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# Assessment of an Online Piloted Module Targeted towards Home-Based Food Operators in Iowa

A paper to be submitted to the Journal of Food Science Education

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**ABSTRACT:** Understanding safe food practice is important for home-based food operators to prevent foodborne illness. Earlier work has shown that home-based food operators have shown a lack of food safety knowledge and may benefit from training that is specifically tailored to their needs. Unfortunately, home-based food operators may be deterred from enrolling in traditional educational formats due to their busy schedules. The objective of this study was to pilot and evaluate the effectiveness of an online food safety educational module, for home-based food operators in Iowa, through three learning assessments. Twenty-one participants enrolled in a blended workshop, where participants completed an online pilot module before attending a face-to-face session to complete the remaining five modules. The effectiveness of the online module was measured by examining the first-attempt average scores on learning assessments, the number of assessment attempts required to achieve 100%, and the first-attempt performance by question type. The three learning assessment tools resulted in first-attempt averages of 86.33%, 90.53%, and 83.09%, surpassing our standard of effectiveness of 75% and showing good potential for the online format. The learning assessment attempt numbers of 4.65, 1.67, and 3.81 showed trouble with knowledge transfer on some topics. Comprehension and analysis-style questions had first-attempt success rates of 84.92% and 87.84%, respectively. Knowledge and application-style questions were lower, with first-attempt success rates of 80.19% and 75%,

respectively. These findings were used to make changes to improve the first online module and guide the transition of the remaining five modules to the online platform.

## **1 Introduction**

According to the Food & Drug Administration (2019), foodborne illness is a common and life-threatening public health issue, despite being largely preventable if consumers and food producers use proper safe food practices. A report by the Center for Disease Control & Prevention, covering the years 1998 to 2008, stated that 9% of American foodborne outbreaks were due to food prepared in a private residence (Gould et al., 2013). These private residences are a concern because home-based food operators prepare foods from their homes to be sold at places like farmers markets and restaurants (DIA, 2012). According to Bjork (2018), Iowa had over 220 farmers markets in operation, allowing Iowa to have the second most farmers markets per capita in the United States in 2018. Issues related to unsafe home food preparation practices and the abundance of farmers markets create possible opportunity for a foodborne outbreak to take place. The Center for Agriculture & Food Systems (2019) stated that the lack of safe food practice and food safety training enforcement by farmers market vendors makes foodborne outbreaks very likely to occur. Local foods, such as bakeries, farms stands, and farmers markets have been the source of several foodborne illness outbreaks in recent years, as demonstrated by the examples in Table 1 (Friedman & Heisey-Grove, 2005; Stone, 2011; WDHS, 2017). It can be seen by these examples that many local foodborne outbreaks occur due to a lack of food safety. A food safety knowledge gap appears to be present in farmers market vendors, as they have shown a lack of knowledge and practice of workspace sanitation, proper worker food safety training, and food storage, among several other practices (Benson, Niewolny, & Rudd, 2014;

Harrison, 2017; Harrison, Gaskin, Harrison, & Cannon, 2013; Laury-Shaw, Strohbehn, Naeve, Wilson, & Domoto, 2015; Parker, DeNiro, Lewis Ivey, & Doohan, 2016).

Farmers' market vendors, which includes both farmers and those who prepare foods at home, rely on Iowa State University Extension and Outreach to provide research-based curriculum and resources that address food safety (ISU, 2019; Laborde, 2019; Purdue, 2019). Although face-to-face education may be practical for many farmers, approximately 75% of them spend ten or more hours each day completing farm work (Scahfer, 2013) and 43% of Iowan farmers work six to seven days a week (Johanns, 2012). Online learning provides flexibility to busy farmers, as well as other busy workers, with the opportunity to complete education at times that fit their demanding schedules. Closing the gap in food safety knowledge for farmers market vendors may aid in preventing foodborne illness in the state of Iowa. Several studies testing the effectiveness of an online format have shown that online education has the potential to effectively instruct students in food safety and promote behavioral change (Abbot & Policastro, 2012; Alberts & Stevenson, 2017; Wallner, Kendall, Hillers, Bradshaw, & Medeiros, 2007).

In this study, one module of a current face-to-face food safety training ISU Extension and Outreach program was piloted using an online platform in an effort to provide an effective alternative learning environment. The objective of this study was to evaluate the effectiveness of the online pilot module at instructing home-based food operators by analyzing the outcomes of three learning assessments. The results of these assessments were used to guide the transition of the remaining five modules from the face-to-face workshop to the online platform.

## 2 Materials and Methods

### 2.1 Overview

An instructional module taken from a face-to-face workshop was converted to an online platform for a pilot study. The module focused on the topic of instructing Iowan home-based food operators on regulations, allergens, labeling, specialized products, and fruit jams, fruit jellies, and fruit butters. The online module was used as one part of a blended pilot workshop titled “Home-Based Food Operators: Regulations and Food Safety,” which can be found at the link: <https://moodle.extension.iastate.edu/>. This workshop invited volunteer participants to take part in a blended workshop, in which they engaged in the first module online, then attended a face-to-face instructional session to engage in the remaining five modules. Learning assessments were used to gauge the effectiveness of the online lectures within the module. The results of these online learning assessments would then guide the further online transition of the remaining five workshop modules. All course materials were reviewed for curriculum alignment by an education expert from the Iowa State University Center for Technology in Learning and Teaching (CTLT) to ensure they were suitable for instruction.

### 2.2 Participants

“Home-Based Food Operators: Regulations and Food Safety” is a workshop series designed to provide home-based food operators with the proper knowledge and tools to safely and effectively operate their business to the best of their ability. Home-based food operators (n=21) from across the state of Iowa were recruited through Iowa State University Extension and Outreach to participate in this study. These home-based food operators were 90.5% female and 9.5% male and had varying levels of education. Participants volunteered to participate in the pilot transitioned online module, which they completed independently over the course of a week,

prior to attending the face-to-face one-day session to complete the remaining five modules. Prior to the beginning of this pilot testing, participants signed a consent form, confirming their willingness to participate in this human study. The study was approved by Iowa State University's Institutional Review Board (IRB) and was given the study number 18-429.

### **2.3 Overview**

The piloted transition of module one covered the topics of Iowa policies and regulations, allergens, labeling, specialized products, and fruit jams, fruit jellies, and fruit butters. All online instruction occurred using Moodle, a learning management system commonly used by extension and outreach units across the country due to its versatility and allowance of third-party logins (Moodle, 2018; Wiebke, 2019). On the online learning site, participants were provided with the following: (a) a course overview, (b) a Moodle navigation video, (c) a list of module learning objectives, (d) three module lecture videos, (e) three module learning assessments, and (f) several resources pertaining to topics instructed. The course overview provided a brief paragraph to introduce the course and discuss the objective of the workshop. The Moodle navigation video provided a screen recording that walked the participants through the Moodle website and instructed them on how to navigate their online course materials. The module one learning objectives stated the desired learning objectives of the students: (1) define the meaning of "perishable foods" (2) recognize examples of perishable foods (3) recall various regulations regarding specialized products, fruit jams, fruit jellies, and fruit butters (4) identify the "Big 8" allergens (5) identify necessary components for labeling requirements. These learning objectives guided the design and development of the learning materials and learning assessments. Aligning the online module materials to these learning objectives helped the course developers to ensure that the participants were assessed appropriately

## 2.4 Module Lectures

The online module lecture videos consisted of recorded slideshow presentations with recorded vocal instruction and were created using the screen recorder and video editor Camtasia®. They followed a similar style to the face-to-face slideshow presentations, with plenty of engaging activities to maintain participant focus. Module one was split into three recorded lectures videos: (1) Home Bakeries & Exempt Home Food Operations, (2) Big 8 Allergens & Labeling, and (3) Special Products, Fruit Jams, Fruit Jellies, & Fruit Butters. The lecture curriculum was developed from thorough research of government-issued and peer-reviewed materials (e.g. The Food & Drug Administration, The Iowa Food Safety Task Force, The Iowa Department of Inspections & Appeals, etc.). Simple terminology and detailed explanations were used to ensure the lecture could be easily followed by the participants. The slides provided various instructional tools such as definitions, principles, categorizing exercises, and examples of concepts to facilitate knowledge transfer. Real-life examples, such as examples of food recalls and outbreaks, were used to capture the attention of participants by displaying the relevance of the information presented. Guided activities like matching and categorizing exercises were included for participants to practice with new information. Examples of this include allergen classification and definition matching. After each lecture video, participants took the corresponding learning assessment.

## 2.5 Learning Assessments

The learning assessments consisted of multiple-choice, true or false, and multiple-answer questions. These questions included knowledge, comprehension, analysis, and application style questions, which are commonly used to assess different skills gained through education (Anderson, Krathwohl, & Bloom, 2001; Crowe, Dirks, & Wenderoth, 2008; Lord & Baviskar,

2007). After completing each learning assessment, participants received feedback under each question, explaining why their answer was correct or incorrect. This allowed affirmation of their correct answers, while providing guidance for their incorrect answers.

Participants were encouraged to take the assessments until a score of 100% was achieved, as this was taken to mean full comprehension of the developed learning objectives for the purpose of analyzing this study. They were given unlimited testing opportunities to reach this score. The number of attempts it took for participants to achieve 100% would give information on the quality of education they received. Questions were kept the same for each participant attempt to maintain consistency of the study.

Note that some questions were multiple-answer questions and therefore, offered partial credit. However, for the sake of examining these questions, any missed credit on a question was considered a full miss for that question. "Quiz One" consisted of primarily single answer questions, while "Quiz Two" and "Quiz Three" consisted of solely multiple-answer questions (including label building or requirement list question). Despite the difference in question quantity between quizzes, the amount of content between them is approximately the same. Additionally, questions were developed in alignment with set learning objectives based upon what information was desired for them to learn for each section. Therefore, no attempt was made to equally divide question types amongst the three learning assessments.

To measure the level of effectiveness of this online format for the pilot transitioned module, the first-attempt learning assessment scores were examined by computing the averages and comparing them to a standard of 75%, which is a common score of successful completion that is used by several nationally recognized food safety courses. The National Registry of Food Safety Professionals, Learn2Serve, and ServSafe each provide online food safety trainings that



are accredited by the American National Standard Institute-Conference Food Protection (ANSI-CFP) and are aimed toward managers, cooks, wait staff, and other food establishment employees (Learn2Serve, 2019; NRFSP, 2019; ServSafe, 2019). These programs teach food safety topics like cross-contamination, sanitation, and storage, among several others, culminating in a final exam that consists of multiple-choice questions (Learn2Serve, 2019; NRFSP, 2019; ServSafe, 2019). For each of these programs, to display adequate knowledge and earn certification, a score of 75% must be achieved (Learn2Serve, 2019; NRFSP, 2019; ServSafe, 2019). The first-attempt scores were analyzed to recognize how much knowledge was gained from solely the training, without any learning taking place from engaging in the learning assessments themselves.

The first learning assessment, "Quiz One", focused on the two types of home-based food operators: home bakers and exempt home food operators, including definitions as well as examples of what types of food products can be sold under government requirements. The questions used for this lecture were primarily knowledge and comprehension-based, but also included analysis and application-based questions. Example questions include participants being expected to define perishable good, as well as to accurately select perishable goods from a list.

"Quiz Two" assessed participant knowledge on allergens and allergen labeling. Knowledge, application, analysis, and comprehension skills were each assessed through this learning assessment. Here, participants had to identify categories of allergens and examples within each category, recognize minimum required labeling components, indicate the need for labeling requirements, and apply allergen knowledge to broader questions.

"Quiz Three" consisted of solely knowledge questions, regarding specialized products. In this learning assessment, participants were expected to be familiar with morel mushroom requirements and the dangers of home-canned goods.

Once the participants completed their learning assessments, the results were gathered through the Moodle website and analyzed, looking at score progression, attempt number, question type, and overall module instruction effectiveness. The results of the learning assessments would aid in gauging the effectiveness of this online workshop, and later aid in the development of the full six-module online workshop from the face-to-face workshop series.

## **2.6 Statistics**

Descriptive statistical analysis was used to analyze all of the data for this study in order to give quantitative descriptions of participant performance. This analysis gave us measures of central tendency and measures of variability. From this analysis, we were able to summarize our data and draw claims from it.

## **2.7 Assumptions**

For the purpose of the analyses of the results of this study, it was assumed that each participant gave their best effort while completing the learning assessments, striving to achieve 100% each attempt. If this was not true, it would be difficult to accurately assess the participants' level of knowledge gained after engaging in the online module. It was also assumed that participants did not get outside help (e.g. internet, textbooks, or content experts) while completing the learning assessments in order to achieve higher scores.

## **2.8 Limitations**

The demographic may have experienced a selection-bias due to the participants having volunteered to participate in this study. Additionally, only one module was piloted, which may not necessarily represent the potential of the full online workshop. Each module covered different topics which may have different levels of online success, despite attempts to keep material difficulty consistent.

### 3 Results and Discussion

One module of a previously-existing face-to-face food safety workshop was transitioned to an online format. The objective of this pilot study was to examine the effectiveness of the online instruction module and use those results to guide the transition of the original workshop to a completely online format. The online module in the pilot study was assessed by looking at the first-attempt scores of the learning assessments, the number of attempts required by the participants to achieve 100%, and the types of questions that were met with difficulty by the participants.

The results in Table 2 demonstrate that the highest success rates were observed for comprehension and analysis-style questions, at 84.92% and 87.84%, respectively. Participants excelled in displaying comprehension and analytic skills. Comprehension-style questions on an examination test the participants' ability to make use of the material presented to them, while analysis-style questions test the ability to break down information or to make relations between the information presented (Anderson et al., 2001). According to previous research, the high average score for the comprehension-style questions suggests that the online module provided an engaging learning experience with recognizable language (Badarudeen & Sabharwal, 2010; Hogan, Bridges, Justice, & Cain, 2011; Pressley, 2001). This allowed participants to fully absorb the information presented to them and to recognize principles in new situations. These results align with the work of Shearer, Snider, and Kniel (2013), who developed curriculum that included interactive web-based activities, lecture presentations, and case studies and found that engaging in these materials led to a positive impact on familiarity with food safety strategies, regulatory requirements, and food terminology. Analysis-style questions showed high success rates, which according to previous research, suggests that this online module provided good

opportunity for independent thinking, while providing solid instruction of concepts and helpful feedback (Barsuk et al., 2012; Bensley, Crowe, Bernhardt, Buckner, & Allman, 2010; Hugerat & Kortam, 2014). Giving the participants these skills allowed them to analyze the unique questions provided to them in the learning assessments. Our findings were supported by previous findings by Adam, Young-Wolff, Konar, and Winkleby (2015) , who showed that their series of online short videos gave participants stronger analytic skills, as they were able to better analyze the nutrition of their meals.

Knowledge-style questions had a slightly lower first-attempt success rate at 80.19%, as displayed by Table 2. These questions require the recall of specific facts, methods, or other pieces of information (Anderson et al., 2001), which was necessary for learning the regulations for each type of home-based food operator. To help enhance this foundational skill, many real-life examples and statistical data (i.e. previous outbreaks, allergen statistics, etc.) were added to both this module and the other five modules upon transition. Research has shown that low knowledge question scores may indicate a lack of evidence-based instruction (Bou-Mitri, Mahmoud, El Gerges, & Abou Jaoude, 2018; Cronenwett et al., 2007; Fritsche, Greenhalf, Falck-Yitter, Neumayer, & Kunz, 2002). These new additions should give a sense of relevance to the materials being presented to the participants. Although the knowledge scores were lower than analysis and comprehension scores, the knowledge question category still surpassed our standard of 75%. This differs from the work of da Silva, Brody, Byham-Gray, and Parrott (2014), who found their knowledge scores to fall short of their standard of 80% for their online nutritional course.

Table 2 demonstrates that application-style questions had the lowest first-attempt success rate, at 75%. To adjust for this slight lack of application skills, module one, as well as the full

online workshop, has been fortified with case studies. Case studies have shown to dramatically improve application skills, as they provide much opportunity for guidance and practice (Bonney, 2015; Collier, 2017; Well, Oyelere, Yeoh, & Firer, 2001). These added case studies may show practical use for material presented and aid in sufficient application-based knowledge transfer. Despite having the lowest first-attempt success rate, the application-style questions still met the standard of 75%, showing acceptable participant application skill. Lohse, Belue, Smith, Wamboldt, and Cunningham-Sabo (2015) also found good transfer of application skill in their study, in which their online program helped low-income women with food management.

Table 3 demonstrates the division of the four question types among the three learning assessments. "Quiz One" contained each type of learning assessment question: knowledge, comprehension, application and analysis. This learning assessment was met with the median learning assessment score, 86.33%, possibly due to the fair balance of different skills needed to complete it. The mean first-attempt averages for each learning assessment in module one can be found in Table 4, along with percent/standard deviations, the final attempt averages, and the average number of attempts that was required by participants to achieve a score of 100%. The "Quiz One" first-attempt average score of 86.33% surpassed our standard of 75%, showing this learning assessment to be very effective at participant instruction. This learning assessment took participants an average of 4.65 attempts to achieve 100%. The high attempt number suggests there was a difficulty in effectively instructing all of the information present. According to Brothern & Wambach (2001), fewer attempts required to achieve the correct response suggests better preparation. This learning assessment had the highest required attempt number out of the three learning assessments, displaying a need for more thorough instruction on home-based food operator regulations. This finding led to more detailed instruction on home bakers and exempt

home food operators, with module one being fortified with extra resources, including extended lists of products that home bakers and exempt home food operators may sell and farmers' market information provided by the Iowa Department of Inspections and Appeals. Summarizing statements were also added throughout the lecture videos to further explain information and clarify concepts learned. Research has shown that high attempt rates may also suggest a lack of sufficient feedback, which helps move learners forward (Cohen & Sasson, 2016). This motivated the alteration of the learning assessment feedback by giving the exact reference locations to participants so that they may further explore each topic.

"Quiz Two" had a fair balance of question types, but had a higher percentage of analysis-style questions than "Quiz One." As Table 2 shows, participants performed best on analysis-style questions, with a first-attempt success rate of 87.84% across all learning assessments. This may have led to the highest learning assessment score of 90.53% on "Quiz Two". This very high average shows the online module did an excellent job at instructing allergens and allergen labeling. Studies have shown that high testing achievement is strongly linked to quality instruction, a positive learning environment, and strong resources outside of direct instruction (Garrett & Steinberg, 2015; Rivkin & Schiman, 2015). This leads us to believe the resources we provided for allergens (food allergen fact sheets, Food Allergy Research and Education website link, extension documents, etc.) effectively furthered their knowledge. This lecture video was also very straightforward and contained the most simplistic slides out of the three lecture videos, which according to many researchers, may have created a positive and non-stressful environment for learning to take place (Bernstein & Mosenson, 2018; Lewish, 2016; Noh, Fauzi, Jing, & Ilias, 2017). It took an average of 1.67 attempts for participants to achieve 100% for this learning

assessment, suggesting a high level of learning assessment preparation by the participants for the topics of allergens and allergen labeling.

"Quiz Three" had the lowest learning assessment average of 83.09%, likely due to the presence of only knowledge-style questions. These questions had the second lowest participant success rate of 80.19%. Although this learning assessment had the lowest average out of the three analyzed, it still exceeded the established standard of effective instruction of 75%. Research suggests that lower scores may suggest a weaker interaction between the participants and instructor (Zhang, Zhang, Zou, & Huang, 2018). To increase perceived interaction, feedback for the "Quiz Three" learning assessment was fortified with specific resource locations and written to be more concise. Additionally, further explanation was given on the dangers of home-canning. Participants took this learning assessment an average of 3.81 times to achieve 100%. This may be an indicator that there was difficulty in knowledge transfer for the topics of specialized products and fruit jams, fruit jellies, and fruit butters. The added discussion and resources were given to provide better knowledge transfer and give more opportunity for deeper learning.

Overall, these learning assessments showed great potential for the online module as an effective means of instruction for home-based food operators. Similar results were found through the research of Wallner, Kendall, Hillers, Bradshaw, and Medeiros (2007), who executed an online six-module course. They deemed their educational format, which closely mirrors this one, to be a convenient effective option of educating dietetic professional and extension educators on food safety issues. Alberts and Stevenson (2017), of North Carolina State University, developed a multimedia case study in order to instruct food safety principles to students. They heavily attributed their use of instructional videos to their success in student knowledge increase, as

videos have shown to give a higher level of student engagement (Borup, West, & Graham, 2012; Yadav et al., 2011). We also found this to be true in this study.

This project was limited by the number of participants involved Twenty-one participants engaged in module one, so it cannot be stated with certainty that this online module is effective at instructing home-based food operators. If we use the number of active home bakeries in the state of Iowa as our population size, 421 (DIA, 2019), then we can calculate a sample population that would be needed to test this online workshop in order to state that it can certainly be deemed an effective educational format. For a population of 421 establishments, a sample population of approximately 202 would be needed to state (with a 95% confidence level and a 5% margin of error) that this online format is effective at educating home-based food operators in the state of Iowa (Israel, 1992; Krejcie & Morgan, 1970; Salganik, 2006; Whitehead, Julious, & Cooper, 2016). However, if we use the Viechtbauer pilot sample size equation to solve for sample size, with a 95% confidence interval, 15% minimum probability of error, and a population of 421 home bakeries, then we get an ideal sample size of 19 participants. (Viechtbauer et al., 2015). Therefore, our sample size of 21 is more than ideal for this pilot study.

This project was also limited by the lack of control present in the testing environment, as it was unknown if the participants were using outside sources to complete their learning assessments. This presents a possible direction for future research. It may be quite useful to have participants engage in the online platform in a controlled environment where supervisors can ensure they are not consulting with the internet or other outside resources. This would help ensure that learning assessment scores are fairly gauging participants' online learning.

Additionally, it may also be beneficial to compare scores of participants engaging the online



platform to the scores of participants engaging in the face-to-face platform, which would allow researchers to determine if the online platform is producing approximately the same results.

#### **4 Conclusion**

This research has shown that online education has potential as an effective means of instructing home-based food operators on Iowan regulations and policies, food allergens, specialized products, fruit jams, fruit jellies, and fruit butters. Each learning assessment given resulted in average scores greater than the common standard of food safety training success of 75%. The results of this study have led to the further development of a fully online six-module workshop, with the addition of real-life examples, case studies, statistics, and summarizing statements. For busy home-based food operators, online education offers a flexible learning environment that shows great potential for success.

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#### **Author Contributions**

T. Temen designed the online module and associated learning assessments, analyzed the data, and drafted the manuscript. S. Coleman designed the study, supervised the project, developed the manuscript and was in charge of overall direction and planning. N. Jaramillo

Cherrez evaluated lecture video and learning assessment content, provided guidance on online instructional methods, and developed the manuscript.

### **Conflicts of Interest**

There are no known conflicts of interest involved in this project.

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## Tables

Table 1– *Foodborne outbreaks traced back to local food sources from 2002-2017*

Source	Year	Pathogen	Number Affected	Food Source	Cause
Massachusetts bakery <sup>a</sup>	2002	Norovirus	2,700	Wedding cakes	Ill workers
Chicago-area bakery <sup>b</sup>	2010	<i>S. aureus</i>	≈100	Cream-filled pastries	Time-temperature abuse
Rhode Island bakery <sup>c</sup>	2011	<i>Salmonella</i>	19	Various cream-filled baked goods	Improper storage and unsanitary conditions
Oregon farm stands and farmers markets <sup>d</sup>	2011	<i>E. coli</i>	15	Strawberries	Contamination by deer feces
Wisconsin farmers market <sup>e</sup>	2017	<i>Salmonella</i>	7	Fresh-shelled peas	Unknown contamination

<sup>a</sup> Friedman, D., & Heisey-Grove, D. (2005). An outbreak of norovirus gastroenteritis associated with wedding cakes. *Epidemiology & Infection*, 133(6), 1057–1063. <https://doi.org/10.1017/S0950268805004760>

<sup>b</sup> IDPH. (2010). *Foodborne Illness Linked to Bakery*. Springfield, IL. Retrieved from <http://www.idph.state.il.us/public/press10/12.23.10Bakery.htm>

<sup>c</sup> HEALTH Investigating Salmonella Outbreak Possibly Associated with Baked Goods. (2011). Retrieved July 10, 2019, from <https://www.ri.gov/press/view/13483>

<sup>d</sup> Stone, C. (2011). Fresh Strawberries Implicated in *E. coli* O157 Outbreak in NW Oregon. Retrieved July 22, 2019, from <http://www.hort.cornell.edu/fruit/nybn/newslettpdfs/2011/nybn1007.pdf>

<sup>e</sup> WDHS. (2017). *Salmonella Infections Linked to Shelled Peas Sold at Three Wisconsin Farmers Markets*. Retrieved June 22, 2019, from <https://www.dhs.wisconsin.gov/news/releases/081117.htm>

Table 2- *Online module participants' average first-attempt success rate by question type (n=21)*

Question Type	Number of Question	First Attempt Success Rate
Comprehension	6	84.92%
Knowledge	12	80.19%
Analysis	2	87.84%
Application	4	75.00%



Table 3- Participants' average first-attempt question success rate throughout the online module learning assessments (n=21)

Quiz	Question Number	Question Type	First Attempt Success Rate
1	1	Comprehension	76.2%
	2	Comprehension	61.9%
	3	Knowledge	76.2%
	4	Knowledge	57.1%
	5	Knowledge	81.0%
	6	Comprehension	100%
	7	Analysis	81.0%
	8	Application	90.5%
	9	Application	76.2%
	10	Knowledge	85.7%
	11	Knowledge	100%
	12	Knowledge	71.4%
	13	Knowledge	95.2%
	14	Comprehension	90.5%
	15	Comprehension	81.0%
	16	Application	47.6%
2	1	Knowledge	100%
	2	Comprehension	100%
	3	Knowledge	81.0%
	4	Application	85.7%
	5	Analysis	95.2%
3	1	Knowledge	95.2%
	2	Knowledge	100%
	3	Knowledge	33.3%

Table 4- Participants' average first-attempt learning assessment score, final attempt learning assessment score, and the average number of attempts required for them to score 100% (n=21)

Learning Assessment	1 <sup>st</sup> Attempt Average	Percent Deviation	Final Attempt Average	Percent Deviation	Attempts to Achieve 100%	Standard Deviation
1	86.33%	9.05%	97.68%	3.91%	4.65	3.96
2	90.53%	11.90%	99.00%	4.46%	1.67	1.24
3	83.09%	9.74%	98.13%	4.59%	3.81	2.04