The Effect of Video Playback Speed and Repetition in English Learning of Primary School Students

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Abstract. Recently, teaching videos are widely used in primary school students' learning. Video-based learning is an important approach when the primary school students learn English. In order to explore the influence of playing speed and repetition way of teaching video on primary school students' English learning, our study designed the same English teaching video in three different video playback speeds, as 1.0 × speed, 1.5 × speed and 2.0 × speed. To investigate the effect of repetition way, our study designed two different repetition ways, as immediate repetition vs. delayed repetition. Therefore, there are six experimental conditions in our study, as "1.0 × speed immediate repetition", "1.0 × speed delayed repetition", "1.5 × speed immediate repetition", "1.5 × speed delayed repetition", "2.0 × speed immediate repetition" and "2.0 × speed delayed repetition". 261 primary school students participated in this study and did two tests (knowledge memory test and transfer learning test) after learned the teaching video. Our results showed there were significant effects of playback speed and repetition way on testing about knowledge memory, and significant interaction of playback speed and repetition way was found. There was no significant effect of repetition way on testing about transfer learning, however only significant effect of repetition way on knowledge memory test was found. Our study furthers previous understanding about how playback speed and repetition way modulate primary school students' English learning. The implications of this study are particularly highlighting the better transfer learning and memory retention of normal speed and delayed repetition. Moreover, our findings will help primary school teachers and students to getting better outcomes of the teaching videos in daily English learning.

Keywords: Video-based learning, Playback speed, Immediate repetition, Delayed repetition

1 Introduction

1.1 Playback Speed of Teaching Video

As "Internet + education" continues to promote the intelligent development of education, new teaching mode such as teaching video becomes important for students to carry out learning activities [1-3]. In order to adapt to the fast-paced learning, learners

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often save time by increasing the playback speed, and in order to better grasp the knowledge, learners may repeat the same learning video at a faster speed. At present, it has become a popular trend for learners to learn by controlling the playing speed of teaching videos [4-5]. However, with the acceleration of playback speed, the amount of picture information and the speed of explanation of teaching videos have changed. Under this condition, can learners effectively understand the content in the learning videos? It is important to address the question about the learning effect of faster playback speed of teaching video.

Although playing teaching video at double speed helps the learners save their time, the influences of fast playback speed on learning is still unclear. Currently, there are mainly two theories, as one theory is based on stimulus-driven attention, which suggests there is no interference or promotion effect of fast playback speed on learning. The other theory is based on the cognitive load, which suggests that faster playback decrease the learning effect. Recent study investigated how playback speed modulated students' learning and cognitive load, and suggested students' cognitive load increased with playback speed increased [6]. There are many studies on the influences of playback speed of learning videos. However, previous papers on video speed are usually concentrated in the field of colleges and universities, and there is a lack of attention to the group of primary school students [7-8]. It is worth noting that, teaching videos has already been widely used in primary school. Moreover, the physical and mental maturity of primary school students is far from that of middle school students and college students. If teachers can set an appropriate speed threshold in advance, primary school students can get more information in a shorter time and improve their learning efficiency. Therefore, our study investigates how the playback speed affects the primary school students' video-based learning.

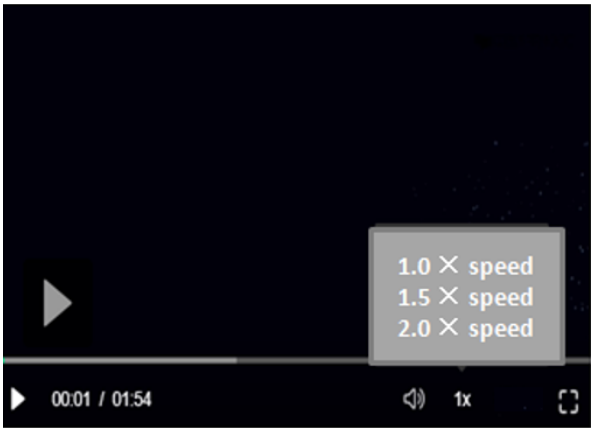

Fig. 1. The playback speeds of the teaching video.

Previous study used 1.0 × speed and 2.0 × speed, and found that younger adults can watch lecture videos at 2.0 × speed without significant deficits in memory [7]. Moreover, researchers employed 1.5 × speed and 2.0 × speed to address the impact of lecture

playback speeds, and found there was no significant difference in college students' concentration or long-term memory retention between different 1.5 × and 2.0 × speeds [4]. However, recent paper suggested the learning effect of 1.5 × speed was considerably lower than that of 1.0 × speed [9]. To investigate the influence of playback speed, based on these previous findings, we designed three playback speeds in our study. As shown in Figure 1, the three playback speeds are 1.0 × speed, 1.5 × speed and 2.0 × speed.

1.2 Immediate Repetition and Delayed Repetition

At present, several researches on teaching video investigate the influence of numbers of playback times on learning effect. For example, previous study compared the learning effects between learning once and learning twice at the same playback speed to investigate the influence of playback times [10, 11]. Moreover, to control the presentation time to be equal, researchers designed different numbers of playback times for different playback speed, as normal speed with two playback times, 1.5 × speed with three playback times and 2.0 × speed with four playback times [10]. They found better learning effect for 2.0 × speed with four playback times than normal speed with two playback times and 1.5 × speed with three playback times [10]. Considering learners usually watch the same teaching video more than one time at different ways, recent study asked one group of learners watch the teaching video once a week for two weeks to investigate the effect of different repetition ways [11]. By comparing the repetition modes under different speeds, we can understand the cognitive processing of learners under different conditions more comprehensively, and then optimize the design of learning materials to improve the learning effect. However, previous studies always focus on the group of college students, and the content selection of teaching videos is relatively limited [12-13]. Therefore, the specific effects of repetition on different learners need to be further studied.

Recently, a paper investigate the effect of lecture video speed on immediate and delayed comprehension, the researchers asked the participants watch the lecture video once at normal speed (1.0 × speed) or twice at 2.0 × speed, and participants in the 2.0 × speed group watched the video again a 1-week delay [11]. And their results suggested comprehension improved when participants watched the video again at 2.0 × speed a 1-week delay. Based on previous study, our study designed the repetition ways as immediate repetition and delayed repetition (1-week delay) to investigate how the prepetition affects the primary school students' video-based learning.

1.3 Video-based Learning on English

In addition, teachers should actively use diversified ways and channels to fully develop and utilize curriculum resources to meet the actual needs of teaching [14]. This not only reflects the teaching orientation of English curriculum, but also reveals the characteristics of primary school English curriculum. Therefore, how to take advantage of the controllability of playback speed and repetition time of teaching videos has become an urgent problem of primary school online learning. And more and more researchers have

investigated how to provide teachers and students with the best playing strategy of video and improve the effect of students' online video learning. As we known, teaching videos about English learning have been widely used and become more and more popular.

Therefore, our study mainly explores the specific effects of video playback speed and repetition style on primary school students' English learning. According to previous studies [4, 7, 10, 11], our study evaluates the effect of primary school students' English learning by controlling the speed of video playback (1, 1.5 and 2 times) and the repetition way (immediate repetition and delayed repetition). Therefore, there are six experimental conditions in our study, as "1.0 × speed immediate repetition", "1.0 × speed delayed repetition", "1.5 × speed immediate repetition", "1.5 × speed delayed repetition", "2.0 × speed immediate repetition" and "2.0 × speed delayed repetition".

2 Methods

2.1 Subjects

In this study, 261 fifth grade primary school students were randomly selected as the subjects, and they were divided into six experimental groups according to the different experimental conditions. As our study designed the same English teaching video in three different video playback speeds, as 1.0 × speed, 1.5 × speed and 2.0 × speed [4, 7]. To investigate the effect of repetition type, our study designed two different repetition ways, as immediate repetition vs. delayed repetition [10, 11]. Therefore, there are six experimental conditions in our study, as "1.0 × speed immediate repetition" (N = 52), "1.0 × speed delayed repetition" (N = 42), "1.5 × speed immediate repetition" (N = 50), "1.5 × speed delayed repetition" (N = 38), "2.0 × speed immediate repetition" (N = 40) and "2.0 × speed delayed repetition" (N = 39). The information of six groups of subjects is shown in the Table 1. None of the subjects have learning experience related to the teaching video.

Table 1. The information of six groups.

Name of Group	Playback speed	Repetition type	Number of subjects
1.0 × speed immediate repetition	1.0	immediate	52
1.0 × speed delayed repetition	1.0	delayed	42
1.5 × speed immediate repetition	1.5	immediate	50
1.5 × speed delayed repetition	1.5	delayed	38
2.0 × speed immediate repetition	2.0	immediate	40
2.0 × speed delayed repetition	2.0	delayed	39

2.2 Teaching Videos

In this study, as shown in Figure 2, the teaching video "The expression of taking a vehicle in English" was selected as the material. The teaching video is a prize-winning video from a provincial competition. And the content of the teaching video is suitable for the fifth grade primary school students. According to the specific requirements of the experimental design, this study used professional video editing software to generate three video files with different playback speeds. The first video file is played at 1.0 × speed, and its total duration is controlled to 4 minutes and 32 seconds; the second video file is played at 1.5 × speed, and its duration is correspondingly shortened to 2 minutes and 58 seconds; the third video file is played at 2.0 × speed, and its duration is further shortened to 2 minutes and 16 seconds. All video files are in standard MP4 format and ensure a resolution of 1280 × 1080.

In the production of video content, the material of each video and the corresponding text information are accurately corresponding one by one to ensure the accurate transmission of information. And the sound information of each video is presented synchronously with the video content to ensure the synchronization of sound and picture, providing learners with a smooth and consistent learning experience.

Fig. 2. The teaching video in this study.

2.3 Experimental Design

The experimental environment is a classroom in the primary school. Several primary school students watched the teaching video in the classroom at the same time as a group of subjects. After the experimenter explained the contents and requirements of the experiment, the subjects began to watch the teaching video. For the group of “1.0 × speed immediate repetition”, “1.5 × speed immediate repetition” and “2.0 × speed

immediate repetition", after the video was repeated twice, the subjects completed two tests (knowledge memory test and transfer learning test).

For the group of "1.0 × speed delayed repetition", "1.5 × speed delayed repetition" and "2.0 × speed delayed repetition", the subjects watch the teaching video once. After one week [11], the subjects came back to the same classroom and watch the teaching video again and then completed two tests (knowledge memory test and transfer learning test).

The two tests include one test is about knowledge memory, and the other is about transfer learning test. Subjects need to finish the two tests in the classroom. The memory test mainly assesses the learner's ability to memorize of learned knowledge in the teaching video. Previous studies usually employed the memory tests to evaluate the influences of playback speed on video-based learning [4-7]. The full score of this memory test is 8 points. The multiple choice part (questions 1 to 5) mainly examines the learners' memorization and understanding of basic concepts, totaling 5 questions, 1 point for each question, totaling 5 points. The fill in the blanks (questions 6 to 8) part focuses on the test of key information, contains 3 questions, 1 point for each question, 3 points in total.

The transfer learning test mainly assesses learners' understanding ability and knowledge transfer ability. Learners need to apply the knowledge they have learned in the teaching video to different contexts. Recent study used transfer learning test to investigate the modulation of playback speed and competition of teaching videos [10]. The full score of the transfer test is 8 points. The multiple choice part (questions 1 to 5), which examines the learner's understanding and flexible use of knowledge by providing different situations, contains 5 questions, 1 point for each question, and 5 points in total. In the part of filling in the blanks (questions 6 to 8), learners are required to fill in the correct expression of vehicles according to the specific situation, including 3 questions, each of which is 1 point, totaling 3 points.

3 Results

For the memory test, results show the different score of six groups, as "1.0 × speed immediate repetition" (mean = 4.33, SD = 2.75), "1.0 × speed delayed repetition" (mean = 6.71, SD = 1.04), "1.5 × speed immediate repetition" (mean = 5.38, SD = 2.02), "1.5 × speed delayed repetition" (mean = 5.39, SD = 1.87), "2.0 × speed immediate repetition" (mean = 4.05, SD = 2.23) and "2.0 × speed delayed repetition" (mean = 5.33, SD = 2.14). These results are shown in Table 2. Based on these data, we did two-way ANOVA on the effects of playback speed and repetition way.

Table 2. Results of memory test.

Name of Group	Mean	SD	Number of subjects
1.0 × speed immediate repetition	4.33	2.75	52
1.0 × speed delayed repetition	6.71	1.04	42

1.5 × speed immediate repetition	5.38	2.02	50
1.5 × speed delayed repetition	5.39	1.87	38
2.0 × speed immediate repetition	4.05	2.23	40
2.0 × speed delayed repetition	5.33	2.14	39

According to the results of two-way analysis of variance, the main effect of playback speed is significant ($P < 0.05$), and the main effect of repetition way is also significant ($P < 0.001$). Interestingly, results show the significant interaction between the playback speed and repetition way ($P < 0.005$). To investigate the significant interaction, further analysis show there is no significant differences of "1.0 × speed immediate repetition", "1.5 × speed immediate repetition" and "2.0 × speed immediate repetition", but significant differences of "1.0 × speed delayed repetition", "1.5 × speed delayed repetition" and "2.0 × speed delayed repetition" ($P < 0.05$).

For the transfer learning test, results show the different score of six groups, as "1.0 × speed immediate repetition" (mean = 4.87, SD = 2.21), "1.0 × speed delayed repetition" (mean = 5.31, SD = 2.03), "1.5 × speed immediate repetition" (mean = 5.06, SD = 2.35), "1.5 × speed delayed repetition" (mean = 5.03, SD = 2.42), "2.0 × speed immediate repetition" (mean = 3.73, SD = 2.57) and "2.0 × speed delayed repetition" (mean = 3.82, SD = 2.52). These results are shown in Table 3. Based on these data, we did two-way ANOVA on the effects of playback speed and repetition way.

According to the results of two-way analysis of variance, the main effect of playback speed is not significant, but the main effect of repetition type is significant ($P < 0.001$). Interestingly, different from the results of memory test, results of transfer test show there is no significant interaction between the playback speed and repetition type.

Table 3. Results of transfer test.

Name of Group	Mean	SD	Number of subjects
1.0 × speed immediate repetition	4.87	2.21	52
1.0 × speed delayed repetition	5.31	2.03	42
1.5 × speed immediate repetition	5.06	2.35	50
1.5 × speed delayed repetition	5.03	2.42	38
2.0 × speed immediate repetition	3.73	2.57	40
2.0 × speed delayed repetition	3.82	2.52	39

4 Conclusion

In this study, we found the main effect of playback speed is different for knowledge memory test and transfer learning test. For the transfer learning test, there is no significant difference of "1.0 × speed", "1.5 × speed" and "2.0 × speed". These results

suggest when the primary school students watched the teaching video about English knowledge, and apply the knowledge they have learned to different contexts, the results of faster playback speed ("1.5 × speed" and "2.0 × speed") is similar with the normal playback speed ("1.0 × speed"). However, previous study found transfer learning performance decreased with the playback speed increased [10]. The different results may due to we combined playback speed with repetition, but previous study only asked the participants watch the teaching video once. Moreover, our results suggested the main effect of repetition type is significant for transfer learning test, as the delayed repetition groups got better performance than immediate repetition groups. Similarly, recently findings also suggested the benefits of watched the teaching video again a week delay [11]. Our results further previous understanding about how playback speed and repetition way modulate transfer learning, and provide more information about video-based learning to primary school teachers and students.

Interestingly, for the knowledge memory test, no significant differences of "1.0 × speed immediate repetition", "1.5 × speed immediate repetition" and "2.0 × speed immediate repetition", these results suggest when the primary school students watched the teaching video about English knowledge twice (immediate repetition), the learning effect of faster playback speed ("1.5 × speed" and "2.0 × speed") is similar with the normal playback speed ("1.0 × speed") on the memory of learned knowledge. Previous studies also found there were no significant different of memory test between different playback speeds [4, 7]. However, for the knowledge memory test, significant differences of "1.0 × speed delayed repetition", "1.5 × speed delayed repetition" and "2.0 × speed delayed repetition" are found in our results. These results suggest if the students learn the same teaching video about English knowledge once a week for two weeks (delayed repetition), the learning effects are better for the normal playback speed ("1.0 × speed") than the faster playback speed ("1.5 × speed" and "2.0 × speed") on the memory of learned knowledge. These results consistent with previous study which indicate participants' comprehension improved for group of watched the teaching video again a week delay [11]. Our study highlights the better learning performance of groups of delayed repetition.

It is worth noting that, we also found the main effect of playback speed is different for the knowledge memory test and transfer learning test. For the transfer learning test, the main effect of repetition way is significant, as the three delayed repetition groups ("1.0 × speed delayed repetition", "1.5 × speed delayed repetition" and "2.0 × speed delayed repetition") obtain better learning effects than the three immediate repetition groups ("1.0 × speed immediate repetition", "1.5 × speed immediate repetition" and "2.0 × speed immediate repetition"). No such results were found for the knowledge memory test.

Taken together, focus on knowledge memory test and transfer learning test, our study indicates the different effects of playback speed and repetition type on primary school students' English learning. The implications of this study are particularly highlighting the better transfer learning and memory retention of normal speed and delayed repetition. Moreover, our findings will help primary school teachers and students to getting better outcomes of the teaching videos in daily English learning.

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References

1. Michael Noetel , Shantell Griffith, Oscar Delaney, Taren Sanders, Philip Parker, Borja del Pozo Cruz and Chris Lonsdale. 2021. Video Improves Learning in Higher Education: A Systematic Review. Review of Educational Research, 91(2), 204-236. https://doi.org/10.3102/0034654321990713.
2. Sven Trenholm, and Fernando Marmolejo-Ramos. 2024. When Video Improves Learning in Higher Education. Education Sciences 14, no. 3: 311. https://doi.org/10.3390/educsci14030311.
3. Massimiliano Tani, Maurizio Manuguerra and Samia Khan. 2022. Can videos affect learning outcomes? Evidence from an actual learning environment. Educational technology research and development: ETR & D, 70(5), 1675–1693. https://doi.org/10.1007/s11423-022-10147-3.
4. Zachary I Merhavy , Lukas Bassett , Michelle Melchiorre , Maureen P M Hall .2023. The impact of lecture playback speeds on concentration and memory. BMC medical education, 23(1), 515. https://doi.org/10.1186/s12909-023-04491-y.
5. Chih-Tsung Hung , Shou-En Wu, Yi-Hsien Chen, Chen-Yeu Soong , Chien-Ping Chiang , Wei-Ming Wang. 2024. The evaluation of synchronous and asynchronous online learning: student experience, learning outcomes, and cognitive load. BMC medical education, 24(1), 326. https://doi.org/10.1186/ s12909-024-05311-7.
6. Chuan-Yu Mo , Chengliang Wang , Jian Dai , Peiqi Jin . 2022. Video Playback Speed Influence on Learning Effect From the Perspective of Personalized Adaptive Learning: A Study Based on Cognitive Load Theory. Frontiers in psychology, 13, 839982. https://doi.org/10.3389/fpsyg.2022.839982.
7. Dillon H Murphy , Kara M Hoover , Alan D Castel. 2023. The effect of video playback speed on learning and mind-wandering in younger and older adults. Memory. 1-16. https://doi.org/10.1080/09658211.2023.2198264.
8. David Lang, Guanling Chen, Kathy Mirzaei, and Andreas Paepcke. 2020. Is faster better? a study of video playback speed. In Proceedings of the Tenth International Conference on Learning Analytics & Knowledge (LAK '20). Association for Computing Machinery, New York, NY, USA, 260–269. https://doi.org/10.1145/3375462.3375466.
9. Liu Rong and Huina Jia. 2024. Effects of instructional video playback speed and pre-embedded questions on learning. Asia Pacific Education Review. https://doi.org/10.1007/s12564-024-09964-3.
10. Ma Anran, Wang Yanqing, Wang Fuxing, Zhou Zhijin. 2021. Effects of Accelerating the Playback of Micro Teaching Video on Learning Performance. Psychological Development and Education, 37(3): 391-399. https://devpsy.bnu.edu.cn/EN/Y2021/V37/I3/391.
11. Dillon H. Murphy, Kara M. Hoover, Karina Agadzhanyan, Jesse C. Kuehn, Alan D. Castel. 2022. Learning in double time: The effect of lecture video speed on immediate and delayed comprehension. Applied Cognitive Psychology, 36(1), 69–82. https://doi.org/10.1002/acp.3899.

12. Jens Madsen, Sara U. Júlio, Pawel J. Gucik, Richard Steinberg, and Lucas C. Parra. 2021. Synchronized eye movements predict test scores in online video education. Proceedings of the National Academy of Sciences of the United States of America, 118(5), e2016980118. https://doi.org/10.1073/ pnas.2016980118.
13. Qing Liu, Xueyao Yang, Zekai Chen, Wenjuan Zhang. 2023. Using synchronized eye movements to assess attentional engagement. Psychological research, 87(7), 2039–2047. https://doi.org/10.1007/s00426-023-01791-2.
14. Xiaoyi Hu, Xian Zhang, Sarah McGeown. 2024. Foreign language anxiety and achievement: A study of primary school students learning English in China. Language Teaching Research, 28(4), 1594-1615. https://doi.org/10.1177/13621688211032332.