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# A Study of the Effect of Text Presentation Type on Video Learning

**Mengtao Yang, Sichu Wu, Lifei Lin**

**Zhejiang Normal University, College of Education, Jinhua, Zhejiang 321000**

***Abstract:*** Teaching videos have become one of the important resources of modern education. Text is the main channel for learners to obtain teaching information. Research with the help of measuring tools and methods such as eye tracing technology and learning effects, cognitive load, learning satisfaction, etc., explore different text presentation types (static printing, verbatim printing, dynamic handwriting) in teaching videos Impact.

***Keywords:*** Teaching video; Text type; Visual attention; Learning effect

## 1. Introduction

With the advancement of information technology in education, instructional videos have become an integral part of modern education, especially during the epidemic, and have become one of the most important resources for schools of all levels to accomplish their academic goals.Despite the growing importance of instructional videos, their practical application has not yet reached the ideal state. One study investigating MOOC platform courses found that MOOC participation rates have dropped significantly and MOOC course completion rates are relatively low at no more than 10%[1], with the quality of instructional videos being one of the key reasons. How to design better quality instructional videos to assist learners in their learning has become one of the concerns of researchers.

In multimedia materials that consist of a combination of text, graphics, images, animation, sound and video, text is the most important channel through which learners obtain information for teaching and learning[2]. Therefore, the design of text in instructional videos may lead to better learning outcomes. Research on text in multimedia materials has yielded many results, with studies on the English alphabet focusing on characters, font size, font colour, contrast, etc., and on Chinese characters focusing on character frequency, number of strokes, component structure, display speed, etc. Comparative studies of different text presentation types in teaching materials are less common.

## 2. Research Design

### 2.1 Research hypothesis

The purpose of this study was to investigate the cognitive load, learning satisfaction, learning effectiveness and visual attention allocation of learners when they watched instructional videos with different text presentation types. The study used an experimental research method with the help of eye-tracking technology to record learners' eye movement trajectories during the learning process and proposed the following four sets of research hypotheses.

Hypothesis 1: (Cognitive load) dynamic handwritten>verbatim printed>static printed.

Hypothesis 2: (learning satisfaction) dynamic handwritten>verbatim printed text>static printed text.

Hypothesis 3: (visual attention allocation) dynamic handwritten text>verbatim printed text>static printed text.

Hypothesis 4: (learning effect): dynamic handwritten text>verbatim text>static printed text

### 2.2 Research Subjects

In this study, 63 undergraduate and graduate students were randomly recruited from a university to fill out a prior knowledge test on the structure and function of cell membranes and were selected as experimental subjects with low scores. Subjects

were between 18-26 years old (M=20.83, SD=2.047), of which 86% were female. All subjects had normal hearing, normal visual acuity or corrected visual acuity, gave informed consent to the experiment, and were paid accordingly at the end of the experiment.

## 2.3 experimental tools

### 2.3.1 Eye-tracking device

The experiment was conducted with a Tobii Pro Fusion under-screen eye-tracking device to track the subject's eye movement trajectory.

### 2.3.2 Prior Knowledge Test

This test was developed by the experimental leader under the guidance of an experienced high school biology teacher to test learners' knowledge of the structure and function of cell membranes. The test consisted of fill-in-the-blank, judgmental, one-way multiple-choice, and multiple-choice questions with a total score of 14 points, and was of moderate difficulty (p=0.41).

### 2.3.3 Learning effect test

The retention test and transfer test were included: the retention test mainly investigated the subjects' knowledge of the content of the instructional videos. The questions included fill-in-the-blank, judgment questions, one-way multiple-choice questions and multiple-choice questions, with a total score of 16 points and moderate difficulty (p=0.55). The transfer test was designed to examine the degree of transfer of knowledge from the videos. The questions included one-way multiple-choice questions, multiple-choice questions and short answer questions with a total score of 14.

### 2.3.4 Learning satisfaction questionnaire

The questionnaire items were selected from the video learning satisfaction questionnaire revised by Professor Yang Jiumin[3], and the study used a five-point Likert scale, with higher scores indicating a higher level of learner satisfaction.

### 2.3.5 cognitive load questionnaire

Paas' nine-point Likert "Cognitive Load Self-Assessment Scale" [4]was used for the questionnaire. The scale includes two dimensions: mental effort and perceived difficulty of the task.

## 2.4 Experimental materials

The video is about the structure and function of cell membranes and is presented in the form of a slide recording without the teacher's presence. The Explain Everything software and the video editing software have been used to create three types of text presentation: static printed text, verbatim printed text and dynamic handwritten text. Static printed text means that all the fonts on the page appear in print without animation; verbatim printed text means that the corresponding text on the page appears in print word by word along with the teacher's voice; dynamic handwritten text means that the corresponding text on the page appears in handwritten font with the teacher's voice. The study controlled for extraneous variables, controlling for the position and size of the corresponding text in the video, and the duration of the text appearing verbatim from the beginning to the end of its appearance was essentially the same as the handwritten text. All three instructional videos were 11 minutes and 40 seconds in length and were played at double speed. The instructional videos are shown in Figure 1.

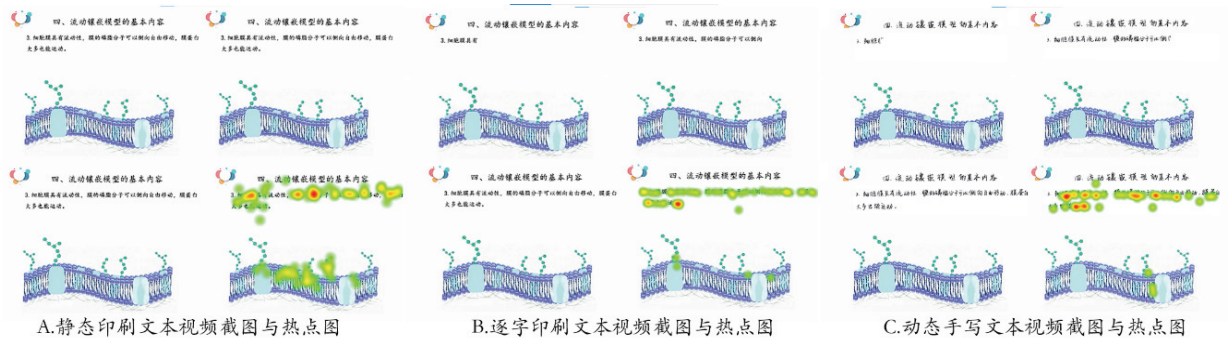


**Figure 1 Video screenshots and hotspots of different text presentation types**

# 3. Experimental results

In this study, a one-way ANOVA was conducted with type of text presentation as the independent variable and cognitive load, video satisfaction, number of text gazes, text gaze time, retention test scores, and transfer test scores as the dependent

variables, respectively. Descriptive results for each variable are shown in Table 1.

**Table 1 Descriptive statistics of each variable for the three groups of learners**

| Text presentation type | Cognitive load | | learning satisfaction | | retention test scores | | transfer test scores | | Number of gaze (times) | | Gaze time (sec) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | M | SD | M | SD | M | SD |
| Static Printing | 11.71 | 1.31 | 22.38 | 1.47 | 9.95 | 1.28 | 8.67 | 1.20 | 1050.71 | 88.69 | 282.67 | 22.60 |
| Verbatim Printing | 12.19 | 1.50 | 23.24 | 1.10 | 11.05 | 1.36 | 9.29 | 1.38 | 1129.38 | 81.45 | 305.05 | 26.52 |
| Dynamic Handwriting | 11.95 | 1.56 | 24.05 | 1.18 | 11.38 | 1.60 | 9.81 | 1.40 | 1172.14 | 83.49 | 316.10 | 24.26 |

## 3.1 Cognitive load

There was no significant difference in the cognitive load of the three groups of subjects on the video ($F(2, 60)=2.38$, $p=0.57>0.05$). Therefore, presenting the text in a dynamic handwritten or verbatim form in the instructional video did not increase the cognitive load of the learners, and the results did not support hypothesis 1.

## 3.2 video learning satisfaction

There was a significant difference in satisfaction with the video between the three groups of subjects ($F(2, 60) = 9.54$, $p<0.001$) A post hoc test found that in terms of video satisfaction: dynamic handwriting > static printing ($p<0.001$), verbatim printing > static printing ($p=0.028<0.05$), dynamic handwriting > verbatim printing ($p=0.038<0.05$), the results supported hypothesis 2.

## 3.3 Visual Attention

The visual attention data of the learners to the text of the instructional video is obtained by drawing interest zones on the text areas in the video.

### 3.3.1 Number of text gazes

A one-way ANOVA revealed a significant difference in the number of times the three groups of subjects gazed at the text ($F(2, 60) = 11.13$, $p<0.001$). Post-hoc tests revealed that in terms of the number of times the text was looked at: dynamic handwriting > static printing ($p<0.001$), verbatim printing > static printing ($p=0.004<0.01$), and there was no significant difference between verbatim printing and dynamic handwriting ($p=0.107>0.05$). This shows that the dynamic presentation of video text significantly increases the number of times learners look at the text area, but there is no difference in the effect of different types of dynamic text on the number of times learners look at the text.

### 3.3.2 Text gaze time

A one-way ANOVA revealed a significant difference between the three groups of subjects for text gaze time ($F(2, 60) = 10.140$, $p<0.001$). A post-hoc test was conducted and found that in terms of text attention time: dynamic handwriting > static printing ($p=0.004<0.01$), verbatim printing > static printing ($p<0.001$), and no significant difference between verbatim printing and dynamic handwriting ($p=0.149>0.05$). It can be concluded that dynamic presentation of video text significantly increases learners' attention time to text areas, but there is no difference in the effect of different types of dynamic text on learners' text attention time, and the results partially support hypothesis 3.

## 3.4 Learning Effect

### 3.4.1 Retention test

A covariance interaction effect test was conducted on the retention test scores with retention test scores as the dependent variable, text presentation type as the independent variable, and subjects' prior test scores as the covariate. The interaction term between text presentation type and subjects' prior knowledge and experience was not found to reach a significant level ($p>0.05$), indicating that there was no interaction between text presentation type and subjects' prior knowledge and experience level, and that a subsequent analysis of covariance could be conducted. The results of the covariance analysis showed that the effect of prior knowledge experience test scores as a covariate on retention tests was not significant ($p>0.05$), and there was a significant difference in the effect of text presentation type on learners' retention tests ($p<0.05$), meaning that text presentation type affected learners' knowledge retention effects. Post hoc tests were conducted and found that the retention performance of subjects in the dynamic handwritten text group was significantly higher than that of the static printed text group ($p=0.002<0.01$), the reten-

tion performance of subjects in the verbatim printed text group was significantly higher than that of the static printed text group ($p=0.015<0.05$), and there was no significant difference between the retention performance of subjects in the verbatim printed text group and the dynamic handwritten text group ($p=0.45>0.05$).

### 3.4.2 Transfer test

A one-way ANOVA revealed a significant difference in the level of transfer between the three groups of subjects ($F(2, 60) = 3.883$, $p=0.026<0.05$). A post-hoc test was conducted and found that at the level of knowledge transfer: dynamic handwriting > static printing ($p=0.007<0.05$), there was no significant difference between dynamic handwriting and verbatim printing ($p=0.137>0.05$) and no significant difference between verbatim printing and static printing ($p=0.207>0.05$). It can be found that the dynamic presentation of the video text can increase the level of knowledge transfer of learners. In particular, the verbatim printed text increased the level of transfer, but not significantly, while the dynamic handwritten text significantly increased the level of transfer. The results support hypothesis 4.

## 4. Discussion

This study was conducted to explore the effects of different text presentation types on learners' visual attention and learning outcomes in an instructional video. The results show that the dynamic effects of both verbatim and handwritten text increase learners' satisfaction with the video and do not place a higher cognitive load on learners. Both dynamic handwritten text and verbatim text significantly direct visual allocation, causing learners to spend more attention on the corresponding information content than static printed text. This may be due to the dynamic nature of their sequential presentation and the increased synchronisation of visual and auditory information that attracts attention. In terms of learning outcomes, both dynamically presented text (verbatim and handwritten) improved retention, and although there was no difference in retention between the handwritten text group and the verbatim group, the former group had significantly higher transfer scores. Possible explanations for this are that the dynamic presentation of video text attracts learners' attention and regulates information, and increases the synchronisation of visual and auditory information, while the verbatim handwritten text, with its realistic human movement and dynamic handwriting effect, creates a strong social cue and thus increases learners' motivation. The learning effect is in descending order: dynamic handwritten text > verbatim text > static printed text.

## 5. Conclusion and Prospect

The results of this study show that dynamic presentation of text is beneficial for learners to learn the video, where handwritten text in one stroke is better than printed text presented word by word. In the future development of instructional videos, it is recommended that most of the text content be set as word-by-word animations to avoid being presented in a static way, and that teachers can demonstrate the text content by handwriting at the key content and important points of the instructional video text (which can be achieved by using teaching whiteboard software such as Explain Everything). The results of this study have enriched the research on the presentation design of instructional videos to some extent.

The shortcomings of this study are the gender imbalance of the subjects and the difference between the laboratory environment and the real environment.

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