Promoting student learning of statistical food sampling plans using an online interactive module

Clint Stevenson, NC State University
Alec Lucas, NC State University
Helen Joyner, University of Idaho
Shelly Schmidt, University of Illinois at Urbana-Champaign
Instructional Challenges in Applied Sciences

• Helping students understand real world applications
• Facilitating experiential learning opportunities
  • Accessibility
  • Time
  • Funding)
• Constructivist approach to teaching
  • Students lack prior experiences necessary for constructing meaning

• Instructional strategies can help overcome barriers, but no universal fix
Project Outline

Goals

1) Develop process for creating a reusable module that is based on sound learning principles,
2) engages undergraduate students with real-world applications of agricultural and food science subject matter through virtual reality, and
3) incorporates adaptive learning strategies

Objectives

1) Develop interactive online virtual reality module that covers statistical sampling principles
2) Assess module effectiveness
3) Refine module based on Objective 2 results
The Spectrum of Costs for Creating e-Learning

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Average Cost</th>
<th>Average Time to Create 1 Hour of Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Content, pages, text graphics, “PowerPoint-to-eLearning”</td>
<td>$10K</td>
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<td>Level 1 plus 25% more interactive exercises</td>
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Our approach:
• Collaboratively draft a design document
• Recruit tech-savvy and motivated undergraduate for design development
• Implement iterative development process

So what do you do when you have limited budget and time?

Successive Approximation Model

Image from https://www.alleninteractions.com/sam-process
Module Design

• Collaborative design process

• Learning goals

• Storyline

• Translation to storyboard

• Module development

• Alpha testing

• Beta testing
Study Design

Pre-Test
- 10 knowledge questions
- 4-point self-efficacy instrument consisting of 9 questions

Intervention

Post-test
- Pretest questions
- Learning Object Evaluation Scale for Students
  - 4 questions each for levels of learning, engagement and quality of design

Statistical Analysis
N=49 (npre-test=24, npost-test =20)
Nonparametric Wilcoxon test
## Change in Knowledge and Self-Efficacy

<table>
<thead>
<tr>
<th>Construct</th>
<th>Pre-Test Average (n=24)</th>
<th>Post-Test Average (n=20)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>69% (SD = 20%)</td>
<td>66% (SD = 17%)</td>
<td>0.36</td>
</tr>
<tr>
<td>Self-Efficacy (5-point scale)</td>
<td>1.9 (SD = 0.66)</td>
<td>2.4 (SD = 0.67)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

I can do this!
Qualitative Feedback

What did students like?

• “I thought the concepts were interesting to learn about and by putting the "player" in a real-world office environment was pretty neat and relatable. Overall, I thought it was pretty fun and conducive to learning. It just needed a few kinks worked out.”
• “It was interactive and had visuals and feedback”

What did students NOT like?

• “The font of the words are too hard to figure. Should make it bigger and clear.”
• “The setup of the module, hard to follow.”

What recommendations did students have?

• “Make the words in the module bigger and clear.”
• “Maybe add in more videos.”
n = 24
# Awareness of Real-World Applications

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Somewhat disagree</th>
<th>Neither agree nor disagree</th>
<th>Somewhat agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The module was designed in a way that helped me understand the real-world applications of acceptance sampling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The module helped me imagine myself applying acceptance sampling in the real world</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experiencing the module put acceptance sampling into a real-world context</td>
<td></td>
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</tbody>
</table>
Lessons learned

• Module boosted self-efficacy, but not actual learning
• Adaptive learning helps target areas where students struggle

• Expert blind spots
• Iterative testing is necessary!
• Work around limitations of program
• Make sure module is intuitive to use!
  • Functionality
  • Context
Acknowledgements

• Association of Public Land Grant Universities – Innovative Teaching award
• WSU/UI, UofI, NCSU Food Science departments
• Glen Joyner
• University of Illinois Students
Thank you!

Questions?
## Four Learning Theories

<table>
<thead>
<tr>
<th>Behaviorism</th>
<th>Cognitivism</th>
<th>Humanism</th>
<th>Constructivism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus on behavior change</td>
<td>Requires prior knowledge: mind is “black box”</td>
<td>Educator is facilitator, not teacher</td>
<td>Learner constructs information based on prior knowledge</td>
</tr>
<tr>
<td></td>
<td>Learning principles:</td>
<td>Learning principle:</td>
<td>Learning principles:</td>
</tr>
<tr>
<td></td>
<td>• Direct Instruction</td>
<td>• Experiential Learning</td>
<td>• Situated Learning</td>
</tr>
<tr>
<td></td>
<td>• Programmed Instruction</td>
<td></td>
<td>• Problem-Based Learning</td>
</tr>
<tr>
<td></td>
<td>• Social Learning Theory</td>
<td></td>
<td>• Case-Based Learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Social Development Theory</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Cognitive Apprenticeship</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Discovery Learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Activity Theory</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Actor-Network Theory</td>
</tr>
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<td></td>
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</table>

Our Collaborative Approach to Teaching an Undergraduate Course on Quality Control

<table>
<thead>
<tr>
<th>Core Domains*</th>
<th>Instructional Strategies</th>
<th>Level of Students’ Proficiencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality management principles and programs</td>
<td>Discussions, case studies</td>
<td>Medium-High</td>
</tr>
<tr>
<td>Basic quality tools</td>
<td>Peer reviewed case studies**</td>
<td>Medium-High</td>
</tr>
<tr>
<td>Root cause analysis</td>
<td>Peer reviewed case studies**</td>
<td>Medium-High</td>
</tr>
<tr>
<td>Control charts</td>
<td>Peer reviewed case studies**</td>
<td>Medium-High</td>
</tr>
<tr>
<td>Hypothesis testing</td>
<td>Peer reviewed case studies**</td>
<td>Medium-High</td>
</tr>
<tr>
<td>Acceptance sampling</td>
<td>Peer reviewed case studies**</td>
<td>Low-Medium</td>
</tr>
</tbody>
</table>

*Joyner and Stevenson. 2018. If you don’t know, ask! Using expert knowledge to determine what content is needed in an undergraduate food quality management and control course. Journal of Food Science Education 16: 19-27

** Case studies published through the National Center for Case Study Teaching in Science
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