TypeRighting: Combining the Benefits of Handwriting and Typeface in Online Educational Videos

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ABSTRACT

Recent years have seen enormous growth of online educational videos, spanning K-12 tutorials to university lectures. As this content has grown, so too has grown the number of presentation styles. Some educators have strong allegiance to handwritten recordings (using pen and tablet), while others use only typed (PowerPoint) presentations. In this paper, we present the first systematic comparison of these two presentation styles and how they are perceived by viewers. Surveys on edX and Mechanical Turk suggest that users enjoy handwriting because it is personal and engaging, yet they also enjoy typeface because it is clear and legible. Based on these observations, we propose a new presentation style, TypeRighting, that combines the benefits of handwriting and typeface. Each phrase is written by hand, but fades into typeface soon after it appears. Our surveys suggest that about 80% of respondents prefer TypeRighting over handwriting. The same fraction of respondents prefer TypeRighting over typeface, for videos in which the handwriting is sufficiently legible.

Author Keywords

Online education; massive open online course; handwriting

ACM Classification Keywords

K.3. Computers and Education

INTRODUCTION

While educational technology has been an active area of research for decades, currently we are witnessing an unprecedented surge in the amount of course content that is available online. Initiatives such as Coursera, Udacity, and edX are collectively offering over 250 "massive open online courses", enabling online audiences to learn from top university professors for free. Meanwhile, the Khan Academy has logged over 225 million views of free video lessons, mostly targeted at K-12 learners.

Despite the momentum surrounding online education, to date there has not been consensus on one of the most basic questions: what is the best format for a video lecture? Sites such as the Khan Academy and edX rely mainly on handwritten tutorials, produced using a digital pen and tablet, with an audio voice-over from the lecturer. In contrast, Coursera content is typically structured around typed (PowerPoint) presentations, sometimes with pen annotations, and often with a visual view of the lecturer. Udacity content is mostly handwritten, and includes a semi-transparent view of the lecturer's hands. Content from NPTEL, a collection of 136 video courses from top universities in India, includes a mix of handwritten and typed content.

Figure 1: TypeRighting example. Typeface fades in to replace each handwritten phrase soon after it is drawn[1].

The first goal of this paper is to understand the benefits and drawbacks of handwritten tutorials versus typed presentations for online educational videos. We conduct such a comparison using three videos drawn from edX and the Khan Academy, and opinions gathered from almost 150 survey respondents on edX and Mechanical Turk. Our results are mixed: sometimes handwriting is preferred for its personal and engaging style, but sometimes typeface is preferred for its clarity and legibility. Our first contribution is demonstrating this variation of opinion – both across respondents and across videos – suggesting that neither handwriting nor typeface is the best solution for all cases.

Building on these observations, our second contribution is to define and evaluate a new style of presentation, TypeRighting, that combines the benefits of handwriting and typeface. The idea behind TypeRighting is simple: words are handwritten by the lecturer, but soon after they appear, they morph into typeface (see Figure 1). This video style preserves the personality and engagement of handwriting, while also enabling a legible display as soon as each handwritten phrase is fully drawn. We evaluate TypeRighting via surveys on edX and Mechanical Turk. Results show that about 80% of respondents prefer TypeRighting to the handwritten videos, and the same fraction prefers TypeRighting to typeface when the handwriting is of sufficient quality. While this study is exploratory in nature, we conclude that TypeRighting is a promising video style for online educational content.

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[1] Please see http://www.youtube.com/watch?v=RCihSaGX0WE for a video example of TypeRighting.

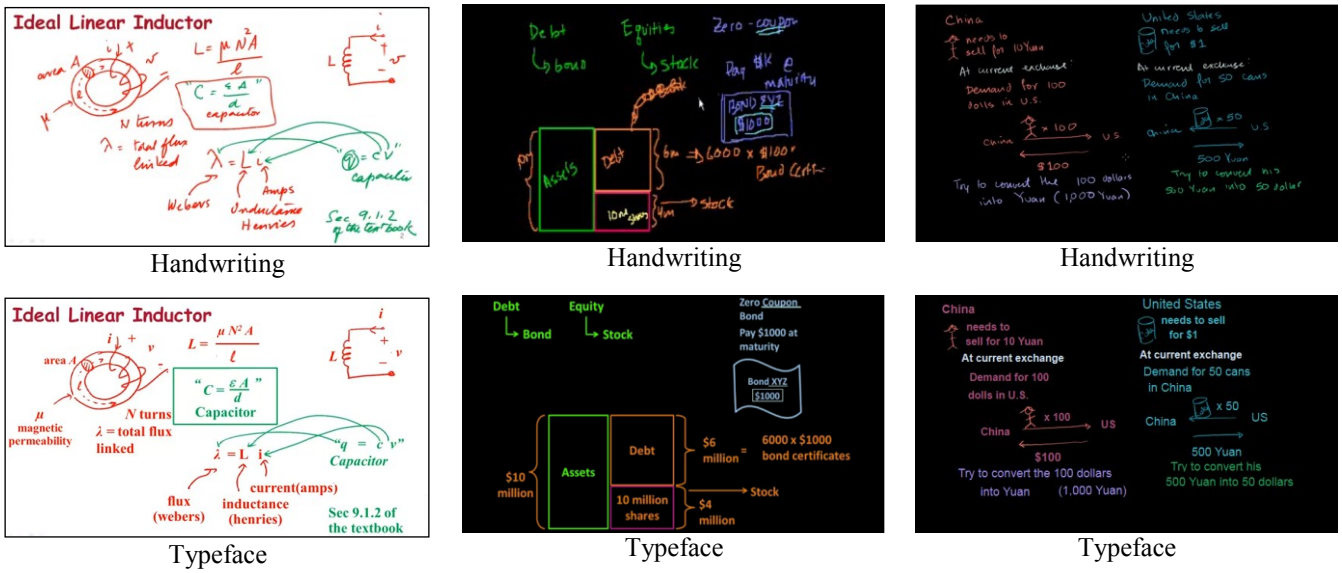

Figure 2: Videos used in the experiments.

RELATED WORK

Prior work has considered student preferences in classroom lectures, comparing PowerPoint slides with writing on a chalkboard, whiteboard, or overhead projector. Studies consistently show students' overall preference for PowerPoint slides, when used appropriately, citing benefits such as improved organization of the lecture, improved legibility compared to handwritten notes, and availability of slides before and after class [3,5,8]. These results may or may not extend to the online scenario, as classroom lectures retain personal interactions between lecturers and students; in the online context, handwriting may help to preserve this personal connection more than PowerPoint slides.

Other studies on multimedia use in learning have shown that blending PowerPoint slides with ad-hoc handwritten notes offers similar benefits [1,7]. Extensive research has been done on best practices for multimedia e-learning, adding the caveat that lecturers must be aware of the cognitive load put on viewers by multimedia presentations [6]. These works emphasize using multimedia in a way that is clear, emphasizes key points, and avoids excessive or distracting content or animations.

HANDWRITING VS. TYPEFACE

The goal of our first experiment is to assess preferences for handwriting versus typeface in online educational videos. The "handwritten" condition corresponds to videos recorded using a digital pen and tablet, as is customary on popular sites such as the Khan Academy. The "typeface" condition represents animated text and graphics, as is often produced using PowerPoint. Our goal is to assess only the viewer's preference for each of these alternatives. While the ultimate aim is to improve learning outcomes, an important prerequisite to learning is retaining the viewers' attention and interest in the video – something that vitally depends on understanding and satisfying their viewing preferences.

Videos

We selected three videos for the study (see Figure 2). The first video is drawn from edX, and explains the concept of an inductor. The second and third videos are drawn from the Khan Academy; one explains the difference between stocks and bonds, while the other explains the effect of trade imbalances on exchange rates. After shortening one of the videos slightly, all are between 7 and 10 minutes long.

The handwritten videos have varying visual quality, reflecting differences in handwriting, resolution, and overall style. In particular, we deliberately selected Khan Academy videos with different resolutions: one is 240p (an older video) and one is 360p (a recent video). To quantify the differences in visual quality, we ran an experiment on Turk (a methodology that has been validated on similar tasks [4]). We asked 50 workers to rate the "quality and clarity" of a still frame from each video on a scale from 1 to 10. The results confirm that the high-resolution Khan Academy video is perceived as having higher visual quality (6.9/10) than the low-resolution Khan Academy video (5.0/10) or the edX video (5.2/10). The difference is significant between the high-resolution Khan Academy video and each of the others (vs. low-res Khan Academy, $t(49)=-5.65$, $p<0.001$; vs. edX, $t(49)=-6.39$, $p<0.001$). The difference observed between the low-resolution Khan Academy video and the edX video is not significant ($t(49)=0.80$, $p=0.43$).

Using the handwritten videos as templates, we used PowerPoint to manually construct videos utilizing typeface in place of handwriting. Each typed phrase appeared independently, in sync with the audio track from the original video. While the typeface videos preserve the overall visual style and color scheme of the handwritten videos, we made minor adjustments to the arrangement of text and drawings. Adjusting the layout is a natural affordance and benefit of using typed slides.

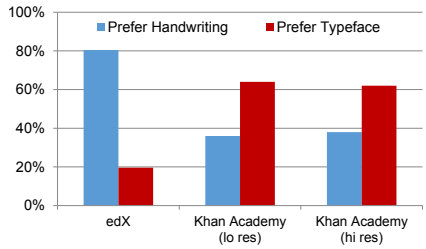

Figure 3: Preferences for Handwriting vs. Typeface

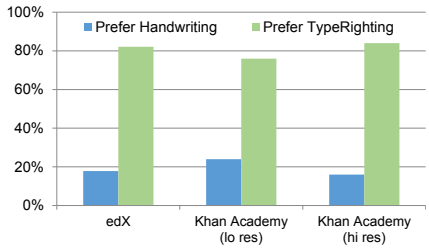

Figure 4: Preferences for Handwriting vs. TypeRighting

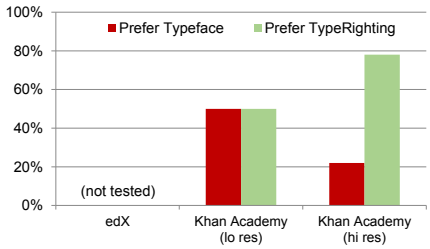

Figure 5: Preferences for Typeface vs. TypeRighting

Participants

We drew participants from different sources, depending on the source of the video. For the edX video, we posted a survey (with permission) in the edX discussion forum. The survey linked to both videos and asked respondents to indicate which video they preferred, and why. We received 46 responses, and 4,000 words of comments in the forum.

To evaluate the Khan Academy videos, we utilized MTurk to recruit participants. Turkers may have some similarity to viewers of online educational videos: they are young, have access to computers, have some free time, and are arguably aspiring to `better themselves' via education or income generation. We ensured that Turkers were attentive to the video (something that was not ensured for edX participants) by promising a monetary bonus ($0.10 on top of the $0.25 payment for the task) if they passed a short quiz, to appear following the video. Also, to make it easy for participants to evaluate both designs, we provided a "toggle" button that switched between handwriting and typeface in real-time, as the video played. Participants could toggle between the video styles at any time, as often as they wanted.

We included Turk participants in our analysis if they watched at least 30 seconds of each video. We ran the experiment until we collected 50 such responses. Because Turkers from the United States and India can display systematic differences in their responses [1], we ensured that the proportion from each country stayed constant across trials. The proportion enforced came from the results of our first trial: 15 from the U.S. and 35 from India. Final respondents had an average age of 29, and 57% were male.

Results

Results of the experiment appear in Figure 3. For the edX video, 80% of respondents preferred handwriting. However, for the Khan Academy videos, the majority (about 63%) preferred typeface, and this preference was almost identical across the two videos. The preferences are significantly different from even proportions: for edX (binomial test, $p<0.001$) and for the Khan Academy videos, combined (binomial test, $p<0.01$). Preferences did not have significant correlation with gender, age, or country of residence.

Those who preferred handwriting described it as "more personal", "more natural", and "more engaging". They also noted that the cursor (not visible in the typeface version) helped them to follow the current point of interest on the slide. The most up-voted comment on the edX forum wrote, "It reminds me of blackboards… written materials have more personality." A Turker also commented, "The handwriting kept my attention. It felt more authentic. I felt as if I was in a class and it made it more 'fun'".

Those who preferred typeface commented that it was clearer, neater, and easier to read. Some wrote that typeface can be especially helpful for symbols, such as *u* vs *v*, *O(n)* vs *o(n)*, and subscripts / superscripts. The most up-voted edX comment in favor of typeface was, "I much prefer the cleaner PowerPoint text as one of my complaints has been the messy scriblings in the videos." A Turker wrote, "I am a longtime follower of Khan Academy videos and have always been bothered by the handwriting aspect. The typeface version looks much neater and more professional."

Discussion

Our conclusion from this experiment is that there is varying preference for handwriting and typeface in online educational videos. While this might seem like an inconclusive result, it provides important context for our primary contribution, which comes in the next section.

Why did the edX experiment show a preference for handwriting, while the Khan Academy experiment showed a preference for typeface? We can only speculate. It seems that handwriting and/or resolution are not responsible for this difference, as our study of visual quality shows that the handwritten edX video is amongst the pair of lower-quality videos. Moreover, despite significant differences in visual quality, the two Khan Academy videos led to a similar preference for typeface over handwriting. There are several differences between the edX experiment and the Khan experiment that could explain the results, including the lecturer. One edX respondent favored handwriting because they "would not wish to diminish the experience of receiving personal tutorial with Prof. Agrawal".

In addition, an important observation grew out of the edX survey: participants do prefer typeface to handwriting for review of lecture materials. In the words of one respondent, "I like the handwriting when watching the lecture videos. But when I go back to review the lectures I have trouble reading the notes again because there is scribble everywhere." To quantify this sentiment, we augmented our survey with a second question, asking whether handwriting or typeface is preferred for reference notes. Out of 44 responses, 64% indicated a preference for typeface, while 27% preferred handwriting, and 9% were indifferent.

This result led us to the question: is it possible to combine the benefits of handwriting (during the presentation) with the benefits of typeface (for the sake of review)? To use the words of an edX respondent, "It would be nice if the handwritten presentation of the lectures could be somehow combined with the clearer lecture notes for reviewing."

COMBINING HANDWRITING AND TYPEFACE

To combine the benefits of handwriting and typeface, we propose TypeRighting: a style of visual presentation in which each handwritten phrase is replaced by typeface soon after it appears. This simple concept is illustrated in Figure 1. TypeRighting preserves the engaging and personal style of handwriting, as the animation of pen strokes remains the same. However, when a handwritten phrase is fully written, its static image is replaced by typeface, thereby enhancing legibility for the remainder of the video.

To evaluate TypeRighting, we followed the same methodologies described previously. We manually constructed videos in the TypeRighting style by embedding the handwritten videos in PowerPoint and drawing typeface animations as overlays. We posted surveys on edX and MTurk, asking participants to compare either: (i) the TypeRighting video to the handwritten video, or (ii) the TypeRighting video to the typeface video. The second test was done on MTurk only, due to time constraints. The edX survey drew 28 responses (and 2,000 words of comments), and each task on Turk was completed by 50 workers. The parameters of the tasks, including the balance between India and the U.S., were the same as before.

As shown in Figure 4, TypeRighting is consistently preferred to handwriting by a wide margin, even in the case (edX) where typeface is not preferred. Overall, 80% of participants prefer TypeRighting to the handwritten version.

Comments received in support of TypeRighting mirrored our expectations of combining the benefits of handwriting and typeface. One participant wrote, "It had a personal touch, but still was easy to read and comprehend." Another commented, "Things that were not clear became clear in this mode. There I had to strain my eyes to understand but the moment it became bold, it was so clear." Overall, TypeRighting was said to preserve the most beneficial aspects of handwriting, notably the authentic feeling of a classroom lecture, the engaging aspect of visuals changing with the narration, and the helpful visualization of the lecturer's cursor to focus attention.

The small minority of respondents who favored handwriting over TypeRighting sometimes found the transition to typeface to be distracting. A respondent on edX wrote, "I found myself slightly distracted waiting for the transition." However, this respondent and others noted that TypeRighting might feel more natural over time: "I think that issue would resolve after the novelty wears off."

With respect to TypeRighting versus typeface, the results (Figure 5) depend on the video. For the high-resolution video, 78% of respondents prefer TypeRighting. However, for the low-resolution video, only 50% of participants preferred TypeRighting. We believe this difference is due to the low quality of handwriting in the low-resolution video. Several participants wrote that the handwriting did more harm than good in the low-resolution case, e.g., "The handwriting was too messy and unreadable, so it might as well just be skipped." Our conclusion is that TypeRighting offers benefits over both handwriting and typeface, so long as the handwriting is of sufficient visual quality.

CONCLUSIONS

Despite the burgeoning usage of online educational videos, there has been little study of how best to present lessons in video format. This paper helps to fill this gap by conducting a methodical comparison of handwriting versus typeface in educational videos. Our first contribution is to demonstrate that these formats are preferred at different times, and for different reasons: handwriting is personal and engaging, of particular value during the lecture, while typeface is clear and legible, of particular value during review.

Our second contribution is a novel presentation style, TypeRighting, that combines handwriting and typeface while preserving the benefits of each. Our experiments show that TypeRighting is highly preferred over handwriting, even in cases where typeface alone is not preferred. Our results on Khan Academy videos suggest that 80% of lessons delivered – a sum of 180 million to date – would have been improved via adoption of TypeRighting.

This exploratory paper has some limitations that will be important to address in future work. We evaluated only a small number of videos (and limited subject matter) and used audio tracks from handwritten videos, which likely have different pauses in speech, etc., than audio from a slide-based lecture. Also, all videos in TypeRighting format were constructed manually by the authors. In ongoing research, we are developing new ways to simplify construction of videos in this format. Just as video subtitles are often provided by volunteers, we believe that typeface annotations can be quickly generated by the crowd.

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