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Implementing Experiential Learning Activities in a Large Enrollment Introductory Food Science and Human Nutrition Course

Dawn M. Bohn and Shelly J. Schmidt

ABSTRACT: Experiential learning activities are often viewed as impractical, and potentially unfeasible, instructional tools to employ in a large enrollment course. Research has shown, though, that the metacognitive skills that students utilize while participating in experiential learning activities enable them to assess their true level of understanding and mastery of the subject matter. The objectives of this study were to (1) create and implement 2 experiential learning activities in our introductory, large enrollment course and (2) evaluate their cognitive and affective impact on student learning. For the 1st activity, completed in class during the nutrition and health section, the instructional team asked the students to complete a dietary intake assessment. For the 2nd activity, completed via the course website, the instructional team asked the students to complete a food safety survey prior to the commencement of the food microbiology and processing section to assess the students' own personal food safety behaviors. The 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. The majority of the students that participated in the experiential learning activities reported that the activities helped them learn the course material (97% for the dietary intake activity and 77% for the food safety activity) and that they liked participating in the activity (85% for the dietary intake activity) or were engaged by the activity (77% for the food safety activity). These results indicate that experiential learning activities can be successfully created for and implemented in large enrollment courses.

Introduction

Experiential learning can be broadly defined as the process by which a learner creates meaning from direct experience.[1] As implemented within the context of a classroom setting, we more specifically define experiential learning as occurring when students participate in a contrived "real life" activity, reflect upon that activity, use their critical analysis skills to derive useful knowledge, meaning, and insight from the experience, and then incorporate their new understandings into their daily lives.

David Kolb's (Kolb and Fry 1975; Kolb 1984) experiential learning model suggests that most adults utilize a 4-stage cyclical process to learn new information (for example, about new subject matter). Though Kolb and Fry (1975) suggest that the cyclical learning process can begin at any one of the 4 stages, the learning process often begins with the "Concrete Experience" stage, in which learners participate in an actual experience that is critical to the subject matter. In the next stage, "Reflective Observation," the learner personalizes the experience by reflecting on it and relating it to their own life. This stage is followed by the "Active Conceptualization" stage, during which the learner attempts to integrate the experience into a theory that he/she can relate to, and then finally the "Active Experimentation" stage, during which the learner assesses the theory in different situations. Depending on the results of the "Active Experimentation" stage, the process may start again with the "Reflective Observation" stage. By including experiential learning activities in the classroom, students are able to participate in the stages outlined by Kolb, solidifying their comprehension of the subject matter (Cano 2005).

Research has shown that the metacognitive skills that students utilize while participating in experiential learning activities enable them to assess their true level of understanding and mastery for the subject matter (Flavell 1973; Brown 1975; NRC 2000). Incorporating experiential learning activities into the classroom has also been shown to improve student grades by as much as 8.6% in an introductory food science course (Reitmeier 2000), to improve student attitudes toward challenging material in a nursing curriculum (Pugsley and Clayton 2003), and to help students' motivation by placing learning in a real-world context and showing them how the knowledge they are being presented with can be applied to their lives (Briers 2005). In addition, Luckner and Nadler (2002) identified a number of other benefits of including experiential

MS 20070477 Submitted 6/21/2007, Accepted 9/19/2007. Author Bohn is with Univ. of Illinois at Urbana, Champaign, 539 Bevier Hall, 905 South Goodwin Ave., Urbana, IL 61820, U.S.A. Author Schmidt is with Univ. of Illinois at Urbana, Champaign, 367 Bevier Hall, 905 South Goodwin Ave., Urbana, IL 61820, U.S.A. Direct inquiries to author Bohn (E-mail: dbrehart@uiuc.edu).

[1] A large and varied number of definitions and contexts for experiential learning exist. The broad and classroom setting definitions given in the text were influenced by Luckner and Nadler (1997) and Smith (2001).

learning in a classroom, the most significant ones for a large enrollment course being relationship building, safe risk taking, and fun.

Because of the use of real-life experiences, experiential learning activities are often viewed as impractical, and potentially unfeasible, instructional tools to employ in a large enrollment course. However, the reported benefits of using experiential learning in smaller classroom settings mentioned previously strongly suggest the need for determining how to develop and implement "do-able" experiential learning activities for the large enrollment classroom. Given the special dynamics present in a large enrollment course,[2] the development and adaptation of experiential learning activities for the large enrollment course could result in an end product that is considerably, and perhaps fundamentally, different from that able to be implemented in a small enrollment course. However, the large enrollment version of the experiential learning activity could still yield similar benefits.

Thus, the objectives of this study were to (1) create and implement 2 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. For the 1st activity, completed in class during the nutrition and health section, the instructional team asked students to select 1 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. For the 2nd activity, completed via the course website, the instructional team 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 and processing section. After participating in each experiential learning activity, the students were asked to evaluate both the cognitive (did it help them learn) and affective (did they like it or did it engage them) aspects of each activity by completing a reflective questionnaire.

Materials and Methods

FSHN 101 is a large enrollment (643 student) lecture course that meets for three 50-min sessions per week and has an instructional team composed of 1 full-time instructor, one 40% time teaching assistant, and one 30% time teaching assistant. During the spring semesters, the course fulfills both a Campus and Liberal Arts and Sciences General Education course in the Natural Sciences and Technology, Physical Sciences area; thus the majority of the students are not majoring in one of the options offered through the Food Science and Human Nutrition (FSHN) department (for example, during the Spring 2007 semester, 3 of the 643 students were majoring in one of the FSHN disciplines and 1 student was minoring in one of the FSHN disciplines). In addition, the students enrolled in the course ranged from 1st-y students through seniors. The course introduces students to the basic concepts of food science and human nutrition. The course is divided into 4 content sections: 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 1st (nutrition and health) and the 3rd (food microbiology and processing) sections. Based on the development and class time required for each activity, the instructional team decided that it was best to concentrate on developing and implementing experiential learning activities for only 2 of the 4 content sections during the 1st semester that experiential learning activities were being introduced into the class. The Univ. of Illinois, Urbana-Champaign Institutional Review Board (IRB) approved studying the effectiveness of both experiential learning activities in FSHN 101 for the Spring 2007 semester. The students were required to complete both activities for course credit; however, participation in the study was voluntary and there was no impact on their grade if they chose not to participate in the study.

Nutrition and health experiential learning activity—dietary intake assessment

In the 1st experiential learning activity, the students participated in a basic dietary intake assessment activity that occurred during a regularly scheduled 50-min class period. A worksheet with 4 different menu selections for breakfast, lunch, dinner, and snack (Table 1) was posted on the course website. The students were instructed to print off the worksheet and bring it to class with them. At the start of the class, the students were asked to select the meal choices that most closely resembled their own daily meal choices (from any of the categories). After their selections were completed, a brief lecture was given on the nutrition facts label. Lectures on nutritional adequacy and the body, macronutrient requirements, micronutrient requirements, nutrient digestion and absorption, and the Dietary Guidelines for Americans and the Food Guide Pyramid had already been presented to the students during the semester; thus, a brief introduction to the nutrition facts label was all that was needed to complete the dietary intake assessment. Once the students learned how to obtain information from the nutrition facts label, they were given a packet of information. On the 1st page, nutritional information for each breakfast, lunch, dinner, and snack was provided. The nutritional information was obtained from the actual product nutritional facts label. The cost of each meal was also given and this information was obtained from the Schnucks online shopping website (http://www.schnucks.com/express/). On the 2nd page, the students were asked to complete a basic dietary intake assessment using the meal choices they had selected during the 1st step of the activity. The students were first instructed to complete a table that focused on the kcal, fat (g), carbohydrates (g), protein (g) cholesterol (mg), sodium (mg), and fiber (g) contained in each meal, as well as the total cost of each meal they selected (Table 2). They were then asked to reflect on their course materials 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 (DRI Summary Tables 2005) as well as their course notes, they began to fill in the 2nd table (Table 3), which included space for (1) the nutritional contributions the meals made to their dietary intake (from Table 2) and (2) their recommended Dietary Reference Intake values (based on their age, gender, and health status, included at the bottom of Table 3). After completing Table 3, the students were asked to consider the outcomes of their meal choices by completing a reflective questionnaire.

Throughout the activity, the instructional team interacted with the students, providing them feedback and offering assistance. The activity was worth 10 points and the students were required to be in class in order to complete the activity and earn the points.

[2]Scale imposes unique problems on the instructor, teaching assistants, students, and the teaching-learning environment of large enrollment courses. Instructors have long grappled with problems of managing, engaging, and assessing students in large classes. For further discussion on the special dynamics of large enrollment classes, the reader is referred to the following resources: Weimer (1987), McGee (1991), Gibbs and Jenkins (1992), and Carbone (1998).

Food microbiology and processing experiential learning activity—food safety survey

The 2nd experiential learning activity was a 2-part activity that primarily occurred outside of the classroom. Prior to the start of the 3rd section, food microbiology and processing, the students were asked to complete an online food safety survey (Figure 1—questions only) that asked them about their own routine food safety behaviors. The students were not asked to reflect upon any previously obtained knowledge to respond to the survey questions, but rather they were strongly encouraged to respond to each question based on their own behaviors, regardless of whether or not it was the "correct" response to the question. The students were also informed that they would earn 5 points simply by completing the survey. After the lectures on bacteria, yeast, and mold; food fermentation; biotechnology; and foodborne illnesses were presented, the students were asked to complete the 2nd part of the activity. For those students who attended class, a complete explanation of the best practices and the scoring of the survey was provided during one of the regular 50-min class periods in an attempt to educate the students about which behaviors were considered best practices and why it is important for them to adhere to those behaviors. For those students not in attendance, a written explanation of the best practices and the scoring was posted on the course

Table 1—The meal choice worksheet.

Breakfast	Lunch	Dinner	Snacks
Choice 1	**Choice 1**	**Choice 1**	**Choice 1**
1 C soy milk	1 can low-sodium minestrone soup	Tofu stir fry	6 oz yogurt
1.5 C Raisin Bran	6 oz. cottage cheese with fruit	1 C steamed brown rice	
Clementine	Fuji apple	Garden salad (with shredded cheese, croutons, and low-cal dressing)	
Tea with 2 tablespoons of honey	Water	1 C soy milk	
Choice 2	**Choice 2**	**Choice 2**	**Choice 2**
Western omelet (ham, cheese, green peppers, onions)	McDonald's Quarter Pounder with cheese	3/4 of a frozen supreme Tombstone pizza	King-sized Snickers
2 pieces of whole wheat toast (with butter and jelly)	McDonald's large fries	Garden salad (with shredded cheese, croutons, and full calorie dressing	
8 oz glass of orange juice	McDonald's apple pie	2 C 2% milk	
Coffee with 0.25 oz cream and 2 tsp sucrose	32 oz. coca cola	4 oreos	
Choice 3	**Choice 3**	**Choice 3**	**Choice 3**
1 C 1% milk	Turkey sandwich (2 slices Wonder bread, 3 oz deli turkey, 1 slice Swiss cheese, mustard)	8oz penne pasta with 1/4C marinara sauce topped with 6oz of grilled chicken and Parmasean cheese	2 oz traditional snack mix
1.5 C Frosted Flakes	6 oz yogurt	steamed vegetable medley	
16 oz. apple juice	Fuji apple	1 C 1% milk	
	1 oz bag of Doritos Water	2 garlic breadsticks 1 C ice cream	
Choice 4	**Choice 4**	**Choice 4**	**Choice 4**
1 Nutri-grain Granola bar	Asian sesame chicken salad (dressing included)	Frozen Lean Cuisine dinner	2 oz braided honey wheat pretzels
Water	Roll	Garden salad (with shredded cheese, croutons, and low-cal dressing)	
	20 oz diet soda	20 oz diet soda	
		pudding cup	
		1 bag of low-fat microwave popcorn	

Table 2—Student-completed dietary intake information worksheet.

Meal or Snack	kcal	Fat (g)	Carbs (g)	Pro (g)	Chol (mg)	Sod (mg)	Fiber (g)	Cost ($)
Breakfast								
Lunch								
Dinner								
Snack								
Snack								
Total								
% of total kcal	NA[a]				NA	NA	NA	NA

[a]NA = not applicable.

Table 3—Student-completed dietary intake comparison worksheet.

	Total kcal	Fat (%)[a]	Carbs (%)[a]	Pro (%)[a]	Pro (g)	Chol (mg)	Sod (mg)	Fiber (g)
Your totals from above recommended values								
Gender	M	F						
Age group	14 to 18	19 to 30	31 to 50	51 to 70				
Health status	Pregnant	Lactating						

[a]% of total kcals.

FSHN 101 Food Safety Behavior Survey, Best Practice Explanations, and Scoring

Instructions: Please read each question carefully and then clearly mark the response that best represents your usual behavior.

1. The temperature of my home refrigerator is closest to:
a. 50 °F
b. 45 °F
c. 40 °F
d. I don't know; I've never measured it.

The best practice response is C. Maintaining your refrigerator at a temperature of 40 F (5 C) or less is important because it slows down the growth of most bacteria, especially pathogenic bacteria. The decreased temperature won't kill the bacteria, but it will keep them from multiplying, and the fewer bacteria there are, the less likely you are to get food borne illness. The temperature range 41 and 140 °F is called the "Danger Zone" because many bacteria can readily growth and multiply in that temperature range.

Scoring: C (2 pts)

2. Which of the following best describes your routine hand washing practices?
a. Rinse hands under running water for a few seconds.
b. Clean hands with soap and hot water for at least 10 seconds using a nailbrush when necessary.
c. Rub hands with a waterless sanitizer.
d. I don't wash my hands routinely.

The best practice response is B. Hand washing is an important step in not getting or giving a food borne illness. Any hand washing is better than none, but the best practice is thoroughly washing with warm water and soap for a good length of time (actually 20 seconds is recommended – one round of the ABC song).

Scoring: B (2 pts)

3. I usually defrost (or thaw) my frozen products (i.e., meat, poultry and fish) by:
a. setting them on the counter
b. placing them in the refrigerator
c. microwaving them
d. placing them in a pan of water

Best practice responses are B and C. When thawing food on the counter the outside portion of the food can reach room temperature long before the inside has thawed. This means bacteria can start to grow, and there is likely to be time enough for the bacteria to multiply sufficiently to cause food borne illness. Microwave defrosting is the quick option, but make sure not to then leave the food sitting around at room temperature breeding bacteria – cook it right away. Thawing in water may quicken the defrosting process, but still may keep the item being defrosted too long of a time at room temperature. One last thing, to avoid possible cross-contamination when defrosting in the refrigerator, place the item(s) to be defrosted in a leak proof container.

Scoring: B (1 pt) and C (1 pt)

4. If you use a cutting board to cut raw meat, poultry or fish and it is going to be used to prepare another food, such as lettuce for a salad, the board is:
a. reused as is
b. wiped with a damp cloth
c. washed with soap and hot water
d. washed with soap and hot water and then sanitized

The best practice response is D. If you selected response A, you're violating a critical food safety rule: Never allow raw meat, poultry and fish to come in contact with other foods – this is called cross- contamination. Answer B isn't good, either. Improper washing, such as with a damp cloth, will not remove bacteria, and washing only with soap and water may not do the job, either, but is still much better than responses a and b.

Scoring: D (1.5 pts) and C (0.5pts)

5. I clean my kitchen counters and other surfaces that come in contact with food using:
a. water
b. hot water and soap
c. hot water and soap, then bleach solution
d. hot water and soap, then commercial sanitizing agent

Best practices responses are C or D; answer B is just OK, but not the best. Bleach and commercial kitchen cleaning agents are the best sanitizers--provided they're diluted according to product directions. They're the most effective at getting rid of bacteria. Hot water and soap does a good job, too, but may not kill all strains of bacteria. Water alone may get rid of visible dirt, but not bacteria. Also, be sure to keep dishcloths clean because, when wet, they can harbor bacteria and may promote their growth.

Scoring: C (0.8 pts); D (0.8 pts); and B (0.4 pts)

Figure 1—Food safety behavior survey, best practice explanations, and scoring. Note that the students were presented with only the 10 food safety behavior survey question items during the 1st part of the activity and they were presented with the best practice explanations and scoring information during the 2nd part of the activity (continued on next page).

FSHN 101 Food Safety Behavior Survey, Best Practice Explanations, and Scoring (continued)

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

This statement is false, so B is the correct response. The tricky thing about bacteria that cause food borne illness is that they do NOT make the food to look or taste bad. So people eat the food, but later on start feeling bad.

Scoring: B (2 pts)

7. All of the following are good food safety leftover practice EXCEPT:
a. Partition hot food into small containers before placing in the refrigerator.
b. Put the food immediately into the refrigerator.
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.

Response D is NOT a good leftover practice. We should not leave food unrefrigerated for more than two hours. Refrigerate leftovers in shallow containers so they can cool down as quickly as possible. Bacteria can grow rapidly in the Danger Zone temperature range (41 to 140F) and some bacteria can double in just 20 minutes.

Scoring: D (2 pts)

8. Which of the following best describes your fresh fruit or vegetable preparation practice?
a. I thoroughly rinse all fresh fruits and vegetables before I consume them.
b. I wipe off the fresh fruits and vegetables with a towel before I consume them.
c, I wash only the unwrapped or unbagged fresh fruits and vegetables before I consume them.
d. I often do not wash fresh fruits and vegetables before I consume them.

The best practice is response A. Be very careful if you responded with B, C, or D. Fresh fruits and vegetables could be contaminated with bacteria and need to be washed, even if they are pre-washed by the manufacturer. The recent E coli outbreak with spinach illustrates this danger. Wiping with a towel may giving a nice appearance but doesn't remove all possible harmful microorganisms.

Scoring: A (2 pts)

9. On average, how frequently do you change your kitchen hand towel?
a. every day
b. every other day
c. after 3 to 4 days
d. once a week

The best practice response is A, but B is OK. Changing kitchen hand towels every day is a best practice, since the towels can harbor bacteria. Every other day will get you a little credit – but best to change it every day.

Scoring: A (1.5 pts) and B (0.5 pt)

10. The last time there was cookie dough in my home, the dough was:
a. made with raw eggs, and I sampled some of it
b. made with raw eggs and refrigerated, then I sampled some of it
c. store-bought, and I sampled some of it
d. not sampled until baked

If you answered A or B, you may be putting yourself at risk for infection with Salmonella Enteritidis, a bacterium that can be inside shell eggs. Cooking the egg or egg-containing food product to an internal temperature of at least 160 F (71 C) kills the bacteria. Refrigerating will not kill the bacteria. So answer D – eating the baked product – is the best practice. Commercial produced cookie dough is usually made with pasteurized eggs; that is, eggs which have been heated sufficiently to kill bacteria, and also may contain an acidifying agent that kills the bacteria. But the best practice, even when using products containing pasteurized eggs, is to eat the foods only as they are intended to be eaten, so answer C, sampling the unbaked store-bought cookie dough, will not earn you any points, but it is much safer than responses A or B!

Scoring: D (2 pts)

Figure 1—Continued.

website (Figure 1—in its entirety). 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, if and how they differed from the best practice behaviors, and if and how they will change their behaviors in the future. The students also received 5 points for submitting a completed reflective questionnaire.

Reflective questionnaire assessments

The reflective questionnaires for both experiential 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 reflective questionnaire. For the dietary intake activity student responses for 2 items, (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 student responses for 2 items, (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? (b) 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 also categorized and tabulated.

As discussed by Schmidt (2004), college students have participated in the learning process for 12-plus years and it is a good idea to ask students for their feedback on how to improve classroom activities. Thus, both reflective questionnaires included the following item: "What are your suggestions for improving this activity?" Student responses to this item for each experiential learning activity were grouped into common suggestions for improvement and noted for implementation in future semesters.

Results and Discussion

Nutrition and health experiential learning activity—dietary intake assessment

A total of 567 students participated in the dietary intake experiential learning activity. In response to the 1st reflective questionnaire item, "How did this in-class activity help you learn the course material?", student responses were grouped into one of 8 categories, using the following actual student responses: "The assignment helped me learn how to do the nutritional calculations," "The assignment allowed me to apply the material to my own life/real world situation," "The assignment helped me learn how to use the DRI tables," "The assignment provided me with more practice applying all of the material covered in this section," "The assignment helped me recognize that my eating habits were not as nutritional as I would have thought/liked," "[In general] The assignment provided me with a hands-on activity that helped me learn the material," "The assignment helped me learn how to read nutritional labels," and "The assignment did not help me learn the material."

Figure 2 provides the graphical illustration of the categorized student responses. In total, 97% of the students acknowledged that this assignment helped them learn at least 1 aspect of the

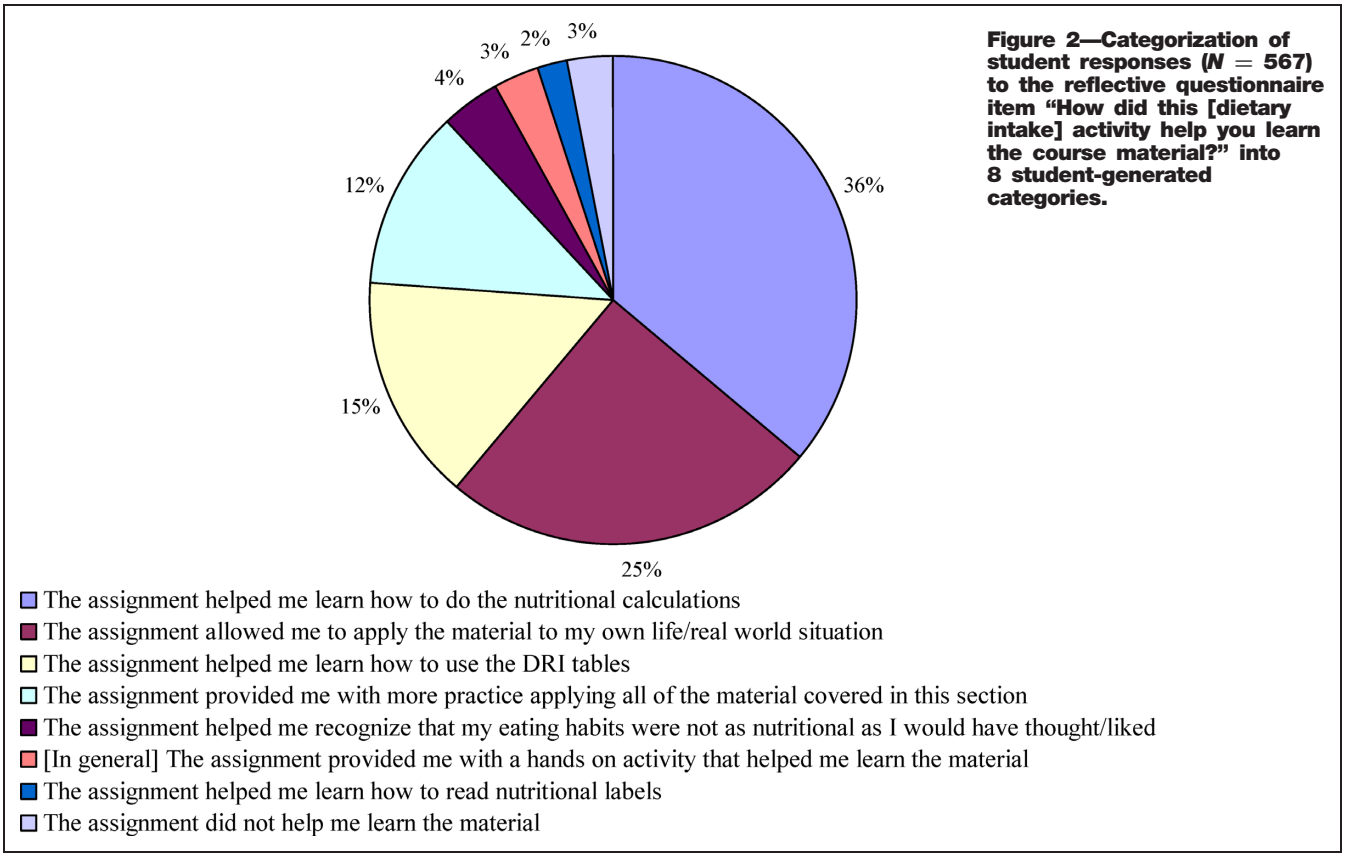

Figure 2—Categorization of student responses ($N = 567$) to the reflective questionnaire item "How did this [dietary intake] activity help you learn the course material?" into 8 student-generated categories.

course material (the remaining 3% did not feel that the assignment help them learn the material). Specifically, a total of 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 nutrition facts 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 during the nutrition and health section of the course each semester. About 25% asserted that the assignment allowed them to apply the material to his/her own life, exemplifying the 2nd stage ("reflective observation") of Kolb's experiential learning model. And 15% noted that the assignment provided them with more opportunity to interact with *all* of the material covered in the nutrition and health section, either noting that the assignment allowed them practice applying the concepts (12%) or that the assignment provided them with hands on experience (3%). The remaining 4% reflected more on the actual observations he/she could make about their dietary intake (for example, "It surprises me how much food I actually consume") rather than how the assignment helped them learn the course material.

In response to the 2nd reflective questionnaire item, "Did you like participating in this activity? Why or why not?", 484 students (85%) reported that they liked participating in the activity. Many students appreciated that they were able to apply the course content to themselves. Actual responses from the students included "Yes, it was interesting to break up my diet and analyze what I'm actually eating and the nutritional value behind it. It's something I would usually never think about." and "Yes, it was fun. I enjoyed calculating and learning more about what I am putting into my body and what that means [nutritionally]." Other students expressed that they benefited from the activity because it allowed them to learn via a different method (for example, active learning rather than lecture). "Yes, I enjoyed this activity because it was a nice alternative to straightforward lecture. I always feel that I learn better by doing." and "Yes, it was interactive as opposed to normal lecture." were typical student responses. In addition, many students felt that this activity was entertaining, and responses such as "Yes, it was fun and enlightening." and "I did [like participating in this activity]. It was a fun way to apply course material." were common.

A small percentage (15%) of the students reported that they did not like participating in the dietary intake experiential learning activity. Common reasons were that they felt that the activity went too fast/they were too rushed, they would have liked to use their own true daily food choices, or they felt that the assignment was busy-work. Responses such as "No [I did not like participating in this activity because] the food choices did not reflect my actual daily intake." and "There wasn't enough time." were common among these students.

In response to the reflective questionnaire item "What are your suggestions for improving this activity?" most students either reported liking the activity "as is" or they suggested (1) bringing to class their own daily food choices and (2) allowing for more time for the activity.

Food microbiology and processing experiential learning activity—food safety survey

Every student that attempted the food safety survey earned 5 points. However, in an effort to gain insight into the students' actual food safety behaviors, point values were assigned to the best practice explanations associated with each question (Figure 1). The highest possible score on the survey was 16.8 points. At least 566 students attempted the food safety survey (which was accessed by the students via the online course website). The average survey score and standard deviation was 8.0 ± 3.1, with a high and low score of 16.8 and 1, respectively.

Of the 566 students that attempted the food safety survey, 451 students completed the reflective questionnaire associated with the survey. In response to the 1st reflective questionnaire item, "Did being asked to reflect on your own personal food safety behavior at the beginning of the food microbiology and processing section: (a) Engage you in learning the course material? If yes, how? If not, why not? (b) Assist you in learning the course material? If not, why not?", 384 of the 451 students (77%) reported that it both engaged and assisted them in learning the course material. Typical positive student responses regarding the activity included "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 it 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." The remaining 13% of the class indicated that they did not feel engaged or assisted by the activity due to the fact that they did not identify the relationship between the survey and the course material (for example, "No, I had no idea that the survey was related to the learning of food microbiology and processing.") or due to the fact they felt that the answers to the survey were common sense and the material covered in class required higher level learning (for example, "The survey seemed more of a common sense poll rather than a source of information and learning").

In response to the 2nd reflective questionnaire item, "Based on the food safety behavior survey, are there any food safety behaviors you are considering changing? If so, why and what are they?", 94% of the students responded that they intended to change at least 1 food safety behavior. Nine behavior changes were common among the students that completed the activity. These behaviors, and the survey questions they correlated to (in parentheses) were:meat/poultry defrosting methods (question 3), hand-washing procedures (question 2), hand towel/dish cloth replacement (question 9), cutting board protocol (question 4), cleaning counters (question 5), left-over handling (question 7), setting the refrigerator temperature (question 1), cleaning vegetables and fruits (question 1), and raw cookie dough "allowances" (that is, allowing themselves to sample the raw cookie dough) (question 10). Students (6%) who did not answer with one of these 9 behavior changes responded that they did not intend on making any changes to their food safety behaviors. Selected reasons such as "Since, for the most part, my [answers to the survey] were correct." and "I believe my food safety behaviors are fine." were common among these students. Figure 3 provides the graphical illustration of the categorized student responses.

During previous semesters of FSHN 101, a few students would informally mention to the instructional team that they recognized some inadequacies in their own food safety behavior because of the food safety information presented during lecture. However, the reflective questionnaire aspect of the experiential learning activity required all the students to personally reflect on their own food safety behaviors in order to assess whether or not any of their behaviors needed changing. Thus, this experiential learning activity allowed students to complete all 4 stages of Kolb's experiential learning process, starting with the "concrete experience" (taking the food safety behavior survey) and ending with "active experimentation" (intended student food safety behavior changes, as illustrated in Figure 3).

In response to the reflective questionnaire item, "What are your suggestions for improving this activity?" many students responded that they liked the activity "as is"; however, some students suggested adding more survey questions that covered additional common food safety mistakes that people make. In addition, many students mentioned that the explanations of the best practices given in class were the most beneficial part of the activity. Thus, in future semesters, attendance will be required on the day that the best practices are explained.

Instructional team reflections

Experiential learning activities can and, based on the positive results reported here, should be utilized in large enrollment courses. However, in order for the experiential learning activity to be an effective and impactful learning tool in a large enrollment classroom, as well as manageable to conduct and assess, a considerable amount of time and effort must be expended by the instructional team when creating the activity. For example, great care must be taken when designing the worksheets and constructing the reflective questionnaire items, since awkward worksheet design and/or unclear reflective questions can cause confusion and frustration that might be able to be alleviated in a small enrollment class, but may not be able to be overcome in a large enrollment class. Ensuring that students have, and understand 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 practice both activities during a concurrent, off campus, smaller-enrollment, class (60 students). Presenting the activities to a smaller audience and asking for their feedback about the effectiveness of both the content and delivery of the activity prior to presenting it to the large class was beneficial. It enabled the instructional team to eliminate many potential issues that would have frustrated students and impacted their participation in the large enrollment version of the class. Since it is not always possible to practice the activity with a smaller size class before using it in a large class, an alternative would be to practice the activity on some volunteers. Any means of practicing the activity first is exceedingly helpful in working out the issues while obtaining constructive feedback in order to alter the activity before launching it on the masses.

As additional experiential learning activities are developed and assessed for classroom use, it would also be beneficial for the students to complete the Kolb's Learning Style Inventory (LSI). The LSI describes 4 dominant types of learning styles based on the 4 stages of learning: convergers, divergers, assimilators, and accommodators. Collecting the students' LSI information would allow the instructional team to investigate the possible correlation between different student learning styles and students' liking (or not) of experiential learning activities.

Conclusions

Although the idea of utilizing experiential learning activities in a large, lecture-style class is often neglected, their use has proven beneficial to students in our large introductory food science and human nutrition course when learning about dietary intake and food safety behavior subject matter. A considerable amount of effort must be expended by the instructional team to create valuable experiential learning activities, especially when they are being developed for a large enrollment course. The educational enhancements they provide

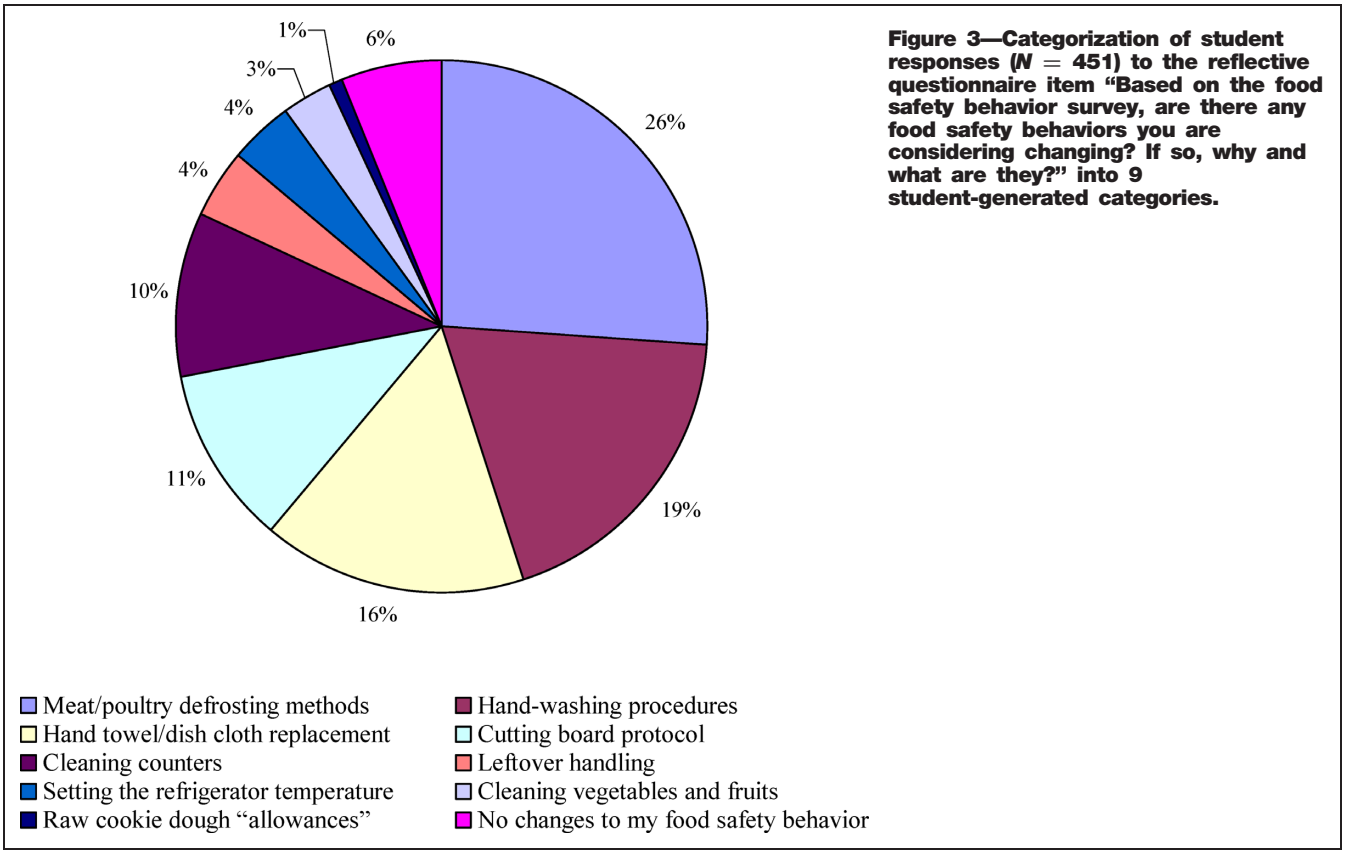

Figure 3—Categorization of student responses (*N* = 451) to the reflective questionnaire item "Based on the food safety behavior survey, are there any food safety behaviors you are considering changing? If so, why and what are they?" into 9 student-generated categories.

for the students, however, far outweigh the effort. By including experiential learning activities in the large enrollment classroom, students are able to personalize their learning experiences, an advantage that is quite difficult to achieve in a large lecture-style course, and this personalization, in turn, enhances both student learning of (cognitive benefit) and liking or engagement with (affective benefit) the course material.

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