Panopticon as an eLearning Support Search Tool

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ABSTRACT
We present an evaluation of Panopticon, a video surrogate system, as an online eLearning support search tool for finding information within video lectures. A comparison was made with a standard video player (YouTube) in two scenarios with two classes of users: revision students and independent learners. Results showed that users of Panopticon were significantly faster at finding information within the lecture videos than users of the YouTube player. It was also found that videos predominantly featuring a talking lecturer took longest to navigate, presenting design implications for lectures to be uploaded to open eLearning platforms.

Author Keywords
Video browsing; eLearning;

ACM Classification Keywords

H.5.2 User Interfaces: Evaluation/methodology.

INTRODUCTION & RELATED WORK

Learning using online materials and guides – or eLearning – has become increasingly popular to enhance distributed and local learning (e.g. [6,7]). eLearning in a local context can refer to the availability of course slides, videos and other materials in an online portal to supplement live lectures. On the other hand, in a distributed context it usually refers to Massively Open Online Courses (MOOCs) which have seen a recent rise in popularity due to their global availability and flexible learning times.

Lecture videos are an important component in both eLearning contexts and vary widely to support a range of learning habits – from 11 hours for a university-level MOOC [1] to 44 hours for a typical university course. In addition to the primary consumption of the video material, the videos are provided as refreshers during revision periods [3]. In a local situation, students are known to take fewer notes during lectures when they know the video will be available at a later date [2], suggesting the need for a usable facility to search such content.

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Furthermore, little thought has been given to independent learners who may access the freely-available lectures in order to complement their existing courses or to further their own knowledge [8]. *iTunes U* and *YouTube Education* allow users to freely view lecture videos covering a wide range of subjects, and users who view videos from these platforms have a need to search the content, for example to find sample problems or to revisit information that they found difficult to understand [4].

Existing player interfaces for iTunes U – QuickTime Player – and YouTube Education – Adobe Flash based player – equip the user with basic controls like as pause, play, fast-forward and rewind. YouTube also presents temporal context in the form of thumbnails of adjacent frames. However, the random access approach provided by these interfaces is not well suited to searching for specific content.

Panopticon was originally conceived as a video surrogate system and has been shown to help users in finding points of interest in certain videos faster than other player interfaces including YouTube [5]. The system displays a tiling of video thumbnails for a complete film and does not exclude any frames. The animated tiles scroll from left to right as the video plays, thus removing the distracting effects of static thumbnails that reset regularly. Users can mouse over the tiles to reveal an enlarged presentation of the tile and its corresponding audio (see Figure 2 for example interface). In principle this should make Panopticon an effective search tool for lecture videos, but the composition of the videos may play a role, e.g. [5].

With this in mind we evaluated Panopticon's suitability for searching lecture videos by comparing it to the YouTube player with three classes of lecture videos (mean length: 30 minutes; standard deviation: 2 minutes 45 seconds) obtained from the *HEC Paris* iTunes U portal. The first video predominantly featured a talking lecturer with minimal focus on the PowerPoint slides (Talk), the second video focused predominantly on PowerPoint slides (Slides) and the final video featured interactive content such as videos in addition to PowerPoint slides (Interactive). The videos were tested in two scenarios: a student using the lecture video from a course they are enrolled in for revision and an independent learner looking to further their knowledge on a subject.

The next section describes the design and materials of the user studies and the details of each individual study along with its results. The final section discusses the implications of the findings and presents design guidelines for uploading lecture videos to eLearning platforms.

USER STUDIES

The two studies shared the same two factors: interface (YouTube, Panopticon) and class of video (talk, slides, interactive). The variable under investigation was the time taken to correctly find all the points of interest in each video (seconds).

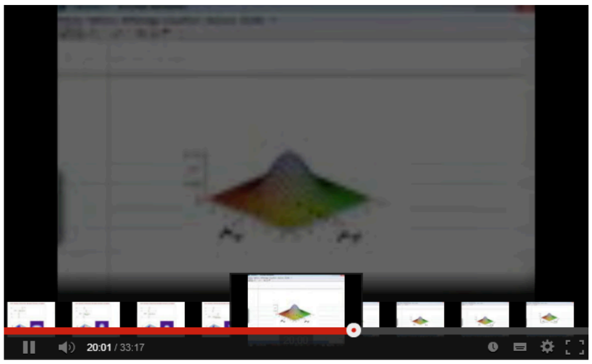

Figure 1: YouTube Interface (with localised context)

The YouTube player (see Figure 1) presents an improvement over QuickTime Player – the default video application for iTunes U content – by providing the user with localised context when scrubbing. The context on screen only covers approximately 10 seconds of a 30 minute video. Panopticon (see Figure 2) was initially conceived as a video surrogate system that presented a complete overview of the whole video without missing out any frames. As such, every frame is viewed in its original context.

Figure 2: Panopticon Interface (with viewing window, centre)

Three questions accompanied each video which covered three styles of search for each lecture: visual search where the answer was present on the on-screen material, verbal search where the answer was delivered verbally but cued with on-screen material, and problem search where participants had to find the answer to a question posed by the lecturer. These three mechanisms were chosen to cover a range of possible behaviours that viewers may want to perform.

Study 1 looked at participants who had previously seen the video and were looking to answer the three questions posed by the researcher. Study 2 looked at participants who had not seen the video before but were looking to answer the same three questions. As such, Study 1 simulated revision students while Study 2 simulated independent learners.

Study 1: Revision Students

A 3x2 independent design was used with the factors under investigation being the video player (Panopticon, YouTube) and lecture type (Talk, Slides, and Interactive).

Participants

24 participants from the local population (mean age: 25 years, SD: 7.3 years) were recruited to take part in the study. Participants were recruited in person by the researchers and no financial reward was given. They were required to have used a video hosting website (e.g. YouTube) at least once.

Procedure

Participants were randomly assigned to one lecture type and a video player. They were required to carry out the search tasks (i.e. the study) in isolation, but were allowed to watch the videos in a group.

Once participants had been briefed, and informed consent collected, they were shown one of the lecture videos (approximately 30 minutes in length) on a laptop screen. Participants were asked to be quiet and pay attention to the material as they would be quizzed on it later. The experimenter supervised participants throughout the duration of the video.

Once the video was finished, participants were individually introduced to their randomly-selected system. This process consisted of participants using a practice video ('Big Buck Bunny') to answer practice questions to familiarise themselves with the different functionalities of their system.

Following the practice, participants were given the first question both orally and on a tablet device and were asked to answer the question verbally. Once participants had correctly answered the initial question, they were asked another question. Once the second question had been answered, the third and final question was asked.

Results

A 2-way independent ANOVA was carried out on the data with system and lecture as the independent factors and time (seconds) as the dependent variable.

A main effect of system was found (F(1,18)=4.408, p=.05) where participants using Panopticon (38.03 seconds) were significantly faster than those using YouTube (51.17 seconds).

	Interactive	Slides	Talk	**Total**
Panopticon	16.87 (3.98)	25.75 (5.31)	71.47 (16.22)	**38.03 (8.50)**
YouTube	39.50 (2.88)	40.87 (8.94)	73.13 (32.14)	**51.17 (14.65)**
Total	**28.19 (3.43)**	**33.31 (7.13)**	**72.30 (24.18)**	

Table 1: Means (and standard deviations) for completion times in seconds for revision students.

A main effect of video was present (F(2,18)=19.707, p<.001) where the Talk lecture (72.30 seconds) took significantly longer to complete when compared to both the Interactive lecture (28.19 seconds; p<.001) and the Slide lecture (33.31 seconds; p<.001). No interaction effect was found.

Study 2: Independent Learners

A 3x2 mixed design was used with the factors under investigation being the video player (Panopticon, YouTube) – independent – and lecture type (Talk, Slides, and Interactive) – repeated.

Participants

16 different participants from the local population (mean age: 24 years, SD: 4.9 years) were recruited to take part in the study. The same recruitment procedure and inclusion criterion was used as for the first study.

Procedure

A similar procedure to Study 1 was used. The main differences were that participants were evaluated on all three videos (order counterbalanced) and they did not watch the videos prior to commencing the main task.

Results

A 2-way mixed ANOVA was carried out on the data with system as the independent factor and lecture as the repeated factor and time (seconds) as the dependent variable.

	Interactive	Slides	Talk	**Total**
Panopticon	151.24 (106.28)	194.51 (125.00)	714.13 (393.74)	**353.29 (208.34)**
YouTube	452.63 (67.34)	439.48 (159.49)	582.88 (245.90)	**491.66 (157.58)**
Total	**301.94 (86.81)**	**317 (142.25)**	**648.51 (319.82)**	

Table 2: Means (and standard deviations) for completion times in seconds for independent learners.

A main effect of system was found (F(1,14)=5.124, p<.05) where participants using Panopticon (353.29 seconds) were significantly faster than those using YouTube (491.66 seconds).

A main effect of video was present (F(2,13)=7.608, p<.010) where the Talk lecture (648.51 seconds) took longer to complete when compared to both the Interactive lecture (301.94 seconds; p<.005) and the Slide lecture (317 seconds; p<.010). No interaction effect was found.

DISCUSSION

The effectiveness of searching lecture videos using two video interfaces – Panopticon and YouTube was investigated. Searching was evaluated in two studies of distinct scenarios: revision students using a lecture video and independent learners using the lecture video to clarify topics. In accordance with previous studies, Panopticon was significantly more effective than YouTube for finding specific information in lecture videos for both scenarios. Additionally, the type of lecture video played a role in the ease of finding information. Participants searching the Talk lecture video fared the worst (slowest) in both scenarios, while no difference was found between highly interactive and slide-based lectures. These findings present some important implications for the design and editing of video lectures as well as for the tools that are available to users for online courses.

Implications

The advantage that users of Panopticon had over YouTube users means that students could save a significant amount of time when using this interface for searching within lecture videos. While the advantage was observed for both revision students and independent learners, the latter are set to benefit the most from using Panopticon: they on average saved upwards of two minutes while revision students on average saved just over 13 seconds.

While Panopticon was effective for searching videos, the practicality of using the interface for watching the video in its entirety or to obtain its gist are up for debate. QuickTime Player, for example, is a good option for watching the videos from start to finish with its minimalistic interface and basic controls. Meanwhile, a short text summary of the video written by the lecturer would probably be preferable for gist comprehension rather than skimming through the video. In other words, we do not propose that Panopticon should be the sole video player for lecture videos, but rather that it should be an optional search tool for students.

With regards to designing video lectures, the study has shown that talk-only lectures – or lectures with minimal focus on visual aids – are not optimal for students in need of searching for information. Our Talk lecture did include slides in its original live form, but the main focus of the recording was the speaker. Therefore, it is recommended that videos destined for eLearning platforms heavily feature slides in the edited final video. Work by [4] found that the presence of a lecturer on screen during a video lecture improved the students' enjoyment of the video, but not the retention of the material. As such, they also recommend that slides feature heavily in lecture videos.

No time difference was found between the Slides video and the Interactive video, suggesting that the presence of a visual aid is more important than the type. This supports our other finding that a video with little focus on slides leads to longer search times. While it is not expected that this finding will influence the design of the live lectures themselves, it does mean that lecturers should focus the video recording on the visual aids to support independent learners and their own students for revision.

Limitations & Future Work

There are a couple of limitations with this study that should be considered. Firstly, the subject matter covered in the videos was different for all three videos – marketing, statistics, and education. They were all chosen from the same institute – HEC Paris – to minimise the impact of confounds such as video quality (e.g. encoding) and participants' previous exposure to the videos. The questions for each video covered the same aspects – visual search, problem search, and oral search – but it is possible that participants may have been more familiar with one topic and that could have played a part in their performance. However, we believe that any effects of participants' previous knowledge would have been minimal given the questions were video-specific rather than subject-specific meaning they could not be answered based on subject knowledge alone.

This plays into the second limitation: participants in the revision condition had not attended the live lectures. An evaluation using these types of students would yield a more accurate result for revision students where they have more knowledge of the material and less knowledge of the editing of the video.

We note that errors were not measured directly in our design, but they were measured indirectly in that the overall time taken to complete the task took into consideration any mistakes made by participants – i.e. they could only move on once they had answered the question correctly. While we believe this measurement evaluates an important aspect of the search tools, we acknowledge that other measures should be considered for evaluating the usability of the systems, including error rates and qualitative measures.

As another future step, it may prove beneficial to refine the Panopticon application to allow more seamless multitasking. In its current state, Panopticon operates in a full screen window mode that easily allows users to take notes on paper, but may prove inconvenient for note-taking on the same machine.

In order to make it easier to find the desired section of the video, a feature could be implemented where keywords are displayed near or around a selected frame. The keywords should reflect the content or the spoken word of the selected scene. With this the user would be able to simply hover over the single frames to get an overview of its content. It might be even possible to see where a specific topic starts and ends.

CONCLUSION

Panopticon was evaluated as an online eLearning support search tool for finding information within video lectures. We found that users of the interface could find information in lecture videos significantly faster than users of the YouTube player. We also found that participants took significantly longer finding information in the video that did not predominantly feature visual aids. We therefore recommend that recordings of lectures destined for eLearning platforms should principally focus on the slides rather than the lecturer to support both local students and independent learners.

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