Teaching Natural Resource Economics with Digital Learning Objects: Evolution from Chalk to Digital Ink
A learning object is defined by IEEE as “any entity, digital or non-digital, that may be used for learning, education or training"
8 year search for a “good” tool.

Voice recording Solutions

- Camtasia Studio
- Adobe Presenter
- Echo 360

What is missing?

Question: How can we develop a traditional chalkboard experience for students?
Pen Solutions

- Tablet Technology
- Gateway Tablets (2004)
- **Pro**
  - Write and record step by step problems using Camtasia Studio.
  - Great for grading!
- **Con**
  - Expensive
Familiar pen and paper format
- Digital handwritten ink and synchronous voice recording
- Uploaded to a website
- Assigned a URL
Problem 4.1
Present Location: NW Farm.

(a) $q = 0.0625 \frac{g}{m^2}$

Given: $C = 0.4$, $A = 80$ ha, Find $q$?

(b) $T_{ce} = 0.0195 \left(\frac{C}{A}\right)^{0.7} \left(\frac{E}{T_{ce}}\right)^{0.35}$

Find $T_{ce}$

Find $x$, $y$ (Table 2.1 and 2.2)

Find $A$, $B$, $C$, $D$ per Table

$A = 1.6$, $B = 3.4$, $C = 3.1$, $D = 7.0$

Table 2.1

<table>
<thead>
<tr>
<th>y</th>
<th>x</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

$s_0 = \frac{x}{y} = \frac{1}{3}$

$x = 2.8$, $y = 2.4$

$I = 0.0195 \left(\frac{3.1 - 1.6}{1.6}\right) \frac{0.005}{6} \left[\left(\frac{3.1 - 1.6}{1.6}\right) \left(3.1 - 2.4\right) + 0.01\left(3.1 - 1.6\right)\right] + 1.2$

$I = 1.6 \times 1.8 \times 3.5 \times 0.0195$

$P_{ce} = 35.7 \text{ mns}$

$\frac{0.0195 \times 60}{1.8} = 2.17 \text{ mns}$

$q = 0.0625 \left(\frac{1.8}{1.6}\right) \left(127.2 \text{ mns}\right) \left(984 \text{ m}^2\right) = 11.99 \frac{n}{m^2}$
Livescribe Link Page
Livescribe Pulse & Echo Smartpens looks like a somewhat large pen. They are a bit thicker than a regular pen, but they don’t feel abnormally large or heavy.

The ink pen is simply an INK PEN. The specially encoded paper is still just PAPER!

So how does it write? – Just like pen and paper!
What Can I Write?

Anything You Want!
Echo Smartpen Overview

**Micro-USB Connector**
Transfers notes and audio to your computer and recharges your smartpen using a standard cable connection.

**Audio Jack**
Standard 3.5mm jack fits your own earphones or the Echo 3-D Recording Premium Headset to enable binaural recording.

**Microphone**
Capture your meetings or lectures with crisp clear sound.

**OLED Display**
High-contrast OLED display makes it easy to navigate smartpen apps.

**Built-in Speaker**
Built-in speaker produces rich full sound to play back your recorded audio.

**Memory Storage**
Holds 400 or 800 hours of recorded audio. (4GB and 8GB models available)

**Soft Rubber Grip**
The new ergonomic design and soft rubber grip provide comfort while writing.

**Replaceable Ink Tip**
Simply remove the ink cartridge with your fingers and insert a new one.
Echo - What’s in the Box
4 Gb $169 & 8 Gb $199

Contents of the Echo Smartpen Package

- Starter Dot Paper Notebook
- Interactive Getting Started Guide
- Smartpen Tips and Tricks
- 2 Smartpen Caps
- Echo Smartpen and Included Apps
- 2 Ink Cartridges
- Standard Micro USB Cable
- Livescribe™ Desktop Software (Download)
- 500MB of Online Pencast Storage
Using the Livescribe Smartpen

- Turn It On!
- Write on the Special Livescribe dot-encoded paper.
- If you want it to record your voice, simply Click the “Record Button” and Click the Stop Button when you want to Stop recording audio.
- You can “Tap” anywhere on the notes you have written, and it will play back the audio that occurred at that time.
Previous Experiences: Undergraduate Students

Undergraduate Survey at UTM
Measure of Effectiveness

- Three semesters of class data for AGET 110
  - Class A - Spring 2010 - traditional lecture based teaching methods (Control)
  - Class B - Fall 2010 - traditional lecture based teaching methods and DLOs created with the Smartpen
  - Class C - Spring 2011 - traditional lecture based teaching methods and DLOs created with the Smartpen

- Student Survey
# Student Survey Outcomes

## Class B responses (n=30)

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Somewhat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you access the DLOs when completing your homework?</td>
<td>23</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Did you access the DLOs when studying for your exam?</td>
<td>23</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Did you find them helpful?</td>
<td>21</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

## Class C responses (n=49)

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Somewhat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you access the DLOs when completing your homework?</td>
<td>41</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Did you access the DLOs when studying for your exam?</td>
<td>30</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Did you find them helpful?</td>
<td>32</td>
<td>7</td>
<td>10</td>
</tr>
</tbody>
</table>
## Statistical Analysis

### Average Exam Scores

<table>
<thead>
<tr>
<th>Class</th>
<th>Exam 1</th>
<th>Exam 2</th>
<th>Exam 3</th>
<th>Final Ex</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (n=28)</td>
<td>83.4</td>
<td>62.0</td>
<td>73.3</td>
<td>71.9</td>
</tr>
<tr>
<td>B (n=30)</td>
<td>83.8</td>
<td>64.8</td>
<td>77.7</td>
<td>79.9*</td>
</tr>
<tr>
<td>C (n=48)</td>
<td>74.7*</td>
<td>74.8*</td>
<td>77.4</td>
<td>74.9</td>
</tr>
</tbody>
</table>

*Significant at the 0.01 level

Class A *(Control)* had no DLOs available.
Student Perceptions

- Students perceived the DLOs were advantageous to them
- DLOs were accessed for exam preparation an average of 60%
- Final Survey
  - Overall opinion of the DLOs for the course
“Did you find them helpful?”

Class B – 87% found DLOs helpful or somewhat helpful
Class C – 86% found DLOs helpful or somewhat helpful

“Please rate your overall opinion of the availability of the DLOs and their helpfulness for this course.”

Class B (86%)
- Very positive – 33%
- Positive – 53%

Class C (89%)
- Very positive – 56%
- Positive – 33%
Previous Experiences: Faculty
Who Responded to the Survey? (n = 27)

Survey Demographics

<table>
<thead>
<tr>
<th>Role</th>
<th>No. of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Professor</td>
<td>8</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>1</td>
</tr>
<tr>
<td>Professor</td>
<td>8</td>
</tr>
<tr>
<td>Instructor</td>
<td>6</td>
</tr>
<tr>
<td>Graduate Student</td>
<td>1</td>
</tr>
<tr>
<td>Undergrad</td>
<td>1</td>
</tr>
<tr>
<td>IT Staff</td>
<td>1</td>
</tr>
<tr>
<td>Admin Asst</td>
<td>1</td>
</tr>
</tbody>
</table>
Do you have a Windows or Macintosh based computer?
Teaching Style

Classification and Teaching Style

- Undergraduate - Online: 41.2%
- Undergraduate - In Class: 58.8%
- Undergraduate - Hybrid: 11.8%
- Graduate - Online: 35.3%
- Graduate - In Class: 5.9%
How do you share your Livescribe teaching modules with others?

- Post a Link in Bb CMS: 35.3%
- Email Link: 35.3%
- Upload PDF documents: 5.9%
- Embed Link in PowerPoint: 5.9%
- Post to departmental website: 29.4%
Save Time?

Does the Livescribe Pulse Pen save you time?

- No: 2
- Yes: 13
Would You Recommend the Livescribe?

Would you recommend the Livescribe Pulse Pen to a colleague?

- Yes: 14
- No: 2

0 2 4 6 8 10 12 14 16
Does the Livescribe Pulse Pen enhance your ability to develop meaningful Learning Objectives?
What are students saying?

Feedback from Students

<table>
<thead>
<tr>
<th>Feedback Type</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Positive</td>
<td>27</td>
</tr>
<tr>
<td>Positive</td>
<td>27</td>
</tr>
<tr>
<td>Negative</td>
<td>0</td>
</tr>
<tr>
<td>Strongly Negative</td>
<td>0</td>
</tr>
<tr>
<td>No Feedback</td>
<td>47</td>
</tr>
</tbody>
</table>
The Livescribe Smartpen provides a user-friendly digital interface for traditional pen and paper mathematical solutions with voice.

Helpful in engaging students outside the classroom.

Great advantage of accessibility for students.

More inclusion in courses in the Department of Agriculture, Geosciences and Natural Resources.
Example of Problem Solving

- Example Problem (Dr. Sandy Mehlhorn)
- Welfare Analysis Graph: Externalities (NRM 730)