A Beginner’s Guide to Creating Short Videos for Geoscience Courses
Earth Educators’ Rendezvous 2019

David McConnell
North Carolina State University
Department of Marine, Earth, and Atmospheric Science

Workshop Goals

1. Identify some basic steps to create a short instructional video
2. Apply those steps to create an outline for a mini-video that includes a script and associated images
Participant Goals?

Why make videos for geoscience courses?
Flipped Class Format

Students view brief videos as preclass assignments then . .

Naming Igneous Rocks

Videos begin with learning objectives, often contain formative assessments, and end with a reflection activity.

. . complete an online quiz

Average completion time ~30 minutes
Flipped Class Format

Early in next class
• Answer video review questions

Some instruction presented online before class
• Frees 10-20 minutes of class for more challenging concepts and active learning exercises

Lesson timeline and content before/after introduction of videos

<table>
<thead>
<tr>
<th>Before</th>
<th>LO</th>
<th>Igneous rock classification</th>
<th>Partial melting processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>After</td>
<td>LO</td>
<td>Igneous rock classification</td>
<td>Partial melting processes</td>
</tr>
</tbody>
</table>

LO = learning objectives
Flipped Introductory Class

Brief videos to support flipped class model
https://www.youtube.com/c/Geosciencevideos/

Research\(^2\) shows that median engagement time is ~6 minutes regardless of length of video

Topics reflect basic content for an introductory geoscience course

Video Characteristics

• Brief (~6-7 minutes)

• Associated quizzes and other resources on blog

https://geosciencevideos.wordpress.com/

### Student Performance: Text vs. Video

**Classification of Faults**

**Learning with Video vs. Text**
- 15 students read text, 15 students watched short (~6 minute) video
- Pre-treatment quiz scores → no significant difference
- Post-treatment quiz scores significantly higher (p<0.05) for students who watched videos
- Dual channel processing (visual + auditory) → greater learning

### Student Performance: Video vs. Lecture

**Learning with Video vs. Lecture**
- Control (2014, n=94): basic content presented in class by lecture, activities
- Treatment (2016, n=91): basic content presented in pre-class videos w/online questions
- No significant difference in performance on the same related exam questions
Watch the two short videos that follow

Compare and contrast how similar information is presented

**Multimedia principle** – People learn better from words (narration, text) and pictures (photos, maps, diagrams, animations, video) than from words alone

Cognitive theory of multimedia learning

**Dual-channels principle:**
There are separate information processing channels for visual and verbal information

- Diagrams
- Animations
- Video demonstration
- Narration
- Text on slides

**Limited-capacity principle:**
Only a few items in each channel can be processed in working memory at a time

---

https://3starlearningexperiences.wordpress.com/tag/dual-coding-theory/

**Limited-capacity principle:**
Only a few items in each channel can be processed in working memory at a time.

**Active-processing principle:**
Learners need to engage in appropriate processing tasks including selecting, organizing and integrating information.
Cognitive theory of multimedia learning – People learn better from words and pictures than from words alone

- **Dual-channels principle**: Separate channels for visual, verbal information
- **Limited-capacity principle**: A few items can be processed at a time
- **Active-processing principle**: Students organize and integrate information

**Challenge**: How to design lessons to encourage active-processing without overloading visual and verbal channels

- Caveat – experimental results, multimedia not necessarily the same as video

**Design Goals for Multimedia Learning Materials**

1. **Reduce extraneous processing**: Minimize distractions, emphasize key information
2. **Manage essential processing**: Create suitable representations of necessary information
3. **Foster generative processing**: Design elements of lesson to motivate students to learn effectively
Coherence Principle
Students learn better when extraneous details are excluded

Most significant when:
• Extra material is very interesting
• Lesson is cognitively demanding

Example:
Ocean waves lesson
• Group A: Reviewed more concise materials (653 words, 6 illustrations).
• Group B: Reviewed expanded materials (980 words, 11 illustrations) including related mathematical formulas and computations.

Essay Assessment Results:
Group A > Group B (t(41) = 4.29, p < .01)

Signaling Principle
Include cues to help learner focus on essential content

• Bold, colored, highlighted text
• Arrows, labels
• Most significant for students with low prior knowledge
Redundancy Principle
Graphics and narration better than graphics, narration and on-screen text

- Applies when text is redundant with narration; OK for few words
- Most significant effect for students with low prior knowledge
- Narration and text OK w/out graphics

Spatial Contiguity Principle
Place text near corresponding parts of images

- Text is not presented in standard “caption” format below figure
Temporal Contiguity Principle
Present graphics and text and/or narration simultaneously

- Successive presentation of text and images essentially doubles cognitive load
- May not apply with small amounts of information or easier material

Strategies for Reducing Extraneous Processing

- **Signaling Principle**: Include cues to help learner focus on essential content
- **Coherence Principle**: Students learn better when extraneous details are excluded
- **Spatial Contiguity Principle**: Place text near corresponding parts of images
- **Redundancy Principle**: Graphics and narration better than graphics, narration and on-screen text
- **Temporal Contiguity Principle**: Present graphics and text and/or narration simultaneously

**Suggestions for Creating Videos**

**Identify Learning Objectives**

Which principle(s) is/are best represented by identifying learning objectives?

- **Temporal Contiguity**
  - Present graphics and text and/or narration simultaneously

- **Redundancy**
  - Graphics and narration better than graphics, narration and on-screen text

- **Spatial Contiguity**
  - Place text near corresponding parts of images

- **Coherence**
  - Students learn better when extraneous details are excluded

- **Signaling**
  - Include cues to help learner focus on essential content

---

**Design Goals for Multimedia Learning Materials**

1. **Reduce extraneous processing**: Minimize distractions, emphasize key information

2. **Manage essential processing**: Create suitable representations of necessary information

3. **Foster generative processing**: Design elements of lesson to motivate students to learn effectively

Segmenting Principle
Divide lesson into smaller, user-paced segments

Modality Principle
Graphics and narrations are better than graphics and on-screen text

- More significant for non-segmented lessons, with dynamic (not static) graphics and learners w/low levels of prior knowledge
Strategies for Managing Essential Processing

Pre-training Principle
Introduce key terms before using them in a lesson

Segmenting Principle
Divide lesson into smaller, user-paced segments

Modality Principle
Graphics and narrations are better than graphics and on-screen text

Effect Size

How many words would you speak in a minute?

Suggestions for Creating Videos

Write a Script

- Script length ~800-1200 words
Write a Script

- Narration rate average
  - ~150 words/minute

More likely to pause narration to include assessment exercises

Script length ~800-1200 words
- Range = 90-200 words/minute
Suggestions for Creating Videos

Break script into scenes/slides

Public domain (e.g., NOAA, NPS, USGS, USDA)

Created images and videos

Suggestions for Creating Videos

Use one or more slides/scenes per point

- Recent videos: average slide rate ~4 slides/minute
- ~10 text words per slide
- ~40 spoken words per slide

Sync Visuals and Narration
Suggestions for Creating Videos

Which principles are best represented in writing a script and adding appropriate visualizations, text and narration?

- **Temporal Contiguity**
  Present graphics and text and/or narration simultaneously

- **Redundancy**
  Graphics and narration better than graphics, narration and on-screen text

- **Modality**
  Graphics and narrations are better than graphics and on-screen text

- **Spatial Contiguity**
  Place text near corresponding parts of images

- **Coherence**
  Students learn better when extraneous details are excluded

- **Signaling**
  Include cues to help learner focus on essential content

- **Pre-training**
  Introduce key terms before using them in a lesson

- **Segmenting**
  Divide lesson into smaller, user-paced segments

Design Goals for Multimedia Learning Materials

1. **Reduce extraneous processing**: Minimize distractions, emphasize key information

2. **Manage essential processing**: Create suitable representations of necessary information

3. **Foster generative processing**: Design elements of lesson to motivate students to learn effectively
   - Social agency – sense of partnership between student and instructor

 Strategies for Encouraging Effective Processing

Personalization Principle
Present words in conversational, not formal, style

- More effective for low prior knowledge learners
- **Voice principle** – better learning from human vs. machine-like voice

- **Classify these igneous rocks using their composition.** Which of these examples represent felsic, mafic and intermediate varieties?

- **Let’s try classifying a few igneous rocks by composition.** What about these examples, can you identify the felsic, mafic and intermediate varieties?

Strategies for Encouraging Effective Processing

**Embodiment Principle**

On-screen instructor uses actions, movement

- Explain diagram on white board vs. Draw and label diagram on white board

- May not apply for learners with high level of prior knowledge

People in video: Yes or No?

Limited personal appearances
- Careful to build connection without distraction
- Demonstrate methods, models

Strategies for Encouraging Effective Processing

- **Embodyment Principle**
  On-screen instructor uses actions, movement

- **Voice Principle**
  Better learning from human vs. machine-like voice

- **Personalization Principle**
  Present words in conversational, not formal, style

Suggestions for Creating Videos: Tech

Build video using familiar tools

- Create “base” slides in PowerPoint

- Insert blank placeholders for future images or video clips to be added in editing

Recording visuals
- Smartphone
- DJI Osmo 2 smartphone gimbal
- SONY CX580
- Canon EOS Rebel T7i

Recording audio
- Blue Yeti USB Mic
- Lavalier Mic
- Shotgun Mic
**Suggestions for Creating Videos: Tech**

Creating and editing your video

- Finding your comfort level

![Camtasia](image1)

<table>
<thead>
<tr>
<th>Basic/Free</th>
<th>Relatively Complex/Pricey</th>
</tr>
</thead>
</table>

Creating and editing your video

![Camtasia](image2)

- Original slide with images & text created in PowerPoint
- Video inserted
- Audio track recorded w/USB mic while running PowerPoint
- Call out added

**Camtasia**
Suggestions for Creating Videos for Courses

1. Identify learning objectives
2. Write a script
3. Break script into scenes/slides
4. Use one or more slides/scenes per point
5. Limited personal appearances
6. Build video using familiar tools
7. Select an appropriate video editing program

A Beginner’s Guide to Creating Short Videos for Geoscience Courses

David McConnell

Based on work with
Jennifer Wiggen
Jason Jones

http://www.youtube.com/c/GeoscienceVideos
https://geosciencevideos.wordpress.com/