A Comparative Study of Different Online Teaching Video Modes

https://doi.org/10.3991/ijet.v17i17.29353

Qiuhao Wu(✉), Rong Liu
Business School, Hohai University, Nanjing, China
2106219809@qq.com

Abstract—In order to study the influence of different modes of online educational videos as teaching materials on learners' learning effect, 60 college students were invited to conduct an experiment. On the experimental materials, traditional and automatic video recording and playing, which account for a large proportion of online education, were selected. The process of watching was recorded by eye tracker experiment, and the learning differences were reflected by subjective evaluation and objective indicators. It was found that compared with the automatic video, the traditional video was more attractive to the subjects, the subjects had more concentration, but the cognitive load was higher, and there was no significant difference between the two groups in terms of performance. In addition, the attention distribution of learners in different modes is mainly illustrated, followed by portrait and subtitles. In the two modes of pictures and text, pictures are the main mode. The above research can provide a scientific basis for video designers to select appropriate modes to highlight key information, help teachers and learners to choose more reasonable learning videos from a large number of educational videos, and help online education providers to improve learners' intuitive experience of videos and enhance their competitiveness.

Keywords—online education, video mode, teaching material, learning effect

1 Introduction

Online education began to develop since 1998 in China. So far, the market size of online education has exceeded 450 billion yuan. With the social background of the post-epidemic era and the rapid development of information technology, online education will become an increasingly important education model in the future. As of December 2020, there were 342 million online education users in China, an increase of 109 million from before the epidemic.

As an important teaching means, online education is mainly focused on platform construction, model optimization and teaching video improvement in academic circles. In order to improve the quality of online education, some domestic scholars focus on the function construction of the platform, improving the efficiency and effect of using the student platform by improving the learning recommendation system [1], [2], [3] enhancing the online monitoring function [4], [5], identifying students' emotional states [6], [7] and adding game elements [8].

Some scholars combine online education with classroom teaching, and it is proposed to build a mixed classroom by promoting technology integration [9], improving teachers' information literacy [10], solving the problem of separation between online and offline teaching [11], and rationally distributing the proportion of online learning and classroom learning [12].

The above two types of research still need a lot of time to invest in practical application. Firstly, it is difficult to promote technology. Many technologies used to improve the quality of online education services have only been tested in a small range of effects, with technical instability or cost issues. In addition, at present, there are many learning platforms, among which there are compatibility problems. All of these problems set up barriers to the mass adoption of platform functionality. Secondly, the mixed education model is not mature enough. Scholars have conducted in-depth studies on the connotation, effectiveness and formation mechanism of mixed education, However, it still has problems such as poor teaching effect, poor connection between online and offline, and unclear division of labor between online and offline. It still needs time for development.

Other scholars focus on teaching videos. Online education relies on the Internet, with more diversified videos and richer presentations. As an important part of teaching, students' exposure to different teaching videos will have an impact on their learning results and behaviors, which has been proved by many studies. For example, colors, sounds and simulative design in teaching videos will have an impact on learners' emotions and cognitive load [13]. The design of subtitles in videos will influence learners' eye movement behavior [14], etc. But these studies have a narrow scope, usually looking at a single element of video design. There are gaps in overall comparison and exploration. The improvement cost of teaching video is low and it is easy to popularize. Therefore, it is of great practical significance to study the learning behavior rules under different video modes.

Online learning includes two types based on live broadcasting and recorded broadcasting [15]. Due to research equipment limitations and the importance of videos, this paper conducts an overall study on recorded videos, which are relatively important in online learning, and discusses their influence on learning effect. Recorded videos can be divided into traditional recorded videos mode, full automatic recorded videos mode, mobile recorded videos mode, and compound recorded videos mode [16]. However, the latter two are more inclined to be a recording system rather than a single video. Therefore, this paper focuses on the former two forms and considers their influence on learning effect from both form and content. Among them, form mainly refers to the composition of modal, which is the symbol form [17], such as image, sound, animation, text, chart, video, color and other symbols for communication and ideographic expression.

In traditional recorded videos, through editing, the elements in the video are more abundant, the scene conversion is more smooth, and a variety of symbol systems such as small video, text, static image, animation and sound can be used. Fully automatic recorded videos for the convenience of operation and reduce the possibility of error, the use of elements will often be simpler, the form will be a little more simple. In addition to the modal differences, there are also differences in content design. Because of the long pre-production cycle and high cost of traditional recorded videos, the content updating speed is low. However, due to the simple recording and low cost, the

automatic recorded videos has more advantages in content replacement, higher timeliness of content and more flexible and convenient design. And automatic recorded videos often record teachers' classroom teaching directly, including the interaction process with students, so that learners have a better sense of presence.

For the whole online education industry, through the comparative study of different online video modes, it can improve students' learning effect and promote the development of the whole industry. For online education provider, on July 24, 2021, the state has introduced policies to ease the burden on students, external training discipline class is compulsory education stage, the development of online education space further compression. Facing the competition trend, improving teaching quality through online video mode can provide new development direction for them. For learners, Lazora believes that students' learning autonomy is an important factor to improve the teaching effect under the current information technology background. He believes that modern learners already know very clearly how to navigate in the digital space and evaluate the effectiveness of digital information sources. However, whether such evaluation ability can be further improved? Can the assessment of technical forms be improved to help students choose the right video from the myriad open sources? Mastering the characteristics of different videos can help them select appropriate video materials from tens of thousands of online videos based on their own characteristics [18].

To sum up, this paper studies the influence of traditional recorded videos and automatic recorded videos on students' learning effect from two aspects of mode and content design, so as to fill the blank of online video research and provide scientific basis for the development of online education industry and providers.

2 Theoretical basis

Learning effect evaluation is an important way to determine whether teaching methods can achieve teaching objectives. The shortcomings of the traditional learning effect evaluation by summative evaluation method are gradually revealed, and the formative evaluation method which is more scientific and complete is gradually improved. Formative evaluation refers to the evaluation of learning effect carried out by teachers in the teaching process in order to understand students' learning situation [19]. Formative assessment can be roughly divided into three development stages, as shown in Table 1.

Table 1. Development history of formative evaluation

Stage of Development	Message
Formative evaluation	Receipt data is used for subsequent adjustments at different stages of the development and implementation process
Formative assessment + mastery learning	The classroom teaching is divided into several successive stages. At the end of each stage, students are evaluated by an exam. Teachers will use the results for teaching adjustment and give feedback to students
Formative evaluation + cybernetics	Collect the data of students' learning status, understand the gap between the current teaching status and teaching objectives, and give teaching feedback in time to ensure the realization of teaching objectives.

In the third stage, the formative evaluation method expands the evaluation scope again, and the teaching information collected is no longer limited to the test scores, but expands the vision to each factor that affects the realization of learning objectives. According to zhao Juming, all factors related to learning, such as students' existing knowledge level, learning interest, physical state and emotion, should be taken into account in teaching evaluation.

The purpose of this study is to compare the differences in the effects of online teaching videos of different modes, which is actually to evaluate the learning effects of learners under the teaching videos of different modes. Therefore, in order to ensure the scientificity and comprehensiveness of evaluation, the theory of formative evaluation + cybernetics is taken as the theoretical basis. The four factors of students' existing knowledge level, learning interest, physical state and emotion listed by Zhao Juming are selected as the indicators used in the comprehensive evaluation of subsequent papers. Among them, the physical state was reflected by recording students' eye movement index with eye tracker, and the emotional latitude was measured by learning satisfaction. At the same time, plus the latitude of examination results.

3 Research tools

Table 2. List of research tools

Research Dimension	Research Tools
Content design	Examination
Form tissue	Eye tracker

The tools used to evaluate the impact of differences in content design and formal organization on learning outcomes are shown in Table 2. In the past, researches on students' learning behavior from the multi-modal perspective mostly adopted the method of qualitative research or questionnaire, which was subjective to some extent. About 80%–90% of external information is acquired by human eyes. It can be seen that human information processing is highly dependent on vision [20], and studies have shown that visual channels are more prone to redundancy during integration [21]. Therefore, it is of great significance to study the visual state of learners. At present, researches carried out with the help of eye tracker have been involved in many fields, such as studies on the visual characteristics of drivers of different road designs in the field of traffic [22] or studies on the effects of different advertising designs and layouts on the cognition of viewers in the field of marketing [23]. In the field of education, eye tracker related research is also increasing day by day. A large number of studies have been conducted on media combination, whether to add animation, prompt information, whether to use subtitles and colors, etc., to evaluate the cognitive process and visual processing of learners by using eye tracker [24]. Visual eye tracker is reliable and accurate in visual data collection. However, these research progress are only based on the behavior differences caused by the existence or absence of a certain mode, and the overall study of multi-mode video is missing. Therefore, this paper analyzes the changes of attention and cognitive load in students' learning process by using RED eye tracker, which has scientific tool selection and academic research value.

4 Study 1: the influence of different video modes on students' learning effect

4.1 Research hypothesis

In previous studies, the influence of modal richness on learning has been divided. Those who support it believe that using multiple modes has a positive impact on learning results. First, the use of multi-modal can create a good teaching atmosphere and stimulate students' interest. The characteristics of its use of multiple media enrich the connotation of information transmission and interaction, and bring people's experience has been significantly improved. Classroom knowledge points are output through more diversified channels, thus bringing students more unique physical and mental experience [25]. Multimodal teaching can stimulate learners' senses through various means. Organic combination of various teaching forms to improve teaching efficiency [26]. Second, the use of multimodal can help learners to understand knowledge more deeply. Language can combine video, image, photo and other modes to explain the teaching content or highlight the key points with different modes. When students use multi-modal teaching materials for learning, they can recall more information [27], [28], [29]. Thirdly, use music, animation, color and other multi-modes to improve students' arousal level and enhance their motivation [30]. Fourthly, students have a higher acceptance of multi-modal teaching. In some investigations and studies, a large number of students prefer multimodal teaching [28], [31].

The opposition thinks that the use of multimodal will cause students to consume too much cognitive resources and bring negative effects. Due to the limited capacity of working memory, the brain cannot take into account the information received through various channels. When these information come together, learners are often at a loss to know how to effectively process and output information [32]. Some scholars have conducted researches on multimodal in classroom teaching links, web pages and PPT design. For example, on-screen text on PPT or web pages with the same information as oral presentation may impair learning [33], [34]. In addition, in the multi-modal teaching design, modal types in the multi-sensory channels such as visual and auditory channels are very diverse, which may bring pressure to learners.

Combined with research objects and materials, the use and variation of modes in traditional video recording and broadcasting are more abundant than PPT and web pages. Under the use of multi-modes, students' learning interest is high and their learning motivation is sufficient. As for the problem of impaired learning caused by multimodal, Jingwei Li believes that this is related to the characteristics of the research object. The multi-source information brought by multimodal may have negative effects on professionals, but may be good for beginners [35]. In this study, the research object is limited to the group that has insufficient cognition of the learning content and therefore needs to receive education, belonging to the novice. In conclusion, these novice subjects have better positive performance when faced with multi-modal teaching materials.

From the content dimension, automatic recording and playing video production cycle is short, the cost is low, so the video change speed is fast; Teachers can better visualize concepts and principles according to changes in internal and external environment, knowledge development, updating cases, and technology, and help students better master these concepts and apply them to real life [36].

Based on this, hypotheses 1 and 2 are proposed.

Hypothesis 1: Compared with automatic video recording, students are more interested in learning and more satisfied with learning when using traditional video recording;

Hypothesis 2: Compared with full-automatic video recording, students have worse academic performance when using traditional video recording for learning.

4.2 Experimental design

To select 60 students were explained by the same teacher to watch the same knowledge about organizational behavior of the two video, recorded a video for the traditional video, produced by special video team under the special arrangement of site late for recording and processing completed, modal is rich, including video, audio, animation, text, image multiple modal subtitles, pictures, teachers, There are many kinds of visual language, auditory language and body language, and there are many scenes switching times. Another for automatic recorded video, it is by the same teacher through tencent meeting broadcast live this platform, through the platform to record function is a key, have better interaction, in the case of knowledge points on combining with the social environment for the update, contains two modal words and images, compared to the amount and type of modal were small. The two videos conform to the research Settings in terms of modal and content design. This paper chooses these two videos as materials for experimental research.

4.3 Experimental process

Hamse believes that students' learning styles should be considered so as to provide them with different teaching methods. Therefore, we control the variable of learning style here [37]. Here we use cognitive style instead. The subjects were pretested, including basic information, cognitive style and previous knowledge level. After the test, 60 students were randomly assigned to two groups to watch two videos respectively. After watching the video, we filled in the recall knowledge and transfer knowledge test, cognitive load scale and learning satisfaction questionnaire. After filling in the post-test questionnaire, the experiment ended. In order to simulate the daily online learning environment of learners, the subjects conducted the experiment in a separate room without other people present. Among them, the cognitive style questionnaire used Solomon Learning Style scale; The video satisfaction questionnaire adopts the questionnaire designed by Duan Zhaohui during the network satisfaction survey [38]. The cognitive load scale used the PAAS cognitive load self-rating scale. The previous knowledge level questionnaire contains 9 subjective assessment questions about knowledge familiarity related to organizational behavior. In the recall knowledge test, two multiple choice questions were designed according to the content explained in the video, with 5 points for each question and a total of 10 points. In the transfer knowledge test, a short answer is designed based on the knowledge explained in the video, with a total of 10 points. Subject experts are invited to design knowledge test questions.

A total of 60 college students volunteered to participate in this experiment. None of them had ever received the teaching of organizational behavior before, including 25 males and 35 females. 23 sophomores; 37 junior students; All subjects were randomly assigned to two experimental groups, 30 in the traditional video recording group (25 in visual cognitive style; Speech type 5); Automatic recording and broadcasting group 30 people (including 25 visual cognitive style; Speech type 5).

4.4 The results

Previous knowledge level. Independent sample T test was performed on the prior knowledge level of the control items. The results showed that the group effect of previous knowledge level was not significant, P=0.831. The results showed that there was no difference in previous knowledge level between the two groups, so the influence of this variable will not be taken into account in subsequent studies.

Evaluation of subjective psychological effort involvement, learning task difficulty and learning satisfaction. The independent sample T test was used to evaluate the subjective effort involvement and learning task difficulty as dependent variables. The results showed that there was no significant difference in subjective effort investment between the two groups (ΔM=0.333, P=0.197); There was no significant difference in learning task difficulty evaluation between the two groups (ΔM=−0.303, P=0.393); In terms of learning satisfaction, there is no significant difference between the two groups (ΔM=0.727, P=0.225), indicating that there is no difference in subjective effort investment, learning task difficulty and satisfaction evaluation between traditional and automatic recording and broadcasting videos.

Recall score and transfer score. Recall test and transfer test scores were used as dependent variables to conduct independent sample T-test. The scores will be evaluated by two graduate students respectively and the final average will be taken. When the difference between two people is more than 3 points, the two people will discuss until they reach a unified opinion. The results showed that there was no significant difference in recall performance between the two groups (ΔM=−0.567, P=0.385); There was no significant difference in migration achievement between the two groups (ΔM=−0.0833, P=0.829)

In conclusion, the post-test questionnaire results of the two groups showed that there were no significant differences between the two groups in subjective effort involvement, learning task difficulty, learning satisfaction, recall performance and transfer performance, which failed to support hypothesis 1 and 2. The following will be analyzed by objective eye movement indicators.

Eye movement indicators. In order to test the cognitive load and interest difference between the two groups of videos, representative indicators such as blink frequency, average fixation time, average saccade range and average fixation deviation were selected to measure the learning status of the subjects. Table 3 shows the corresponding behavior meanings of each indicator. In order to avoid the interference of duration factor to the results, we planned to intercept the eye movement data of the same length of two videos for study. The length of the traditional recorded and played video was 26 minutes. In order to avoid fluctuations in the eye movement data at the end of the video, the eye movement data of the first 21 minutes of the two groups of videos were intercepted forward for analysis.

Table 3. Definitions of eye movement indicators

Indicator (Unit)	Indicates the Indicator	Source
Blink frequency [count/s]	Low blink frequency indicates that more effort is needed to manage and analyze information	Zhang Li [39]
Average fixation time [ms]	Average fixation time reflects how carefully the subject processed the material, and is also affected by the length, difficulty and layout of the material, etc. A long fixation time indicates that the task is difficult or the subject is interested in the video	Wang Xue [13]
Average fixation deviation [px]	Large average fixation deviation indicates a wide range of attention or unfocused river wave	Jiang Bo [40]
Average saccade amplitude [degree]	Average saccade amplitude related to the distance between materials and elements and the processing content	Zhang Li [39]

Inter-group independent sample T test of the above indicators shows that there is a significant difference in blink frequency between the two groups ($\Delta M=-177.87$, $P=0.01$), a significant difference in average fixation time between the two groups ($\Delta M=224.25$, $P=0.00$), and a significant difference in average fixation distance between the two groups ($\Delta M=-632365.35$, $P=0.00$), there was significant difference between the two groups ($\Delta M=13.25$, $P=0.00$). In conclusion, compared with automatic video, traditional video recording has lower blink frequency, longer average fixation time, smaller average gaze deviation, lower saccade frequency and larger average saccade amplitude.

The study partially supports hypothesis 1, but does not support hypothesis 2. Combined with the meaning of the indicators, it can be inferred that, for the subjects, the rich modal composition of traditional video recording requires them to work harder to manage and analyze information, process materials more carefully, and have a higher cognitive load. The saccade range was relatively large during the whole video, indicating that the subjects were constantly adjusting the allocation of attention in multiple modes. The other two videos explained the same content, and there was no difference in task difficulty, indicating that the traditional recording and playing videos were more attractive to the subjects. The size of the two videos was 1280*720, and there were fewer modes in the automatic recording and playing videos, and they were mainly concentrated in the center of the screen compared with the traditional recording and playing videos. Therefore, The results showed that the attention of the subjects was not as good as that of the traditional video.

5 Study 2: modal and attention distribution

According to the results of study 1, students showed higher interest and more concentration when faced with multimodal learning videos, but multimodal brought about an increase in cognitive load during task processing. Learners divide their attention between different modes to complete information acquisition and retention. In the process of video presentation, the designers of some teaching materials often cause information repetition in order to highlight the key and difficult points, that is, when

there is only mode difference between two information sources without information difference, or when the information of two information sources can be understood independently without integration, redundancy effect will be caused when they appear at the same time [41]. Therefore, repeated design should be reduced in the presentation of difficult and important information. If repetition is not an option to capture the learner's attention, can excessive modes be used to capture the learner's interest? The answer is no. Christof Wecker found that the large number of elements in traditional PPT made students prone to problems in the allocation of attention, which inhibited the retention of information in the presentation to the teacher [42]. Therefore, how to highlight the difficult information in the limited modal selection becomes very important.

5.1 Experimental design

In the second study, the two videos were further analyzed by eye tracker data. According to the characteristics of the two videos, the attention distribution of students in different modes was studied. The first video can be divided into two categories: modal teaching and modal discourse. From the two kinds of video clips, some modes that appear more frequently and are commonly used in daily videos are selected for analysis. In modal teaching, three kinds of teacher image, subtitle and text are selected. Choose text, text and subtitles in modal discourse. The research focus of the first video is to specifically analyze the differences of learners' fixation time allocation in the three modes of teacher, subtitle and text in the two video clips. In the second video study, the difference of fixation time allocation between pictures and texts was studied.

The length of learners' fixation time in different interest zones was recorded by dividing the two videos into different interest zones of different modes. Each mode corresponds to one interest zone. Considering the modal in a video teaching modal words and rendering time is different, the two types of stimulus directly in present time as the denominator of all stimuli proportion is not scientific, so the teaching mode and modal words present whole screen each designated as an interest area, choose this two interest looking time respectively as the denominator consider different modal looking time accounted for.

5.2 The results

Table 4. Attention distribution in traditional video recording

Category	Modal	Fixation Time (ms)	Proportion
Modal Teaching	Subtitle	2691172.9	18.54%
	Teacher	5396089.8	37.18%
	Pictures and Texts	1706816.1	11.76%
	Total Fixation Time	14514865	100%
Modal Discourse	Pictures and Texts	3262812.5	60.98%
	Subtitle	786090.1	14.69%
	Total Fixation Time	5350207.8	100%

Research on the distribution of attention in traditional video recording. It can be seen from Table 4 that the selected mode is the main mode in the video, accounting for more than 60% of the attention distribution. In modal teaching, most of the subjects' attention was paid to the teacher, followed by the subtitle, and the proportion of pictures and texts was the lowest. In modal discourse, text and text account for the highest proportion, followed by subtitle. Since the text and text are not always presented in the modal teaching, the text and text, subtitles and teacher images cannot be compared together in the fragment. However, the teacher image and subtitle in modal teaching and the picture and text in modal discourse always appear simultaneously. Combining the two clips, when the text and caption were presented together, the subjects' attention was largely focused on the text and caption; when the caption and portrait were presented together, the attention was more allocated to the portrait, but at this time, the attention allocated was reduced and the attention on the subtitles increased. To sum up, the attention of the subjects in the face of these three modes was allocated in the order of text, portrait and subtitles.

Table 5. Attention distribution in automatic recording and playing video

Modal	Fixation Time (ms)	Proportion
Pictures	10451294.5	58%
Texts	7416371.2	41%
Automatic recording and playing video	17888305.8	100%

Research on attention distribution in automatic recording and playing video. In the fully automatic recording and playing video, it was mainly composed of pictures and words. Through comparison, it was found that subjects paid more attention to pictures than words. To sum up the two groups of videos, we can conclude that learners' habits in attention allocation are carried out in the order of pictures, portraits and subtitles, and pictures are the main part in the pictures. Therefore, in subsequent video production, appropriate modal presentation forms for different knowledge points can be selected according to this rule of attention distribution.

6 Discussion

The above research mainly selects recorded and played videos of high importance in online education as research materials, and compares the subjective evaluation and objective performance of learners when learning traditional and automatic recorded and played videos, so as to discover the rules of learning behavior. The differences between the two types of videos are shown in Table 6.

Table 6. Comparison of differences between traditional video recording and full-automatic video recording

Category	Cost	Modal	Content	Learning Effect
Traditional video recording	High production cost; Long production cycle	Rich	Slow update	Students are more interested, more focused and have a higher cognitive load.
Automatic recording and playing video	Low production cost; Short production cycle	Simple	Quick update; Effective; Strong interaction	Students lack concentration.

Learners have different attention allocation in different modes, which provides a basis for subsequent video production. Learners pay a lot of attention to pictures and texts, which are mainly pictures. It is suggested that video producers highlight the difficult points through pictures more. In addition, portraits and subtitles will also occupy a lot of learners' attention. In video production, the presentation time should be controlled to reduce the distraction effect.

There is no obvious difference between the two groups in learning achievement and learning satisfaction. There was no significant difference between students' recall scores and transfer scores, so the learning effect brought by knowledge timeliness of automatic recording videos was not significant in this study. In the author's opinion, the reason may be that in order to control the experiment time, each video contained limited knowledge points, so it was not obvious in the performance. There is no obvious difference between the two groups in the subjective satisfaction evaluation of learners. In the post-test questionnaire evaluation, a number was set for each subject in order to ensure the correspondence with eye movement data. Although in-depth experimental communication has been carried out, the subjective choice may be affected by the social praise behavior of the subject.

Video production of the paper for online education provides advice, improve the quality of video can directly influence learners' learning evaluation, on the one hand, can help learners in countless choose appropriate forms of video in the video learning, on the other hand can also help improve video quality online education provider, to improve learners' learning evaluation, for online education in the fierce industry competition to help.

7 References

[1] Z. Wu, Y. Tang, C. Huang, Y. Huang, and R. Ding, "Research on Learning Recommendation System and Its Implementation on Academic Social Networks," *China Educational Technology*, no. 3, pp. 75–81, 98, 2016.

[2] N. Guo, M. Lu, and X. Zhao, "Correlation Analysis of Exercise and its Vectorization Method," *Computer Engineering & Science*, vol. 39, no. 10, pp. 1950–1957, 2017.

[3] B. Liu, X. Hu, W. Luo, and C. Huang, "Research and Practice of Resource Organization Model Based on Application Semantics in Cloud Learning Space," *Modern Distance Education*, no. 1, pp. 69–81, 2020.

[4] H. Ma, "Design and Realization of the Online Learning Process Monitoring System," *Experimental Technology and Management*, vol. 28, no. 5, pp. 93–94, 111, 2011.
[5] S. Li, Q. Zheng, J. Du, and S. Wang, "The Relationship between Online Learning Attention Engagement Characteristics and Learning Completion Degree—Analysis based on Click Stream Data," *China Educational Technology*, no. 2, pp. 105–112, 2021.
[6] M. Li, P. Guo, and Z. Li, "Self-Adaptive Regulation Strategy for Distance Learning based on Emotion Recognition," *Distance Education in China*, no. 11, pp. 18–24, 79, 2015.
[7] C. Huang, J. Yu, and X. Wang, "Emotion Analysis and Its Learning Recommendation Applications in the Learning Space Based on Cloud Environments," *China Educational Technology*, no. 10, pp. 7–14, 39, 2018.
[8] Z. Ozcinar, N. Orekhovskaya, M. Svintsova, E. Panov, E. Zamaraeva, and A. Khuziakhmetov, "University Students' Views on the Application of Gamification in Distance Education," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 16, no. 19, pp. 4–15, 2021. Available: https://www.learntechlib.org/p/220035/; https://doi.org/10.3991/ijet.v16i19.26019
[9] N. Wu, "Blended Learning Space: Connotations, Utility Representation and Formation Mechanism," *e-Education Research*, vol. 38, no. 1, pp. 21–27, 2017.
[10] X. Chen, A. Yang, and T. Wang, "Application of "Mixed" Teaching in Medical Immunology Teaching," *Chinese Journal of Cellular and Molecular Immunology*, vol. 36, no. 8, pp. 760–766, 2020.
[11] N. Wu, and H. Xia, "Virtual-Reality Interaction-The Essential Ideas of Class Optimization of Blended Learning," *Modern Distance Education*, no. 2, pp. 33–42, 2019.
[12] Z. Duo, W. Zhao, Y. Li, and Y. Ren, "Blended Learning Design Based on Online Learning Space from the Perspective of Problem-solving Learning," *e-Education Research*, vol. 39, no. 2, pp. 32–38, 2018.
[13] X. Wang, M. Han, Z. Gao, and Z. Wang, "Research on the Mechanism and Optimization Strategy of Visual and Auditory Emotional Design in Instructional Videos," *Journal of Distance Education*, vol. 38, no. 6, pp. 50–61, 2020.
[14] X. Wang, Z. Wang, A. Hou, "The Eye Movement Study on the Design of Subtitles in Network Teaching Videos," Modern Educational Technology, no. 2, pp. 45–51, 2016.
[15] Z. Jiang, C. Zhao, H. Li, P. Hu, Y. Huang, "Influencing Factors of Online Learners' Satisfaction: A Comparative Study on Live Situation and Record Situation," *Open Education Research*, vol. 23, no. 4, pp. 76–85, 2017.
[16] L. Huang, J. Wei, S. Guo, and P. Wang, "Study on Analysis and Comparison of Video Recorded Public Class Mode," *Experimental Technology and Management*, vol. 31, no. 8, pp. 185–187, 199, 2014. https://doi.org/10.1080/10580530.2014.923263
[17] J. Xiao, "Multimodal Discourse Analysis: Theoretical Models and Their Methodological Significance for New Media Intercultural Communication Studies," *Wuhan University Journal (Arts & Humanity)*, no. 6, pp. 126–134, 2017.
[18] O. Lazorak, O. Belkina, and E. Yaroslavova, "Changes in Student Autonomy via E-Learning Courses," International Journal of Emerging Technologies in Learning (iJET), vol. 16, no. 17, pp. 209–225, 2021. Available: https://www.learntechlib.org/p/220066/; https://doi.org/10.3991/ijet.v16i17.23863
[19] J. Zhao, "Align with Learning Outcomes: Highlights of Course-Level Learning Outcome Assessments—Studies of the SC Undergraduate Education Reform in the USA (6)," *Research in Higher Education of Engineering*, no. 6, pp. 15, 2019.
[20] B. Qu, G. Sui, "A Preliminary study on usability test of Online course," *Modern Educational Technology*, no. 3, pp. 84–86, 2008.

[21] R. Moreno, R. E. Mayer, "Verbal Redundancy in Multimedia Learning: When Reading Helps Listening," *Journal of Educational Psychology*, vol. 94, no. 1, pp. 156–163, 2002. https://doi.org/10.1037/0022-0663.94.1.156

[22] J. Tian, S. Li, W. Sun, and F. Qiao, "Effects of Freeway Tunnel Environment on Drivers' Visual Characteristics," *Journal of Chang'an University*, no. 201, pp. 216–221, 2015.

[23] F. Guo, G. Ye, M. Li, and W. Lv, "An Eye-Tracking Study on the Influences of Brand Prominence on the Advertising Effects—A Case of Product Placement in Movies," *Journal of Marketing Science*, no. 4, pp. 18–33, 2017.

[24] Y. Zheng, Y. Wang, and L. Cui, "The Application of Eye Tracking Technology in Multimedia Learning: A Review of Research from 2005 to 2015," *e-Education Research*, vol. 37, no. 4, pp. 68–76, 91, 2016.

[25] X. Zhang, "Semiotic Implications of Teaching and Learning in Multimodal Era," *Education Sciences in China*, no. 3, pp. 57–67, 2020. https://doi.org/10.4324/9781315166896-7

[26] D. Wu, "Research on Teaching Mode of Multimodal Film and Television Material," *Educational Review*, no. 5, pp. 108–110, 2014.

[27] Z. Zhang, "Research on the Application of Multi-Modal Teaching Mode in English Teaching in Vocational Colleges," *Journal of Social Science of Hunan Normal University*, no. A1, pp. 454–456, 2014.

[28] T. L. Hallett, and G. Faria, "Teaching with Multimedia: Do Bells and Whistles Help Students Learn?," *Journal of Technology in Human Services*, vol. 24, no. 2–3, pp. 167–179, 2006. https://doi.org/10.1300/J017v24n02_10

[29] L. Kang, "Multimodal Semiotics Perspective on Design of English Teaching and Learning for College Athlete Students," *Journal of Wuhan Institute of Physical Education*, vol. 50, no. 10, pp. 90–95, 2016.

[30] D. G. Levasseur, and K. Sawyer, "Pedagogy Meets PowerPoint: A Research Review of the Effects of Computer-Generated Slides in the Classroom," *Review of Communication*, vol. 6, no. 1–2, pp. 101–123, 2006. https://doi.org/10.1080/15358590600763383

[31] M. Li, "Multimodal Pedagogy in TESOL Teacher Education: Students' Perspectives," *System*, vol. 94, pp. 102337, 2020. https://doi.org/10.1016/j.system.2020.102337

[32] L. Hu, "Experimental Analysis of Multi Modal Functions of English Majors Listening Teaching," *Research and Exploration in Laboratory*, vol. 37, no. 2, pp. 170–173, 2018.

[33] R. E. Mayer, and C. I. Johnson, "Revising the Redundancy Principle in Multimedia Learning," *Journal of Educational Psychology*, vol. 100, no. 2, pp. 380–386, 2008. https://doi.org/10.1037/0022-0663.100.2.380

[34] H. C. Liu, M. L. Lai, and H. H. Chuang, "Using Eye-Tracking Technology to Investigate the Redundant Effect of Multimedia Web Pages on Viewers' Cognitive Processes," *Computers in Human Behavior*, vol. 27, no. 6, pp. 2410–2417, 2011. https://doi.org/10.1016/j.chb.2011.06.012

[35] J. Li, P. D. Antonenko, and J. Wang, "Trends and Issues in Multimedia Learning Research in 1996–2016: A Bibliometric Analysis (Review)," *Educational Research Review*, vol. 28, pp. 100282, 2019. https://doi.org/10.1016/j.edurev.2019.100282

[36] Y. Xiao, "Application of Case Teaching Method in Economic Teaching—Comment on Case Teaching Method in Management Education (First Edition)," *Journal of the Chinese Society of Education*, no. 12, pp. 1, 2015.

[37] M. Hamse, S. Lotfi, and M. Talbi, "Identification and Learning Styles' Variation Factors for a Hybrid and Distance Learning Professional Training ODL-SPOC," International Journal of Emerging Technologies in Learning (iJET), vol. 16, no. 17, pp. 89–106, 2021. Available: https://www.learntechlib.org/p/220068/; https://doi.org/10.3991/ijet.v16i17.20851

[38] Z. Duan, "The Personalized Interactive Model of Students with Different Learning Style in Online Video Learning and its Mechanism: Explorations based on Activity Theory," Wuhan: Central China Normal University, 2018.
[39] L. Zhang, J. REN, L. XU, J. Zhang, and J. Zhao, "Visual Comfort and Fatigue Measured by Eye Movement Analysis When Watching Three-Dimensional Displays," *Ophthalmology in China*, vol. 23, no. 1, pp. 37–42, 2014.
[40] B. Jiang, X. Wang, Y. Liu, M. Gao, "Research on the Learners' Eye Movement Behavior in Online Testing—Taking the Eye Movement Experiment in Zhejiang University of Technology for Example," *Modern Educational Technology*, vol. 28, no. 5, pp. 19–25, 2018.
[41] S. Kalyuga, P. Chandler, and J. Sweller, "When Redundant On-Screen Text in Multimedia Technical Instruction Can Interfere With Learning," *Human Factors*, vol. 46, no. 3, pp. 567–581, 2004. https://doi.org/10.1518/hfes.46.3.567.50405
[42] C. Wecker. Slide Presentations as Speech Suppressors: When and Why Learners Miss Oral Information [J]. *Computers & Education*, vol. 59, no. 2, pp. 260–273, 2012. https://doi.org/10.1016/j.compedu.2012.01.013

8 Authors

Qiuhao Wu, Master, is a student of Hohai University. Her research interests focus on Enterprise Training and Human Resource Management (email: 2106219809@qq.com).

Rong Liu, Ph.D., is an associate professor of Hohai University. Her research interests focus on Enterprise Training and Human Resource Management (email: liurongliu@sina.com).

Article submitted 2022-01-07. Resubmitted 2022-07-03. Final acceptance 2022-07-04. Final version published as submitted by the authors.