and absorption; Dietary Guidelines for Americans; the Food Guide Pyramid, and the food label, and identify what their nutritional needs were for their age, gender, and health status. Once they had identified their nutritional needs from the Dietary Reference Intake Tables and their notes, they began to fill in a second table (Table 3). After completing Table 3, the students were asked to consider their meal choices by completing a reflective questionnaire. The activity was worth ten points and the students were required to be in-class in order to complete the activity and earn the points.

Food microbiology and processing experiential learning activity – food safety
The second experiential learning activity was a two-part activity that primarily occurred outside of the classroom. Prior to the start of the third section, food microbiology and processing, students were asked to complete a food safety survey (Figure 1) that asked them about their own routine food safety behaviors. After the lectures on bacteria, yeasts, and molds; food fermentation; biotechnology; and foodborne illnesses were completed, students were asked to complete the second part of the activity. For those students who attended class, a complete explanation of the ‘correct’ answers to the survey was provided during one of the regular class periods in an attempt to educate the students about which behaviors were the right behaviors and why it is important for them to know these behaviors. For those students who did not attend class, a written explanation of the correct answers was posted on the course website. After the students either listened to or read the explanations, they were asked to complete a reflective questionnaire that asked them to consider their behaviors, and how they differed from the correct behaviors, and how they will change their behaviors in the future. The second part of the activity was also worth five points.
Hand-washing procedures

3% 2% 3%

1. The temperature of my home refrigerator is closest to:
   a. 50 °F
   b. 40 °F
   c. 32 °F
   d. I don't know; I've never measured it.

2. Which of the following best describes your average hand washing practices?
   a. Rinse hands under running water for a few seconds, but sometimes I don't wash my hands at all.
   b. Rub hands with a waterless sanitizer.
   c. Wash hands with soap and hot water.
   d. I often wash my hands but not with soap and hot water.

3. If you are washing hands but not with soap and hot water, do you intending to:
   a. Wash hands with soap and hot water.
   b. Rub hands with a waterless sanitizer.
   c. Not wash hands at all.
   d. Wash hands with soap and hot water, but only if necessary.

4. How often do you change your kitchen hand towel?
   a. Every day
   b. Every other day
   c. Once a week
   d. Once a month

5. I clean my kitchen counters and other surfaces that come in contact with food using:
   a. A sponge and detergent
   b. A disinfectant spray
   c. Hot water and soap, then bleach solution
   d. Paper towels

6. I feel safe eating most foods because the bacteria that cause food borne illness also cause the food to look or taste bad.
   a. True
   b. False

7. I often make homemade meat/meat substitutes (e.g., hamburgers, hot dogs, meatballs) and store them in the original package in the freezer or refrigerator. I do this because:
   a. I have learned that this is best practice.
   b. It is easier to store them this way.
   c. I am not sure if it is safe to store them this way.

8. Which of the following best describes your fresh fruit or vegetable preparation practice?
   a. Wash only the unwrapped or unbagged fresh fruits and vegetables before I consume them.
   b. Wash all fresh fruits and vegetables before I consume them.
   c. Reheat the food to 165°F and test it using a metal stem probe thermometer.
   d. Cool the food on the counter for several hours before refrigerating.

9. On average, how frequently do you change your kitchen hand towel?
   a. Every day
   b. Every other day
   c. Once a week
   d. Once a month

10. What is the primary reason that you change your kitchen hand towel?
    a. To avoid spreading germs
    b. To remove dirt or stains
    c. To keep it fresh
    d. To prevent it from becoming too slippery

11. I wash my hands before:
    a. Eating
    b. Using the restroom
    c. Playing outside
    d. Touching food

12. The list that you made using the above categories is an example of:
    a. Categorization
    b. Cause and effect
    c. Sequence
    d. Comparison

13. The list that you made using the above categories is an example of:
    a. Categorization
    b. Cause and effect
    c. Sequence
    d. Comparison

Reflective questionnaire assessments

The reflective questionnaires for both experimental learning activities were assessed after the semester was completed and the grades for all of the students were submitted. Specific questions were evaluated in each reflection. For the dietary intake activity, 1) “How did this in-class activity help you learn the course material?” and 2) “Did you like participating in this activity? Why or why not?” were categorized and tabulated. For the food safety activity, 1) “Did being asked to reflect on your own personal food safety behavior at the beginning of the food microbiology and processing section (via the pre-quiz you did on Illinois Compass): a. Engage you in learning the course material? If yes, how? If not, why not?” and 2) “Assist you in learning the course material? If not, why not?” and 2) “Based on the food safety behavior survey, are there any food safety behaviors you are considering changing? If so, why and what are they?” were categorized and tabulated.

RESULTS AND DISCUSSION

Five and sixty-seven percent of students participated in the dietary intake experimental learning activity. Each reflective questionnaire was read and categorized based on the actual student responses. In response to the question “How did this in-class activity help you learn the course material?” student answers fell into one of eight categories (see the legend in Figure 2). Figure 2 provides the graphical breakdown of the responses. In total, 97% of the students acknowledged that this assignment helped them learn at least one aspect of the course material (the remaining 3% did not feel that the assignment helped them learn the material). Specifically, 53% of the students stated that this assignment helped them learn how to do the nutritional calculation (36%), use the DRI tables (15%), or read the nutritional labels (2%). Thus, this activity provided the students with another opportunity to ask questions and practice the concepts that are typically the most difficult concepts to grasp each semester. Twenty-five percent asserted that the assignment allowed them to apply the material to his/her own life, exemplifying the second stage (“reflective observation”) of Kolb’s experiential learning model. Fifteen percent noted that the assignment provided them with more opportunity to interact with all of the material covered in behavior changes were common among most of the students that completed the survey, including 15% of the students who intended to change their behavior.

In response to the second reflective question item “Did you like participating in this activity? Why or why not?” 484 students (85%) reported that they enjoyed participating in the activity. Many students appreciated that they were able to apply the course content to themselves. Select responses from students are shown in Table 4.

Food microbiology and processing experimental learning activity – food safety survey

Of the 451 students that participated in the reflection assignment that accompanied the food safety behavior survey, 348 (77%) of them said that it both engaged and assisted them in learning the course material. Actual comments such as “It provided a direct relationship to the material. It provided everyday examples which made the information easier to remember.” “The information has been reinforced. We learned on the survey and also in the lecture, so doing the survey really made the information hit home.” and “It peaked my interest in terms of whether or not I was engaging in food safety measures. Everything discussed in class gave me good guidelines for how to prepare food which engaged me” were positive comments made by students about the assignment.

With regard to the questions “Based on the food safety behavior survey, are there any food safety behaviors you are considering changing? If so, why and what are they?” changes occurred among most of the students that completed the survey (see the legend in Figure 3). Figure 3 provides the graphical breakdown of the student responses, with 95% of the students identifying at least one key food safety behaviors they intend to change. Students have casually recognized their own food safety behavior inadequacies in past semesters, however, by asking them to identify which food safety behaviors they intend to change, students were required to specifically reflect on their own behaviors in order to suggest a change. This assignment allowed students to complete each stage of Kolb’s experiential learning process, starting with the “concrete experience” (the survey) and ending with “active experimentation” (their food safety behavior changes indicated in Figure 3).

Instructional team reflections

Experiential learning activities can, and definitely should, be utilized in large-enrollment, introductory courses. A considerable amount of time and effort must be expended when creating an activity for a large classroom in order for it to be an effective and impactful as possible. For example, care must be taken when deciding upon worksheet appearance and reflective assignment word selection. Ensuring that students have understood how to use any supplemental materials required for the activity is also essential. In addition, this instructional team had the advantage of being able to audition both activities during a concurrent, smaller-enrollment class. Presenting the activities to a smaller audience and asking for their feedback about the effectiveness of the activity prior to presenting it to the large class enabled the instructional team to eliminate many potential issues that would have frustrated students and impacted their participation.

CONCLUSIONS

The student responses that were collected and evaluated, students find experimental learning activities quite helpful when learning new subject matter, and although the idea of utilizing experiential learning activities in a large, lecture-style class is often neglected, they have proven to benefit students in a large introductory food science and human nutrition course. A considerable amount of effort must be given to create a valuable activity, especially when it is created for a large-enrollment course, however, the educational assistance it provides the student far outweighs the effort. By including experiential learning activities into the large classroom, students are able to personalize their learning experiences, an advantage that is often impossible in a lecture-style course and, in turn, improves their comprehension of the course material.

REFERENCES
