Enhancing Information Retrieval from Lecture Recordings

Principal’s Teaching Award Scheme

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Introduction

• University wide lecture recording project for past two years.

• What do students want from lecture recording?

• What is the ideal form for presenting online recordings?
Students’ use of lecture videos

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review difficult concepts</td>
<td>77.2%</td>
</tr>
<tr>
<td>Review for a quiz or test</td>
<td>77.0%</td>
</tr>
<tr>
<td>Review class I did not attend</td>
<td>65.7%</td>
</tr>
<tr>
<td>Review concept I missed in the class</td>
<td>45.9%</td>
</tr>
<tr>
<td>Preview a lecture before class</td>
<td>10.1%</td>
</tr>
</tbody>
</table>

**Fig. 13** Student-selected purpose of use (N = 444)

“I would view the lecture once, but pause it and replay it constantly, to write down extra notes that I might have missed during the first viewing. This was extremely helpful to be able to do this.”

User Behaviour

• In-video dropout.
• Watching and re-watching selected sections of a video.
  • Particularly true of recorded tutorials.
• Also observed in lectures at transitions, and when key concepts are explained.
• Non-visual explanations had the highest proportion of “peak” activity.

‘Understanding in-video dropouts and interaction peaks in online lecture videos’, J. Kim et al., Proceedings of the first ACM conference on Learning @ scale, L@S’14, pp 41-50. DOI 10.1145/2556325.2566237
Features requested by students

“They were less interested in missing whiteboard content than in easily navigating to material. Their answers reinforced that better search and navigation was among the students’ highest priorities.”

Benefits of segmentation

- Reduces in-video dropout
- Simplifies finding content
- Improves retention in on-line format

The Ideal Lecture Recording?

• “A versatile learning resource comparable to a textbook.”

• Ability to navigate large volumes of lecture recordings.
  • Efficient information retrieval.
  • Key-points, highlighting.
  • Topical lecture themes.
  • Transcription for indexing and accessibility.
  • “Chalkboard” summaries.

• Minimise in-video “drop-out” and enhance engagement.

• Integrate note-taking.
Media Hopper Replay vs the Competition

Media Hopper Replay (MHR)
- 50 minutes duration for a typical lecture.
- Search limited: index by date/capture time, and title (if edited).
- Timeline preview for searching/playback x2.

What’s the Competition?
- YouTube lectures, duration typically 5 to 13 minutes.
- Presented as part of a focused “Channel” with meta-enhanced context.
- Information found easily and quickly by a Search.
- Often “Branded”.
- Easy to leave comments, and “Timestamps”.
- Some services correlate video with slides.
How to Achieve the Gold Standard

• Manually segment 50 minute lectures into shorter video segments based on topic (using video editing software).

• Write searchable text summaries (based on lecture notes?).

• Semi-automated caption/subtitle generation.

• Manually add meta-data linking video segments, time-stamps, lecture notes, external reading materials.

• Enhance chalk/marker-board and visualiser captures (crop/contrast, using image processing software etc).

• Unlikely any Academic Staff member would do this regularly!
PTAS Project: Enhancing Information Retrieval by Improving Content Organisation

- Nevertheless, is it worth it?
- The literature says yes, but we tried this to verify!
- With Student help!

“We hypothesise the ability to retrieve information quickly from a video will increase engagement.”

- Segmented lecture into ~10 x 5 minute video “highlights”.
- Student-created summaries describing content.
- Added meta data for search indexes (Keywords).
- Timestamped important content.
Summaries and Timestamps for Full Lectures

https://media.ed.ac.uk/channel/ELEE09027%2BSignals%2BBand%2BCommunications%2B3/88532151

- Concise summaries of full lecture written by students
- Timestamps for material

**EXAMPLE: Summary**
Showing how one can use MATLAB for investigating the workings and properties of a digital filter, ...

**Topic/ sub-topic:**
@00:36: Review the digital filters: the different equations and block diagram which describes them
@1:10: Using an example to explain the implementation in software.
Short Lecture Capsules


- Students created ~5 min length Lecture Capsules by editing full lecture – segmented as the students saw fit.
- Student-written summary of lecture capsules, list of keywords
- Built a “Channel” in Media Hopper Create (searchable).
Perception of Enhanced Content

• Questionnaire evaluated appeal of enhanced content.
• Students with access to enhanced content found it to be a significant improvement
  • Perception of Media Hopper Replay declines when compared with enhanced functionality.
• While students found the enhanced content to be of benefit, they do not like to change platforms.
• Encouraging Student Feedback through Questionnaire “Comments”
Technological Solutions

Can we automate this?
• Yes! Well, sort of ... active research topic!

Techniques include:
• Automatic key-frame recognition
• Automatic speech recognition
• Emotion recognition and Acoustic Emphasis
• Word-frequency for segmentation
• Crowd-sourced captioning
Technological Solutions: PTAS Project

Can we automate this?

• Two current joint Engineering and Informatics enthusiastic to develop “Automation Tools for Instructor-Led Segmentation and Indexing Markup”.
Worldwide University Projects

University of Houston
Taufun Tuna et. Al (PhD thesis)

Hasso Plattner Institute, Germany

http://videopoints.uh.edu/
Image Processing for Chalkboard Summaries

- Occlusions from lecturer.
- Non-linear flow of material.
- Foreground subtraction and segmentation for chalkboard “notepads”.
- Important for STEM subjects.
Technological Solutions

- University of Southampton: SyncNote
  - Speech recognition based.
  - Crowd-sourced fixes to transcription errors.
  - Lecture notes uploaded and aligned.
Captioning (Supported by MHR)

- Improves accessibility.
- Allows video to be watched in quiet spaces.
- Stimulates dual channel processing through verbal and visual stimulus.
- Increases clarity where the lecturer and class languages are not the same.
- Enables further language learning (esp technical terms).
- Supports better searching of video content.
Fig. 6. Question: The videos with captions/transcript (text given for spoken sentences) are preferable than videos without them. Please express the strength of your agreement.
Fig. 13. Question: Would you be interested in working with other students to correct captions for your class lectures using this caption editor if you receive some incentive (for example academic credit)?
Takeaways (Conclusions)

• Reviewed academic studies on how lecture recording material is used and consumed.
• YouTube content: short, focused, part of a meta-enhanced channel with descriptions, user comments, and recommendations.
• PTAS project showed content segmentation and indexing is desirable from UoE students.
• Reinforces results found in the literature.
• Benefits for accessibility.
• Commercial solutions available for some features, though not others.
• Very rich academic literature in high-profile journals.