Pilot Intervention Using Food Challenges and Video Technology for Promoting Fruit and Vegetable Consumption

Carol S. O’Neal, PhD1; Adam R. Cocco, PhD1; Lindsay J. Della, PhD2; Mary Z. Ashlock, PhD2

ABSTRACT
Objective: To evaluate the feasibility of a Social Cognitive Theory-based intervention on cognitive, affective, and behavioral outcomes in a college nutrition course.

Design: A pre-post quasi-experimental design.

Setting: Large metropolitan university.

Participants: College students (n = 138) aged 18–40 years.

Interventions: Students participated in weekly food challenges during a 15-week nutrition course to apply nutrition knowledge, develop self-efficacy and promote positive behavior change. Food challenges were implemented by a guided goal-setting strategy. Cooking videos, which modeled important nutrition-related skills, accompanied each challenge. Students independently selected 2-goal options to implement weekly and wrote a reflection about their experiences.

Main Outcome Measures: Cognitive outcomes (nutrition and cooking self-efficacy), affective outcome (cooking attitudes), and behavioral outcomes (fruit and vegetable consumption).

Analysis: Descriptive statistics and paired sample t tests.

Results: Analyses showed significant increases in cognitive outcomes (produce consumption self-efficacy \( P = 0.004 \), cooking self-efficacy \( P = 0.002 \), using fruit/vegetables and seasoning self-efficacy \( P = 0.001 \)) and behavioral outcomes (fruit consumption \( P < 0.001 \), and vegetable consumption \( P < 0.001 \)).

Conclusion and Implications: This pilot study suggested a framework for behavioral change, grounded in constructs central to Social Cognitive Theory, that simplified the goal-setting process (by using guided goal setting) and used video technology to decrease the cost of implementation.

Key Words: goal setting, self-monitoring, video cooking skills, self-efficacy, fruit and vegetable consumption (J Nutr Educ Behav. 2022;54:707–717.)

INTRODUCTION
Obesity in the US is a significant risk factor for numerous chronic diseases.1 Consumption of fast food and away-from-home meals is associated with lower diet quality and obesity in adults.2 In the quest to positively affect adult nutrition behavior and obesity rates in the US, young adulthood presents a critical time frame for establishing healthy eating habits. Many young adults are newly independent and responsible for making their own dietary choices, often for the first time.3 Given this window of opportunity for aiding adults in establishing healthy eating habits, dietary interventions focused on young adulthood are vital to the long-term health of the nation.

College students comprise a large portion of the young adult population,4 and national data suggest that college students’ diets are high in overall fat intake and inadequate in key food groups such as low-fat dairy, whole grains, fruits, and deep yellow and green vegetables.5 Specifically, Dingman and colleagues6 found that many college-aged students’ diets largely consisted of fast or convenience foods. Barriers to healthy eating for this group includeed a lack of nutrition and culinary knowledge, financial instability, inadequate access to healthy food options, and time.7,8 Larson and colleagues9 also noted that low self-efficacy and inadequate cooking skills could pose barriers to healthy meal preparation.
College courses present an opportunity to address barriers to a healthy diet. However, traditional college nutrition programs tend to focus on knowledge acquisition and nutrition assessment skills. Skinner found that traditional nutrition classes increased nutrition knowledge but did not change dietary behavior. Although a necessary element of behavior change, research shows that knowledge and nutrition assessment skills should be supplemented with behavioral self-efficacy to prompt lifestyle change. Nutrition education programs grounded in the Social Cognitive Theory (SCT) are particularly effective in changing dietary behavior because of their focus on self-efficacy and behavior-oriented programmatic elements. Specifically, Anderson and colleagues showed that important SCT constructs (eg, self-efficacy, outcome expectations) could effectively improve adults’ diets. Poddar and colleagues presented evidence that self-efficacy and outcome expectations are correlated with maintaining college students’ healthy dietary patterns. In addition, interventions targeting specific nutrition behavior in college students, such as fruit and vegetable (F&V) consumption, have effectively improved diet. Ha and Caine-Bish showed increases in F&V consumption among college students following an intervention in a general nutrition course using strategies on the basis of SCT. Conventional education materials were combined with goal-oriented activities, which encouraged students to use their dietary behavior and lifestyle choices as a framework to learn course materials. Class activities included introducing simple F&V recipes, home cooking assignments, and tasting healthful snacks. In addition, key learning opportunities included dietary analysis and goal setting to motivate students to change their eating habits.

Research shows that including the SCT concepts of goal setting and self-monitoring and nutrition education can be an essential component for interventions addressing college students’ diets. As such, Kelly and colleagues suggested incorporating diet-related interventions into preexisting courses for this population. Schnoll and Zimmerman found course integration to be an effective approach, noting that dietary change did not occur with self-monitoring alone but when goal setting and self-monitoring were combined in a college nutrition course. O’Donnell and colleagues reported that F&V consumption increased with weekly goal setting and self-monitoring in a web-based intervention with college students, and subjects who met a majority of their goals consumed more F&Vs. Guided goal setting, in which individuals are given choices from a collection of practitioner-developed major and minor goals with attributes necessary for optimal goal effectiveness: specificity, proximity, difficulty, and attainability, has been successful with adolescents in affecting positive behavior change. Goal monitoring and feedback focusing on accomplishments have been shown to enhance self-efficacy.

In addition to goal setting and self-monitoring, nutrition interventions for college students that include nutrition education and hands-on cooking components show promise for eating behavior changes and self-efficacy for cooking. The challenge of integrating interventions that include hands-on cooking components into preexisting courses is that a kitchen facility is usually unavailable. Moreover, purchasing ingredients for hands-on class experiences can be financially burdensome for students and wasteful, as unused ingredients cannot easily be saved for future use. There is a need for a less costly, more sustainable way of providing cooking instruction to develop self-efficacy for healthy cooking and nutritious dietary consumption.

One promising option for addressing the pitfalls of in-class experiences is video technology. A wide range of short instructional cooking videos is available on the internet. With the advent of low-cost video production and editing equipment, instructors can also prepare theory-based demonstrations that can be watched and followed at home. Brown and colleagues explored the use of vegetable preparation videos with vegetable tasting experiences in a nutrition class and found that this was an effective method for increasing self-efficacy for vegetable preparation and readiness to increase vegetable intake of college students. Given the success of research by Brown and colleagues, the purpose of this study was to evaluate the feasibility of integrating the outcome expectations, observational learning, goal setting, self-monitoring, and self-efficacy constructs of the SCT with instructional cooking videos modeling specific cooking skills (ie, for home practice and development of self-efficacy) in 2 modalities of a college nutrition course, asynchronous online and in-person. Attitudes toward cooking, cooking and nutrition self-efficacy, and F&V consumption behavior were assessed for change over time. The logic model for this pilot study is shown in the figure to summarize how inputs and activities (instruction, food challenges, and modeling) should function to create outputs (knowledge, goal setting, self-regulation) that are hypothesized to lead to cognitive (cooking and nutrition self-efficacy), affective (attitudes) and behavioral (F&V consumption) outcomes.

**METHODS**

**Research Design and Intervention**

*Research design.* We used a quasi-experimental pre-post 1-group design to investigate changes in students’ attitudes toward cooking, cooking self-efficacy, nutrition self-efficacy, and F&V consumption resulting from a 15-week pilot intervention for nursing, health, and exercise science majors at a large metropolitan university. We collected survey data from students in a human nutrition course (both in-person and asynchronous online) during the first and last weeks of a 15-week semester using Qualtrics. The same instructor taught all course sections.

*Intervention.* Outcome expectations, observational learning, goal setting, self-monitoring, and self-efficacy were incorporated into the course...
Each week, the instructor’s lecture introduced a topic (e.g., carbohydrates). The lecture emphasized knowledge and outcome expectations and incorporated skill-based activities (e.g., how to read an ingredient list for main ingredients) that could aid in achieving nutrition goals (e.g., increase consumption of whole grains). Online students received the same course content through the electronic learning management system (LMS) course. Cooking videos were selected to specifically model nutrition-related skills and behavior relevant to the week’s topic (e.g., how to make overnight oats). The videos were shown during face-to-face class time (for in-person sections) or sent via university email to each student in the online section. In addition, the videos were posted to the course’s online video library in the LMS for unlimited access throughout the course. Online viewing behavior was tracked by the LMS. One or 2 videos (3–7 minutes each) were presented/posted each week. Students were offered an opportunity to ask questions and seek clarification about important concepts presented in the videos during class meetings or on the online course discussion board. In this way, the videos and class conversations focused on skills required for students to develop cooking and nutrition self-efficacy.

To help apply new knowledge, increase self-efficacy, and positively affect behavior, students participated in at-home food challenges that aligned with each week’s instructional topic. Posted to a private class-based virtual discussion board and linked to the online library of resources pertinent to specific skills, food challenge topics included: observe hunger and fullness, control portion size, get more F&V in your diet, go with whole grains and decrease added sugar, choose healthy fats, implement mindful snacking, shake the salt habit, increase your calcium, and cook with herbs and spices.

The food challenges were coordinated with a guided goal setting technique (Table 2) that used behavioral strategies identified by Shilts and Townsend. Guided goal setting, instead of self-set goals, was used as a pedagogical tool to support course learning outcomes and help students learn how to translate general goals into specific and measurable ones using specific, measurable, attainable, realistic, and time-bound (SMART) criteria. Thus, each course topic/unit and corresponding food challenge were coupled with 10–15 minor goals from which students were required to independently select 2 to focus on that week, guided on how to rework them into the SMART format, and asked to apply at home. Students were also required to write a weekly reflection tracking their progress against their stated SMART goals. The instructor provided encouragement to support goal achievement, such as “Good job!” or “Keep it up!” If students had trouble implementing strategies to achieve

**Figure.** Logic model for a nutrition behavior change pilot intervention developed using Social Cognitive Theory, a preliminary framework for explaining the relationship between intervention activities and outcomes in a college-student sample.
Table 1. Intervention-Based Operationalization of Social Cognitive Theory Constructs

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Description</th>
<th>Operationalization of the Constructs</th>
</tr>
</thead>
</table>
| Outcome expectations        | Beliefs about the likelihood and value of the consequences of behavior choices | • Instructional lectures provided information about behavior-health links. Information was shared about the health consequences of poor dietary choices over time, and the health benefits of good nutrition were stressed during instruction.  
• Food challenge activities required students to set weekly topic-based goals, directing students’ cognitive focus on specific outcomes and allowing them to adjust personal expectations.  
• Weekly reflection papers encouraged students to address the success/challenges of meeting weekly goals.                                                                                                                              |
| Goal setting                | Identification of SMART statements of behavior or accomplishment            | • Weekly food challenges presented students with a guided goal-setting activity.  
• Students selected 2 minor goals from a list of 10–15 goals pertinent to the week’s instructional unit/topic.  
• Students were then encouraged to create personalized SMART goals for themselves each week using their 2 selected minor goals.                                                                                                               |
| Observational learning      | Learning is acquired by watching similar individuals or role models perform a behavior and observing the outcome | • How to instruction was modeled or demonstrated for a specific behavior (eg, cooking skills, spice and seasoning choice):  
• Demonstration videos from the internet specific to the week’s topic of instruction were provided to all sections.  
• The instructor performed a behavior (in-person or video recorded) specific to a selected goal (eg, reading a food label).                                                                                                               |
| Self-efficacy               | Confidence or belief in one’s ability to perform a given behavior          | • Instructional lectures provided information about the nutritional content and food options to help students expand their nutrition knowledge.  
• The weekly food challenges encouraged students to cook meals at home to practice nutrition and cooking skills. Each skill was broken down instructionally into small measurable steps.  
• Cooking videos and supplemental resources were provided virtually to all students as support for weekly instruction.                                                                                                               |
| Self-monitoring             | Controlling oneself through self-regulation, feedback, and social support  | • The instructor prompted self-monitoring of behavior by requiring participants to keep records of their eating and cooking behavior and writing reflection papers to identify small successes (eg, changes in attitudes and behavior) along the path to larger behavior changes.  
• The instructor provided encouragement, feedback, and praise during reviewing weekly food challenge reflection papers.  
• Students in all sections posted weekly reflections to a section-specific virtual discussion board for peers’ support/feedback.  
• A final course reflection paper assignment challenged participants to review assumptions, barriers, and changes in behavior over the semester and to set future goals.                                                                 |

SMART indicates specific, measurable, attainable, realistic, and time-bound.
Table 2. Alignment of Instructional Units with Food Challenges, Guided Goal-Setting Examples, and Relevant Cooking Videos

<table>
<thead>
<tr>
<th>Instructional Units</th>
<th>Food Challenges</th>
<th>Examples of Minor Goals</th>
<th>Examples of Cooking Videos</th>
</tr>
</thead>
</table>
| Mindfulness         | Observe hunger and fullness | Use the Hunger and Fullness Scale before you eat and during the meal. Stop eating when you reach a comfortable level of fullness (6 or 7). Eat when you are hungry, not because of external cues. | How to Practice Mindful Eating [link]  
Mindful Eating: The Raisin Exercise (Mindfulness-Based Cognitive Therapy) [link]  
Portion Control for Heart-Healthy Living [link]  
Meal Planning for Beginners [link] |
|                     |                  | Use smaller plates and serving spoons. Wait 10 min before you reach for seconds. Serve dinner by the plate, rather than family style. | Basic Knife Skills [link]  
Mindful Eating: The Raisin Exercise (Mindfulness-Based Cognitive Therapy) [link]  
Portion Control for Heart-Healthy Living [link]  
Meal Planning for Beginners [link] |
| MyPlate             | Control portion size | Add a salad to your lunch or dinner and include dark green lettuce and vegetables with low-fat dressing. Make your smoothies at home with bananas, berries, and a little nonfat milk. Buy fresh fruit instead of cookies and pastries. | Portion Control for Heart-Healthy Living [link]  
Meal Planning for Beginners [link]  
How to Stir Fry [link]  
Classic Tuna Salad [link]  
How to Cut an Avocado [link] |
| Menu planning       | Get more fruits and vegetables in your diet | Change your bread or cereal to contain more whole grain. The first ingredient should be whole grain instead of enriched. This change will help increase your fiber intake. | Quinoa 101: How To Make, Use, and Store Quinoa [link]  
Overnight Oats [link] |
| Carbohydrates       | Go with whole grains and decrease added sugar | Eat salmon or tuna, which are good sources of omega-3 fatty acids. Add slices of avocado to salads and sandwiches. | How to Make a Smoothie Recipe Guide: Easy, Tasty, and Healthy [link]  
Asparagus and Herb Omelet [link] |
| Lipids              | Choose healthy fats | Limit distractions. Turn off the TV, video games, and cell phones and turn your attention to your snack so you can be in the moment. Savor your food. Use all of your senses to appreciate the flavor, texture, appearance, and aroma of your snack. | How to Cut Pineapple [link]  
Chia Pudding [link]  
Roasted Vegetables [link]  
How to Make a Smoothie Recipe Guide: Easy, Tasty, and Healthy [link]  
Asparagus and Herb Omelet [link] |
| Energy balance      | Implement mindful snacking | Buy unsalted nuts and snacks. Cook at home! Prepare your food and experiment with herbs and spices instead of table salt. | Spice it Up [link] |
| Minerals            | Shake the salt habit | Add good sources of calcium such as green leafy vegetables, fortified foods such as almond or soy milk, orange juice (fortified with calcium) or cereal, almonds, salmon, or sardines with bones. | Roasted Vegetables [link]  
How to Make a Smoothie Recipe Guide: Easy, Tasty, and Healthy [link]  
Asparagus and Herb Omelet [link] |
| Minerals            | Increase your calcium | | (continued)
their goals, the instructor provided suggestions or helped them revise their goals to better fit the achievable criteria inherent in SMART goals. Research has shown that learning can be reinforced through reflective activities and positive feedback.33 In addition to the course videos, supplemental information about shopping tips, cooking techniques, food science concepts, use of herbs and spices, and healthy recipes were posted to the course webpage in the LMS. Online access to the videos and additional cooking library resources was tracked via the LMS to ensure program fidelity. Students accessed 15 videos (approximately 1 per week) and 30 supplemental resources (approximately 2 per week) across the 15-week semester. All of the students accessed the videos and resources.

**Participants**

University students (n = 142) registered for an introductory human nutrition course participated in the study. Students in 3 sections of the course (2 in-person and 1 online) participated in the study. Each in-person section was filled and accommodated 45 students, whereas the online section accommodated 70, but only 69 students registered. Most students taking the course enrolled in the study, which was approved by the University of Louisville’s Institutional Review Board by expedited review. Consent was provided by an unsigned preamble consent document.

**Instrumentation**

The instruments utilized in this study were previously developed and tested for reliability and validity for college-aged students.27,28,34,35 The survey consisted of a cooking attitudes scale, 3 self-efficacy scales, 2 universal items to measure F&V consumption, and participant demographic questions. Internal consistency estimates are provided for the scales measured before and after the intervention (Table 4).

**Cooking attitudes.** McMullen and colleagues35 cooking attitudes scale consist of 7 statements that measure how participants feel about cooking using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). In our survey, item scores were reverse coded for negatively worded statements when appropriate.

**Self-efficacy.** Three self-efficacy scales were used to evaluate cooking and nutrition-related self-efficacy. Response options for the self-efficacy scales were based on a 5-point Likert scale ranging from 1 (not at all confident) to 5 (extremely confident). The Cooking Self-Efficacy scale28 consisted of 6 statements measuring confidence in culinary skills and food preparation techniques, such as planning nutritious meals, cooking with basic ingredients, using basic cooking techniques, and using knife skills. The Self-Efficacy Produce Consumption scale28 consisted of 3 statements measuring confidence in eating fruits and vegetables as a snack, at every meal, or consuming 9 half-cup servings per day. The Self-Efficacy for Using Fruits, Vegetables, and Seasonings scale28 consisted of 9 statements measuring confidence in cooking with vegetables, fruits, herbs, spices, and other seasonings.

**Fruit and vegetable consumption.** Two single 5-point items assessed how often participants separately consumed at least 5 servings of fruit and at least 5 servings of vegetables per day (1 = not at all; 5 = about every day).35 Higher score responses to the F&V consumption items reflected more frequent consumption of F&Vs.

**Demographic questions.** Gender response options included male and female. Race/ethnicity response options included White (not of Hispanic origin), Black (not of Hispanic origin), Hispanic/Latino, Asian or Pacific Islander, American Indian/Alaskan Native, and Mixed/Other.

**Data Analysis**

Initially, descriptive statistics were computed for each item and total scalar composite scores (calculated as a scaled average). All item and composite scores were checked for
normality. Skewness and kurtosis were also below an absolute value of 3.0. In addition, no outliers (> or < 3.0 SD from the mean) were identified. After the descriptive examination of the data, scalar internal consistency was assessed using Cronbach alpha coefficients, which were calculated separately for pre-intervention and postintervention scalar survey responses, and all fell within an acceptable range (see Table 4).

Finally, to assess the feasibility of the intervention, a series of paired t tests were calculated for students’ cooking attitudes, self-efficacy scores, and F&V consumption data. Although some differences in gender and race/ethnic identity distributions were noted across course modality, segmenting the data by course demographic group resulted in sample sizes too small for adequately powered complex inferential analyses (eg, n = 5 for male students enrolled in the online section). Furthermore, Bonferroni-adjusted independent group t tests between course modalities for the study’s 6 outcome measures showed no significant differences in pretest or posttest data. Data from the asynchronous online and in-person sections were combined for final analysis, and a Bonferroni adjustment was calculated and applied to future analyses (< 0.008) to account for inflated type I error rates across multiple paired t tests. Statistical analyses were conducted using SPSS (version 27.0, IBM Corp, 2020).

### RESULTS

Across the in-person sections, 84 students enrolled in the study and 77 completed the study; 68 students in the online section enrolled in the study and 61 completed the study. Study attrition was low (10%) and did not vary by teaching mode (P = 0.33). A total of 138 students completed the study. Participants who provided usable data for analysis were ages 18−40 years (mean [M], 20.2; SD, 3.0). Most student participants were sophomores (59%), followed by freshmen (20%), juniors (16%), and seniors/others (5%). Almost 82% of the participants identified as female (n = 113). Nearly three-quarters (74%) identified their race/ethnicity as White, and 13 participants (9%) identified as Black. The remaining 23 participants (17%) identified as either Asian/Pacific Islander, Hispanic/Latino, or mixed/other. Demographic distributions across age, class rank, and past food service work experience did not vary significantly by in-person or online section. All students had access to a kitchen, which enabled them to practice cooking at home (Table 3).

Overall, participants reported low levels of fruit (M, 2.3; SD, 1.2) and vegetable consumption (M, 2.4; SD, 1.3) before the intervention, substantiating the need for intervention. Self-efficacy scores ranged by specific skill, with the lowest average scores noted for produce consumption self-efficacy both before and after the intervention (pretest: M, 3.0; SD, 1.0; posttest: M, 3.2; SD, 0.8), followed by self-efficacy for using fruit, vegetables, and seasonings (pretest: M, 3.4; SD, 0.8; posttest: M, 3.6; SD, 0.7). Higher average scores were noted for cooking self-efficacy (pretest: M, 3.8; SD, 0.8; posttest: M, 4.0; SD, 0.6) and cooking attitudes (pretest: M, 3.8; SD, 0.6; posttest: M, 3.8; SD, 0.6). Table 4 provides additional detail regarding average scores for each outcome measure.

The results of the paired t tests between pretest and posttest scores showed a significant increase in cognitive outcomes (Table 4). Specifically, participant’s produce consumption self-efficacy was significantly higher after the intervention compared with before the intervention (t[137] = 2.91; P = 0.004; Cohen’s d = 0.25). Participant’s cooking self-efficacy was also significantly higher
after the intervention compared with before the intervention ($t_{[137]} = 3.23; P = 0.002$; Cohen’s $d = 0.28$). Finally, self-efficacy related to fruits, vegetables, and seasonings for cooking was significantly higher after the intervention than before the intervention ($t_{[137]} = 3.49; P = 0.001$; Cohen’s $d = 0.30$). For each of these self-efficacy scales, Cohen’s $d$ results indicated a small effect size related to the intervention. Although positive attitudes toward cooking were noted at both data collection time points, as evidenced by mean scores above the scale midpoint, no significant attitudinal change occurred in this study ($t_{[137]} = 0.93; P = 0.35$).

For F&V consumption behavior, the data show a significant increase from pretest to posttest. By posttest, reported fruit consumption had increased significantly (posttest: $M, 2.6; SD, 1.1; t_{[137]} = 4.51; P < 0.001$; Cohen’s $d = 0.38$) (a small intervention effect). Reported vegetable consumption had also increased after the intervention (posttest: $M, 2.8; SD, 1.3; t_{[137]} = 5.51; P < 0.001$; Cohen’s $d = 0.47$) (a small-to-medium intervention effect). Thus in this pilot test, the intervention seems to have positively affected self-efficacy and behavior despite a lack of effect on attitudes toward cooking.

### Table 4. Descriptive Statistics, Inferential Statistics, and Reliability Measures for Cooking Attitudes, Cooking and Nutrition Self-Efficacy, and Eating Behaviors Scales and Items

<table>
<thead>
<tr>
<th>Scale/Item</th>
<th>Preintervention</th>
<th>Postintervention</th>
<th>Pre-Post Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>α</td>
</tr>
<tr>
<td>Cooking Attitudes Scale</td>
<td>3.8</td>
<td>0.6</td>
<td>0.78</td>
</tr>
<tr>
<td>I do not like to cook because it takes too much time&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.6</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Meals made at home are affordable</td>
<td>4.1</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Cooking is frustrating&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.7</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>I like trying new recipes</td>
<td>4.1</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>It is too much work to cook&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.5</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Make meals at home helps me to eat more healthfully</td>
<td>4.3</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>I find cooking tiring&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.5</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Produce Consumption Self-Efficacy Scale</td>
<td>3.0</td>
<td>1.0</td>
<td>0.81</td>
</tr>
<tr>
<td>Eat fruits and vegetables at every meal, every day</td>
<td>3.0</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Eat fruits or vegetables as a snack, even if everybody else was eating other snacks</td>
<td>3.3</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Eat the recommended 9 half-cup servings of fruits and vegetables each day</td>
<td>2.6</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Cooking Self-Efficacy Scale</td>
<td>3.8</td>
<td>0.8</td>
<td>0.86</td>
</tr>
<tr>
<td>Cook from basic ingredients</td>
<td>3.6</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Follow a written recipe</td>
<td>4.0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Prepare dinner from items you currently have in your pantry and refrigerator</td>
<td>3.9</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Use knife skills in the kitchen</td>
<td>3.8</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Plan nutritious meals</td>
<td>3.4</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Use basic cooking techniques</td>
<td>4.1</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Using Fruits, Vegetables, and Seasonings Self-Efficacy Scale</td>
<td>3.4</td>
<td>0.8</td>
<td>0.87</td>
</tr>
<tr>
<td>Fresh or frozen green vegetables</td>
<td>3.9</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Root vegetables</td>
<td>3.8</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td>4.2</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Herbs</td>
<td>3.3</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Spices</td>
<td>3.5</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Vinegars</td>
<td>2.8</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Citrus juice</td>
<td>3.1</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Citrus zest</td>
<td>2.9</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Hot sauces</td>
<td>3.2</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>How often do you consume at least 5 servings of fruit/d?</td>
<td>2.3</td>
<td>1.2</td>
<td>N/A</td>
</tr>
<tr>
<td>How often do you consume at least 5 servings of vegetables/d?</td>
<td>2.4</td>
<td>1.3</td>
<td>N/A</td>
</tr>
</tbody>
</table>

M indicates mean; N/A, not applicable.

<sup>a</sup>Item was reverse coded; <sup>b</sup>Statistically significant at $P = 0.008$ (Bonferroni adjustment calculated as 0.05/6).
Qualitatively, a cursory post hoc review of students’ written reflections throughout the semester reflected the positive behavioral outcomes noted in the quantitative analysis results from this intervention. Frequent comments included mentions of meal planning before shopping, preparing meals on weekends, taking lunch to school, and using herbs and spices.

**DISCUSSION**

This pilot study examined a 15-week intervention incorporating food challenges and instructional cooking videos into a nutrition course to promote changes in affective (cooking attitudes), cognitive (cooking and nutrition self-efficacy), and behavioral (F&V consumption) outcomes of college students. Key SCT constructs were operationalized into the intervention by instruction about behavior/health links, modeling through cooking videos, guided goal setting, self-reflection, and review of behavioral goals. These intervention elements appeared to prompt positive changes in key cognitive and behavioral outcomes in our pilot sample. A significant increase from preintervention to postintervention was found in the college students’ self-efficacy for produce consumption, cooking, and using fruit, vegetables, and seasonings. In addition, students reported eating more eating fruits and vegetables. The increase in self-efficacy of college students in this study was similar to previous hands-on culinary interventions using the same evaluation measures. Past research using hands-on interventions with college students also showed increased self-efficacy for using fruits, vegetables, and seasonings,\(^{27,35,39}\) self-efficacy for produce consumption,\(^{35,39}\) and self-efficacy for cooking.\(^{27}\) However, a strength of the present study, which incorporated the intervention into a nutrition course in both in-person and online modalities, is that a more diverse set of students can be impacted with minimal additional resources (i.e., nontraditional students and students living in different geographies taking online courses). The ability to connect with students attending class from a remote location through an online LMS has important implications for health and nutrition educators during the current coronavirus disease 2019 pandemic, as online learning is growing.

This pilot study also supports past research suggesting that behavior-based interventions increase F&V intake.\(^{29,40}\) Behavior change is more likely to occur when education has a skill-based approach emphasizing self-efficacy and goal achievement.\(^{32,41}\) In this intervention, levels of F&V consumption significantly increased among college students, corroborating findings from other intervention studies focused on F&V intake in the past.\(^{30}\) We also found that students participating in the study indicated that they met the goal of eating ≥ 5 servings of F&Vs per day more often postintervention than preintervention. Self-monitoring of behavior was prompted by requiring students to keep records of their eating and cooking behaviors on the basis of their SMART goals and write reflections to identify their small successes. Comments from students’ reflections supported the positive behavioral outcomes noted in the quantitative analysis results.

Although this pilot intervention was associated with positive changes in self-efficacy and behavior, cooking attitudes did not change significantly over time. Nevertheless, attitudes remained positive throughout the semester, suggesting that students signing up for a college nutrition course may already be predisposed to positive attitudes toward healthy cooking. Interestingly, other researchers have found similar attitudinal results after hands-on cooking interventions with college students.\(^{27,35}\) Future research could explore whether the cooking attitudes of students from other majors or disciplines may be less positive, more malleable, and therefore respond better to an SCT-based cooking intervention.

Overall, this pilot study provides a preliminary framework for a nutrition behavior change intervention among college students grounded in SCT constructs, simplifies the goal setting process (by using guided goal setting), and uses video technology to decrease the cost of implementation. Although previous studies with college students used self-set goals and self-monitoring to promote dietary behavior change,\(^{21–24}\) this pilot intervention is unique because it examined the feasibility and effectiveness of integrating a guided goal setting strategy to help teach SMART goal writing with instructional video technology and digital self-reflections in a traditional college nutrition course to enhance SCT constructs and affect behavior. Moreover, there is limited research to support goal setting\(^{27,35,42,43}\) or video technology\(^{30,44,45}\) to increase outcome expectations and self-efficacy for healthy dietary behavior among young adults. This pilot intervention reviewed the feasibility of combining these 2 elements, thereby adding to the extant literature and further expanding our awareness of available methods for operationalizing SCT constructs for young adults. Moreover, the current study provides initial evidence of the viability of this intervention approach in both a traditional, in-person classroom and an online course delivery format, although further research is warranted.

Despite its positive findings, this study had its limitations. The study was not powered on any outcome variables so any non-significant results should be interpreted with caution. Its convenience sample suggests that the study population may not represent all college students. The nature of the sample also prevented the conduct of more complex analyses that would have allowed for a better understanding of how demographic variables might interact with course modality to affect intervention outcomes. Furthermore, using self-reported outcome measures could have introduced social desirability and recall bias into the data, thereby affecting the validity of conclusions drawn here.\(^{46}\) The positive outcomes noted in this study could also have been affected by student motivation/interest in nutrition because one of the researchers was the instructor of the classes. In addition, this pilot study did not use a control group, which limits the causal
inference of the results. A larger controlled trial must be conducted comparing a traditional approach to our enhanced intervention. The long-term effects of the intervention over time were also not included in the study design. Finally, this study did not include a quantitative assessment of outcome expectations, although qualitative instructor reviews of students’ reflections support the idea that students could appropriately set outcome expectations.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The intervention used in this pilot study provides practical ways to make a traditional college nutrition course behaviorally focused and potentially more effective at eliciting behavior change. Future goals mentioned in students’ reflective papers from this intervention included eating more F&Vs, cooking more, and eating out less, suggesting continued maintenance of healthy dietary choices and behavior over time. A mixed method approach in the future, in which qualitative reflections are systematically evaluated and used to augment quantitative data, could help further explicate behavior change processes. The intervention framework provided here could be tailored to address a variety of outcomes in dietetics, health education, or community-based programs. In the future, we recommend larger experimental studies, including a pre-post controlled trial of the intervention, to help further establish intervention effectiveness and long-term efficacy.

REFERENCES


**ORCID**

Carol S. O’Neal: http://orcid.org/0000-0003-1869-9254