Increasing Food Literacy Among College Students

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Abstract

The aim of this pilot study was to determine the impact on food literacy among college students when enrolled in an undergraduate food literacy course. Students enrolled in Food Literacy between spring 2015 and spring 2017 completed pre- and post-course online surveys designed to measure knowledge, attitudes, and behaviors related to food literacy at the beginning and end of the semester. Factor analysis was conducted on 18 survey questions and four factors were identified (1. Confidence of knowledge and role within the food system; 2. Concerns with natural foods; 3. Food preparation and cooking skills; 4. Food purchasing and preparation behaviors). Linear effects mixed models were used to examine differences in factor and question scores over time. Ninety-three students completed both pre- and post-course surveys. Factor scores 1-3 increased over time ($p<0.001$ in all cases). Factor 4 lacked internal consistency and its three questions were analyzed separately. Participants reported preparing more frozen and partially prepared food at the end of the semester as compared to the beginning ($p=0.05$). A Food Literacy course may be an effective way to increase food literacy among college students. Future studies determining effect on dietary choices, utilizing a control group, and a standardized tool are needed.

Introduction

Food literacy is a concept that was formerly introduced by Jones (1992) in the 1990s, though not much had been published on it until the last several years. Despite the fairly recent surge in literature on this topic, articles aimed at delineating food literacy lack consensus (Palumbo, 2016; Truman et al., 2017). One literature review discovered 38 novel definitions for food literacy among 67 full-text articles (Truman et al., 2017). The most common definition cited in the literature by Vidgen and Gallegos (2014, pg. 54) defines food literacy as "t*he scaffolding that empowers individuals, house-holds, communities or nations to protect diet quality through change and strengthen dietary resilience over time. It is composed of a collection of inter-related knowledge, skills and behaviours required to plan, manage, select, prepare and eat food to meet needs and determine intake*."

Other researchers have developed various themes to encompass the breath of food literacy (Vidgen and Gallegos, 2014; Thomas et al., 2019; Truman et al., 2017). Major themes or components include food skills and behaviors, food and nutrition knowledge, self-efficacy and confidence in food and cooking, ecologic factors including food system complexities and social determinants of health, and food decisions (Vidgen and Gallegos, 2014; Thomas et al., 2019; Truman et al., 2017). Food literacy and its components have also been viewed under the framework of Nutbeam's health literacy model (Nutbeam, 2000) which is comprised of three levels: functional, interactive, and critical literacy (Palumbo et al., 2017; Pendergast et al., 2011; Slater, 2013; Slater, 2017; Velardo, 2015). Functional literacy includes the ability

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Acknowledgements:
The authors acknowledge Kristi Spence for project support. There was no funding for this study. This study was completed according to protocol (irb-6689) approved by the Institutional Review at Utah State University. Work was completed at Utah State University.

to understand and use knowledge, while interactive literacy involves applying one's knowledge to enhance health, and critical literacy is the competence to act on and influence social determinants of health (Pendergast et al., 2011; Velardo, 2015). Therefore, according to Nutbeam's theory, critical food literacy extends beyond concern with one's own well-being, rather connecting the health and well-being of society and food systems (Pendergast et al., 2011; Velardo, 2015).

Interventions focused on increasing food literacy are based on the idea that development of food knowledge and skills has the potential to impact food attitudes, which ultimately determines food behaviors (Truman and Elliot, 2019). Food literacy interventions have primarily targeted early adolescents and elementary-aged children (Brooks and Begley, 2014). Studies among youth that include gardening (Savoie-Roskos et al., 2017) and cooking classes (Hersch et al., 2014) have found positive influences on dietary behavior. There is limited research on food literacy among college students. Existing research among this population is narrowly focused and often fails to address many of the major themes identified by previous research on food literacy (Colbath et al., 2010; Ha and Caine-Bish, 2009; Jones et al., 2018; Levy and Auld, 2004; Yang et al., 2017).

Examining the level of food literacy among college students is important because many college students are entering an independent phase of life where they are responsible for accessing, preparing, and consuming food of their own choice within a limited budget. This transition can be challenging and many college students do not meet the recommended intakes of nutrient-dense food groups (Brown et al., 2005; Strong et al., 2008), consume excess dietary fat (Hampl and Betts, 1995), and increase in weight and body mass index (de Vos et al., 2015; Pope et al., 2017). A study conducted at Central Texas University found that only 14% of college freshman had even minimal agricultural literacy indicating the majority of college freshman knew very little about agriculture and food systems. Students' lowest levels of literacy were found in the food, nutrition and health theme (Colbath et al., 2010). These findings further emphasize the need for more food literacy education among college students. The development of food literacy may help college students to make dietary choices that support both health and sustainability.

The purpose of this pilot study was to determine if participation in an undergraduate Food Literacy course, focused on teaching basic culinary skills with an additional emphasis on sustainability and food systems, had a positive impact on the food literacy of students. Objectives included examining whether perceptions of knowledge and role within food systems, purchasing and food preparation behaviors, and food preparation and cooking skills changed among college students. It was hypothesized that as students' level of food literacy increased over the course of a semester, that they would have an altered perception of the food system, have increased self-efficacy of food preparation and cooking skills, and prepare more meals at home.

Methods

The study procedures were reviewed and approved by the Institutional Review Board at Utah State University. All students enrolled in one of six sections of a course titled Food Literacy between spring of 2015 and spring of 2017 were invited to participate (n = 232). Passive consent was provided by 217 of 232 students to allow their survey responses, collected as part of normal class procedures, to be used for the purpose of research. Ninety-three (43%) students completed surveys both during the first and the last week of the course.

All participants were enrolled in the three-credit, 15-week course that consisted of bi-weekly online lectures and a weekly in-person culinary lab titled Food Literacy. This course is required as a foundational course for all dietetics and family and consumer sciences education majors. Issues of sustainable food systems are not often addressed in basic courses teaching food skills, but were included in this class. Objectives related to sustainable food systems included learning about farm-to-fork practices, genetically modified foods, and food waste through online discussions, and guest speakers educating on concerns within our food system such as farming production methods. Students also learned sustainable culinary practices such as recycling, composting, benefits and drawbacks of buying local and seasonal produce, and practiced methods to reduce food waste in labs.

During the first week of the course and again during the last week of the 15-week semester, students were asked to complete an online survey consisting of 61 questions (see supplementary data). Students received five points toward their course grade for completing the pre- and post-surveys. No points were awarded if a survey was not submitted.

Survey Instrument

A pre- and post-course Likert-type scale questionnaire to assess student perceptions toward agriculture developed by Rasmussen et al. (2008) was modified to assess students perceptions toward nutrition and food systems. A panel of experts determined evidence and face content validity of the Rasmussen et al. tool with good internal consistency (alpha=0.65) using Cronbach's alpha as a post-hoc estimate of reliability (Rasmussen et al., 2008). Fourty-one additional questions were included in the survey to assess student demographics, student frequency of food preparation and purchasing habits, and self-perceived adequacy of cooking skills and resources (for example: cooking skills, knife skills, food safety knowledge, etc). Eighteen of the survey questions were selected a priori by a panel of experts to be measured for this study based on their relevance to the major themes of food literacy found in the literature (Vidgen and Gallegos, 2014; Thomas et al., 2019; Truman et al., 2017).

Statistical analysis

A factor analysis of the 18 identified questions was conducted using SAS/STAT 141.3 (SAS Institute Inc., Cary, NC). Polychoric correlations of the eighteen questions were calculated and the correlation matrix was used to

extract underlying factors. Principle component analysis was followed by varimax rotation. Reliability of the factors were assessed by Cronbach's alpha. Factor scores were computed with PROC SCORE in SAS/STAT 14.3 and used for later analysis.

A linear mixed effects model using PROC GLIMMIX in SAS/STAT 14.3 was used to examine change in the score of each of the factors identified. The distribution of variables approximated normality. The associations between the change in factor/question scores and the following covariates were examined: gender, marital status, enrollment status (full-time, part-time, other), declared major, living situation, employment status, level of physical activity (very active, active, somewhat active, sedentary/inactive), and where the student grew up (farm/ranch/dairy, rural/non-farm, small city, large city). Interactions between time and each covariate were also examined. Covariates and interactions with non-significant effects were eliminated to arrive at the most parsimonious model for each factor. Semester (that the student took the class) was modeled as a random factor. Covariance structures were evaluated and compound symmetry structure was employed for pre- and post-course repeated measures based on AIC and BIC selection. Pairwise group comparisons among the covariate levels were adjusted for multiplicity by Tukey-Kramer method. A p-value of <0.05 indicated statistical significance.

Results and Discussion

Characteristics of the participants are described in Table 1. The total sample was largely female between the ages of 18-25 (94%), were single (66%), and grew up in a small city (48%). Also, 71% of the participants were majoring in nutrition and dietetics majors and 62% were working. At the beginning of the semester, students reported fairly high confidence in their food and cooking skills and in their perceived knowledge and role within the food system (see Table 2 for pre- and post-survey observed means).

Four factors were identified as follows: Factor 1 (F1) Knowledge and Role within the Food System, Factor 2 (F2) Concerns for Natural Foods, Factor 3 (F3) Food Preparation and Cooking Skills and Factor 4 (F4) Food Purchasing and Preparation Behaviors (see Table 2 for factor loadings). The internal consistency of the items for each factor were evaluated by Cronbach's alpha and they were 0.82, 0.83, 0.83 and 0.38 respectively, indicating good reliability for each of the factors except Factor 4. Correlation of the three questions within Factor 4 ranged from 0.17 – 0.40. Thus, these three questions were analyzed and discussed separately. The themes identified by the factor analyses are consistent with those identified by others (Vidgen and Gallegos, 2014; Thomas et al., 2019; Truman et al., 2017).

Students experienced changes in LSM of the first three factors scores and one of the three questions that comprised factor four (see Table 3). The next section presents linear mixed model results on the changes of the factor scores by taking the course.

Table 1. Matched Participant Characteristics of Students Enrolled in Food Literacy (n=93)

	Matched Cases	
Characteristic	**n**	**%**
Gender		
Female	87	94
Age Group		
18 -25	87	94
25+	6	6
Marital Status		
Single	62	66
Engaged/Committed Relationships	15	16
Married	16	17
Student Status		
Freshman	16	17
Sophomore	41	44
Junior/Senior	36	38
Enrollment Status		
Full-time	87	94
Major		
Nutrition, Dietetics, and Food Science	64	71
Family and Consumer Science Education	21	23
Other	5	6
College		
Agriculture and Applied Sciences	84	90
Other	9	10
Living Situation		
Own/Rent	72	77
On-campus Housing	15	16
Live with Parents/Family	6	6
Employment Status		
Employed	58	62
Not Employed	35	38
Demographics of Area Raised		
Farm, Ranch, or Dairy	13	14
Rural or Non-farm	28	30
Small City	45	48
Large City	7	8
Physical Activity		
Very Active	20	22
Active	35	38
Somewhat Active	30	32
Sedentary/Inactive	8	9

Table 2. Food Literacy Factor Questions, Factor Loadings, and Observed Means, Median, and Standard Deviations for the Pre- and Post-Course Surveys Among Matched Cases

Item		Pre-Course Survey			Post-Course Survey			Factor Loadings (n=316)[z]
	N	Mean	Median	Std Dev	Mean	Median	Std Dev	
Factor 1: Knowledge and Role within the Food Systems *(Rate: 1=Strongly Disagree to 5=Strongly Agree)*								
Connection between nutrition and food systems is apparent to me.	92	4.0	4.0	0.7	4.5	5.0	0.5	0.870
Connections between nutrition and agriculture are apparent to me.	93	4.1	4.0	0.7	4.5	5.0	0.6	0.885
Connections between nutrition and the environment are apparent to me.	93	4.0	4.0	0.8	4.3	4.0	0.8	0.833
I will be able to apply what I have learned in this class in my future.	93	4.8	5.0	0.4	4.9	5.0	0.4	0.631
I know the origin of the foods I eat.	93	3.0	3.0	0.8	3.8	4.0	0.7	0.496
I am concerned about preserving the environment.	93	3.7	4.0	0.8	4.0	4.0	0.7	0.496
I am concerned about the sustainability of our current food system.	93	3.7	4.0	0.8	4.1	4.0	0.8	0.558
I know how to contribute to a more sustainable food system.	93	2.9	3.0	0.9	4.3	4.0	0.6	0.784
Factor 2: Concerns with Natural Foods *(Rate: 1=Strongly Disagree to 5=Strongly Agree)*								
I am concerned about GMOs.	93	2.8	3.0	0.9	2.4	2.0	1.0	0.849
I am concerned about the use of pesticides on produce.	93	3.1	3.0	1.0	2.6	3.0	1.0	0.902
I purchase organic foods whenever possible.	93	2.4	2.0	1.1	2.1	2.0	1.0	0.823
Factor 3: Food Preparation and Cooking Skills *(Rate: 0=very inadequate, 9=very adequate)*								
Cooking Skills	93	6.0	6.1	1.5	7.4	7.3	1.1	0.843
Knife Skills	93	4.7	5.0	1.8	7.0	7.1	1.1	0.855
Food Safety Knowledge	93	6.2	6.1	1.5	7.7	8.1	1.1	0.800
Ability to interpret food labels (organic, GMO, natural, free-range, fortified, etc.)	93	5.4	5.3	1.9	7.4	7.7	1.5	0.762
Factor 4: Food Purchasing and Preparation Behaviors *(Frequency: Daily, 2-3/wk, 1/wk, 2-3/mo, 1/mo, <1/mo, never)*								
Prepared meals from scratch using mostly whole foods	93	2.6	2.0	1.5	2.4	2.0	1.2	-0.618
Prepared a frozen meal, pre-prepared meal, or meal partially prepared.	93	3.5	3.0	1.6	3.9	4.0	1.6	0.760
Purchased fast food, take-out, or restaurant meal.	93	4.0	4.0	1.1	4.0	4.0	1.2	0.669

zOut of the 217 responded students, some contained only pre- or only post-survey scores. Total observations used in factor analysis is 316.

Factor 1 Knowledge and Role within the Food System

F1 represented the students' knowledge of factors, including personal factors, that influence the food system. Using linear mixed effects models, students had higher scores on this factor after completing the course than they did prior to taking the course (p<.0001), thus their perception of their knowledge and role within the food system significantly improved (see Table 3). This factor score was influenced by where the student grew up. Students who grew up on a farm, ranch, or dairy had higher scores than did students who grew up in the city (p=0.04).

The Academy of Nutrition and Dietetics encourages dietetic professionals to expand their knowledge of food system issues and follow environmentally responsible practices in their personal and professional lives (Harmon and Gerald, 2007; Wilkins et al., 2010). All dietetic students are required to take a culinary basics course, modifying traditional culinary courses to include concepts of farm-to-fork and waste reduction as was done in Food Literacy may be one way to accomplish the Academy's recommendation.

Factor 2 Concern with Natural Foods

F2 represented concern with natural foods including whether foods were genetically modified, used pesticides in production, or were organically produced. Using linear mixed effects models, students had lower scores on this factor after completing the course than they did prior to taking the course (see Table 3), therefore concern for natural foods significantly decreased (p<.0001). Possibly increased knowledge, dispelled myths, and broadened views on these concepts may have allowed for more confidence on the topics and ultimately a decrease in concerns.

This factor score was also influenced by students' reported level of physical activity (p=0.006). Levels of concern for natural foods went up as physical activity increased. The estimate factor score for students that reported being very active was 3.3, 0.5 and 0.8 points higher than those who reported being somewhat active (p=0.07) or sedentary/inactive (p=0.009), respectively. Students who reported being the most physically active had the greatest concerns with these topics at both the beginning and end of the semester. Similarly, Yang et al. (2017) found that college students that frequently consumed organic food exhibited superior physical activity and health concern. Goetzke and Spiller (2014) in a study of 500 German consumers also found that health food consumers or those that consume organic food, whole grain, fresh fruit and vegetables, live a more spiritual and physically active life.

Factor 3 Food Preparation and Cooking Skills

F3 represented students' confidence in their food preparation and cooking skills. Students had higher scores on this factor after completing the course than they did prior to taking the course; consequently, self-efficacy of food preparation and cooking skills increased significantly (p<.0001) following students' enrollment in one semester of Food Literacy (see Table 3). This factor score was also influenced by students' demographics of area raised (p=0.007). Students from farm and rural areas had significantly better food preparation and cooking skills than those from small cities (p=0.02) with corresponding estimate scores of 8.9, 8.6, and 7.9, respectively.

One reason for the significant improvement in food preparation and cooking skills following enrollment was likely due to the extensive hands-on application in the culinary labs. Although changes in dietary choices was not surveyed in this study, hands-on application has been shown to be more effective at changing eating behaviors compared to watching demonstrations (Levy and Auld, 2004). College students are at risk for poor eating behaviors and lack of basic food preparation and cooking skills (Brown et al., 2005; de Vos et al., 2015; Hampl and Betts, 1995; Pope et al., 2017; Strong et al., 2008). Simliar to our findings, several other studies have found significant increases in

Table 3. Least Square Means (LSM)[z] with Standard Error (SE) for Each Food Literacy Factor Pre and Post Course (n = 93)

	Pre		Post		
	LSM	SE	LSM	SE	*P-value*[y]
F1: Knowledge and Role within the Food System	5.0	0.2	5.7	0.2	<.0001***
F2: Concern with Natural Foods	3.3	0.2	3.0	0.2	<.0001***
F3: Food Preparation and Cooking Skills	7.4	0.4	9.0	0.3	<.0001***
F4: Food Purchasing and Preparation Behaviors					
Q1[y]: Prepared meal from scratch using mostly whole foods	2.7	0.2	2.6	0.2	0.23
Q2[y]: Prepared a frozen meal, pre-prepared meal, or meal partially prepared	3.5	0.2	3.8	0.2	0.05*
Q3[y]: Purchased fast food, take-out, or restaurant meal	4.1	0.3	4.1	0.3	0.96

z LSM are estimated with adjusted effects of the covariates in the model: enrollment status (full-time, part-time), living situation (own/rent, on-campus house, live with parents/family, other), demographics of area raised (farm, ranch or dairy; rural or non-farm; small city; large city) and physical activity (very active, active, somewhat active, sedentary/inactive).
y *, *** significant LSM difference from beginning of the course (pre) to end of course (post) at p=0.05, or 0.001 respectively by t-test.
x Q1, Q2, Q3 are the three questions of factor 4 analyzed separately due to lack of internal consistency within factor 4.

the self-reported efficacy of food preparation and cooking skills following a cooking class intervention (Bernardo et al., 2018; Reicks et al., 2018). However, Smith et al. (2011) did not find a strong association between involvement of meal preparation and weight status of Australian young adults. The certainity of increased skills resulting in dietary behavior change is often unknown. Many studies lack a rigorous design, which limits the ability to determine true impacts of increased cooking skills on nutritional outcomes (Reicks et al., 2018). Additional barriers could contribute to lack of dietary behavior changes despite skill development and self-efficacy (Truman and Elliot; 2019).

Still, some studies have shown that higher involvement in food preparation and more food preparation skills among young adults results in consumption of less fast food and more fruits and vegetables (Larson et al., 2006; Soliah et al., 2006; Thomas and Irwin, 2011). Higher consumption of fast-food and take-out have been positively associated with a higher body mass index (Bhutani et al., 2018; Nago et al., 2014). A longitudal study spanning ten years found that those who participated in food preparation as emerging adults frequently prepared meals including a vegetable in their mid-to-late twenties and had a significantly more predicted frequent consumption of breakfast and lunch and less fast-food intake (Laska et al., 2012). Larson et al. (2006) found young adults that reported being highly involved in food preparation were more than ten times as likely to consume five servings of fruits and vegetables compared to those that reported very low involvement in food preparation. Recognizing the importance of these findings, Laska et al. (2012) recommended that nutrition educators work with emerging adults to build food preparation and meal planning skills as a means to foster healthy long-term dietary behaviors. Participation in a food literacy course appears to be an effective way to build these skills.

Factor 4 Food Purchasing and Preparation Behaviors

F4 represented students' behaviors when purchasing or preparing food. Due to lack of internal consistency, the three questions that measured the Food Purchasing and Preparation scale were analyzed separately. Lease squares means of the pre- and post-class ratings are listed in Table 3.

The class significantly improved students' frequency to cook a frozen meal, pre-prepared meal, or meal partially prepared ($p=0.05$) as the rating changed from 3.5 (±0.2) to 3.8 (±0.2). This frequency is also affected by student's physical activity. The most physically active students cooked most often with the partially-prepared food. The estimated score is 4.4, significantly higher ($p=0.006$) than those for less active students whose ratings ranged from 3.2 to 3.6.

The class did not impact the students' behaviors on preparing meals from scratch and on purchased ready-to-eat food (fast food, take-out, or restaurant meal). The frequency a meal was cooked with mostly whole foods, depended on employment status of the students. Non-employed students prepared significantly more meals from scratch ($p=0.023$) than the employed students (full-time and part-time). Frequency of the students' purchasing or eat-out behavior was affected by their living status. Students living with parents/family have significantly higher eat-out/purchasing behavior than the students who rent/own their house. Estimated ratings are 4.7 (±0.5) and 3.5 (±0.2) respectively.

Soliah et al. (2006) found that the frequency of eating out increased in college women as cooking ability decreased. In our study, we didn't see significant changes in eating out of students. Similarly, there was no difference found with preparing meals from scratch. Although we had hoped to see more meals made from scratch at home, the increase in frozen/partially prepared meals instead of fast-food/take out was a promising transitition to more cooking at home. The once clear definition of cooking at home is now blurred and encompasses more than cooking from raw, whole ingredients. There are many fresh, frozen, and canned foods being sold pre-cut, seasoned, and/or ingredients assembled and ready to cook that are nutrient-dense providing short-cuts for individuals who are lacking time to cook at home. Much like our findings, a study examining food preparation skills of young adults found that most food preparation behaviors assessed were not preformed by males or females on a weekly basis (Larson et al., 2006). There are many barriers to cooking for college students, including lack of interest in cooking, limited time, no money, convenience of eating out, and lack of cooking equipment (Jones et al., 2014; Monsivais et al., 2014; Murray et al., 2016; Soliah et al., 2006), all of which may have impacted the results of our study.

Limitations

The sample is not generalizable as it was drawn from college students that were primarily single females from two specific majors with a nutrition emphasis and there was not a control group. Not all students completed both the pre- and post-course surveys (57%), however there were no statistically significant differences between the group that completed both the pre- and post-surveys and the group that completed only one of the two surveys ($p>0.05$). Students enrolled in the spring semesters versus the fall semester did not have the same access to local produce in labs and were unable to visit a farmer's market or roadside produce stand for one of their course assignments due to seasonal variations. We modified a previously validated tool, however researchers continue to use a variety of tools, which make it difficult to compare outcomes across studies (Doustmohammadian et al., 2017; Palumbo et al., 2017; Palumbo et al., 2019; Truman and Elliott, 2019).

Summary

Our pilot study provides evidence that a introductory level Food Literacy course may be an effective way to address each of the major food literacy themes (Vidgen and Gallegos, 2014; Thomas et al., 2019; Truman et al., 2017) and improve functional, interactive, and critical food literacy skills (Palumbo et al., 2017; Pendergast et al., 2011; Slater, 2013; Slater, 2017; Velardo, 2015) among college students. Existing culinary basic courses offered at other higher

education institutions could implement concepts of food sytems and sustainability to ensure a broader view of critical food literacy is addressed. Participants prepared more meals from frozen or partially prepared meals indicating a change in food behavior, the final step in the food literacy model developd by Truman and Elliot (2019) preceded by increases in food knowledge and changes in food attitudes. Positive food behavior changes are needed among college students at risk for many unhealthy food behaviors and excess weight gain (Brown et al., 2005; Hampl and Betts, 1995; Pope et al., 2017; Strong et al., 2008; de Vos et al., 2015). We encourage the consideration of offering a food literacy course to all incoming freshman to build a more sustainable foundation to eating throughout their college years and beyond. Future research would benefit from utilizing a standardized survey tool with a control group (Palumbo et al, 2019; Truman and Elliott, 2019). It would also be of interest to determine the effect of a food literacy course on dietary choices.

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