International Society of the Learning Sciences

Post-flipped Classrooms: Designing a Video-Based Visualization Learning Approach for Supporting Emergency Remote Teaching

Pengjin Wang, Gaowei Chen, Yuyao Tong, Chao Yang
wangpj@connect.hku.hk, gwchen@hku.hk, yyttong@hku.hk, chaoyang@connect.hku.hk
Faculty of Education, The University of Hong Kong

Abstract: During Emergency Remote Teaching (ERT), video conferencing lessons were sometimes recorded for students' reference, however, there is little knowledge on how these recordings can be reused as learning resources. This study aims to design a video-based visualization approach recycling the recorded lesson videos captured during ERT to remediate students' learning loss, with a proposed *post-flipped classroom* pedagogy. Two classes ($n_{students}$ = 54) with two teachers from different disciplines (General Studies and Math) in a Hong Kong primary school participated in this quasi-experimental study lasting three months. After the intervention, students' subject knowledge of Math improved significantly relative to the comparison group, while the General Studies class did not show a significant change. The two teachers and eight students were interviewed for their patterns of using the platform integrating video selection, visualization, discussion forum and quizzes. This study provides implications on the effective use of lesson recordings as learning resources.

Introduction

Under the COVID-19 pandemic, schools in Hong Kong have adopted emergency remote teaching (ERT) to help students learn with the support of technology. However, the effectiveness of ERT is in doubt and the way to remediate learning loss for this generation shall be explored. This paper introduces a novice post-flipped classroom pedagogy using a video-based visualization learning (VBVL) approach that utilizes the video recordings of ERT (e.g., via Zoom). During this project, we developed an online platform that helped teachers cut the long lesson video recording into video segments with visualization of classroom dialogues, supplemented with discussion forums and exercises for active learning. Although the approach is designed for long-lasting emergency situations like the pandemic, it has potential for non-crisis practices (e.g., for sick students and extended learning).

Theoretical background

Pedagogical challenges in emergency remote teaching

Since 2020, students, teachers and school managers have been facing the unprecedented challenges of the worldwide pandemic of COVID-19. School campuses have been closed and not all schools have returned to full-day teaching yet. With a rapidly changing educational landscape, online learning environments have become vital when education recovery has become a priority to avoid catastrophe consequences for the whole generation (The United Nations Educational, Scientific and Cultural Organization, 2021). Teachers and students chose ERT, which is a survival mode of education that aims to minimize spatial distance for continuity of education (Bozkurt & Sharma, 2020). Compared to pre-planned online learning, ERT means a temporary shift of delivery mode that provides quick and reliable access to instructions without establishing a robust educational ecosystem (Hodges et al., 2020). Ferri et al. (2020) identified three challenges for ERT, which are technological challenges, pedagogical challenges, and social challenges, in which pedagogical challenges are learners' lack of interactivity and motivation as well as teachers' lack of social and cognitive presence. In a sudden change to the teaching mode, teachers are underprepared to support learners at a distance using technology and are "building the plane while flying it" (Trust & Whalen, 2020, p.193). To ensure students are attending the lessons as usual, synchronous video conferencing is a popular solution for school suspensions. However, replacing face-to-face teaching with synchronous video conferencing teaching does not mean replacing the media, but the latter requires different and extended skills sets (Peachey, 2017). Other than synchronous video conferences which may be limited by time constraints, asynchronous platforms also have the potential to increase student engagement and enhance learning outcomes (Northey et al., 2015).

Lesson video selection and visualization of classroom dialogue

Lesson recordings, gathered through video conferencing software or other approaches, can serve as effective learning materials (e.g., in Massive Open Online Courses [MOOCs]). First, video length could be a significant contributor to students' engagement. While watching a lengthy video, students may easily be overwhelmed and lose focus. When using videos for instruction purposes, Alpert and Hodkinson (2019) found that students prefer

shorter videos. In MOOCs, the median engagement time of students is 6 minutes and videos within 3 minutes had the highest engagement time from students (Guo et al., 2014). Thus, the first step of using video recordings should be segmenting them into shorter clips purposefully for students.

Second, visualization of classroom dialogue can further support video viewing. The visualization of video has been researched since the early 1990s with a range of tools (e.g., video, timeline, annotations, log, coding; Chen et al., 2020). Classroom Discourse Analyzer (CDA) is one of the representative tools visualizing classroom videos for teacher's professional development purposes, which represents classroom dialogues with synchronization of visualization and transcriptions (Chen et al., 2015, 2020). With the affordances of multiple representations and interactive visualizations, CDA has been used in teachers' professional development (TPD) programmes to support their reflection on dialogic instructions and enhance the efficacy of TPD programmes (e.g., Chen & Chan, 2022; Chen et al., 2020).

Lastly, the pros and cons of using lesson recordings as instructional videos remind platform designers to go beyond video-viewing. One advantage of lesson recordings is that it contains the presence of an instructor, which attracts students' visual attention with a lower level of self-reported mental effort compared to those without instructors (Wang & Antonenko, 2017). However, in contrast to tablet drawing with motion and continuous visual flow, the pre-recorded classroom lectures with PowerPoints are less attractive (Guo et al., 2014) and students are passive in the video-viewing process when they cannot ask questions immediately (Snyder et al., 2014). With these advantages and limitations in mind, the video-based learning platform should consider integrating other tools for students' effective learning, for example, through visualization of classroom dialogues, discussion (Alzahrani, 2017) as well as exercises (Cook & Babon, 2017). With reference to flipped classroom pedagogy, below we propose a post-flipped classroom pedagogy, which consists of video segments viewing, visualization of video recording, discussion and quizzes.

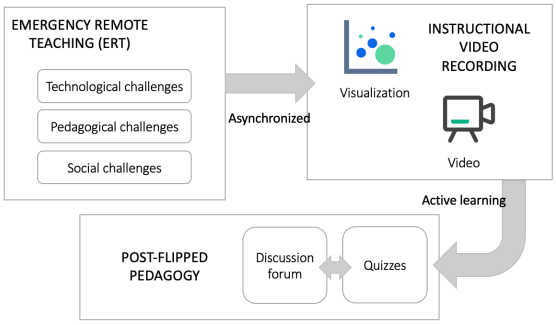
Discussions and quizzes in a post-flipped classroom

Watching lesson video recordings alone cannot be considered active learning, but these recordings can be recycled together with discussion forums and quizzes in an asynchronous post-flipped classroom. Here, post-flipped means the multimedia resources are given *after* the lesson has happened for further learning. In a typical flipped pedagogy, multimedia resources are given *before* class as input and through maximizing interaction in class time, students benefit from this flipped pedagogy regardless it is face-to-face or fully online (Hew et al., 2020; Kay et al., 2019). The sequence of tasks may not be the core, but learning is enhanced with individual components of a flipped classroom, for example, active learning (Lawson et al., 2019). As a student-centred approach, active learning is usually in contrast to a traditional lecture, which highlights the collaboration, engagement and interaction between instructors, students and course content (Prince, 2004).

There is a gap in the literature on how asynchronous platforms can facilitate active learning after watching videos. Discussion forum and quizzes have the potential to facilitate active learning, as discussion forum provides students with a meaningful context for collaboration and interaction, which allows the students to co-construct meanings with peers and teachers. Quizzes have the potentials to provide incentives for students to watch multimedia resources (Cook & Babon, 2017). The theoretical framework for a post-flipped classroom is proposed as in Figure 1. Facing the challenges in ERT, through "asynchronization", the videos were recycled into meaningful learning resources using video selection and visualization. Focusing on the contents in the video, discussion forums and quizzes enable students' active learning using the videos. With this framework, our goal is to further investigate the post-flipped classroom pedagogy and support students' active learning using visualised video segments selected by the teachers, supplemented with discussion forums and quizzes.

Figure 1

The theoretical framework of VBVL approach

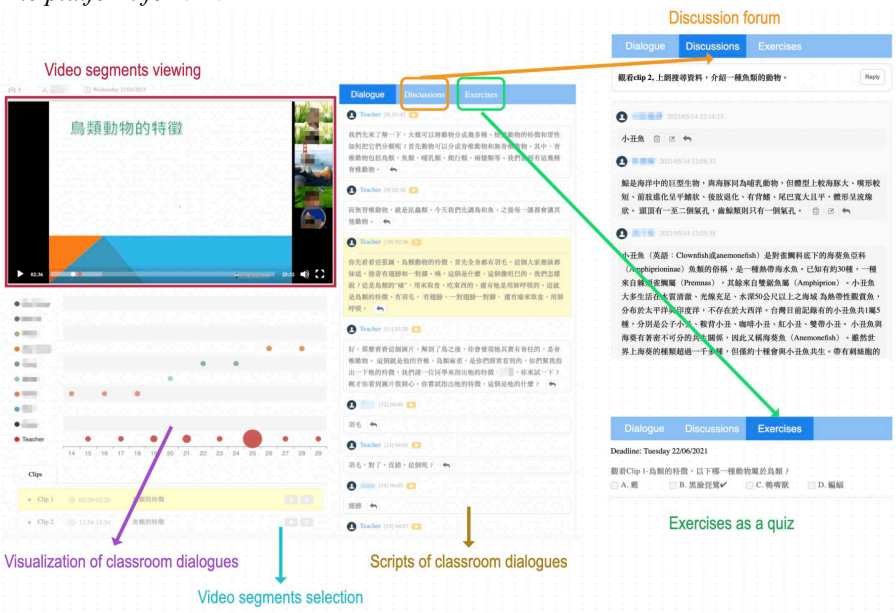


The platform for video-based visualization learning (VBVL)

To investigate the VBVL approach, a platform (see Figure 2 for a screenshot) is designed to facilitate students' active learning utilizing the recorded lessons. The platform integrates CDA (Chen, 2020; Chen et al., 2020) that enables teachers to extract multiple video segments from a long video, which will be reviewed by the students together with bubbles representing dialogues and transcripts synchronized with the video. Teachers can set topics on the discussion forum, which enables students to extend their discussion beyond the classroom. Lastly, teachers can set up quizzes that will be marked automatically for immediate feedback. In sum, the platform aims to recycle the recorded lessons to become tailored learning resources for students and support active learning through discussion forums and quizzes. Based on the research goals and gap in the literature, this study focuses on the following research questions

1. To what extent does the VBVL approach impact students' learning outcomes?
2. How do teachers and students use the VBVL approach effectively in post-flipped classrooms?

Figure 2
The platform for VBVL



Methods

Context and participants

The research was conducted in two 6th-grade classes from a public aided primary school in Hong Kong. One class used the platform in their General Studies (GS) subject whereas the other class used the platform in Mathematics (Math) subject. With the platform supporting VBVL, we conducted a three-month classroom intervention collaborating with the GS teacher and the Math teacher.

Both GS teacher and Math teacher used the record function of their video conferencing software (i.e., Zoom) when having lessons with their students. Participating students had been familiar with the video conferencing software as they have been using it for almost a year. To develop sufficient knowledge of the platform supporting VBVL, the teachers were introduced to the platform with the help of the researcher. Students were supported by the teacher when using the platform.

Pedagogical design

At the beginning of the study, GS and Math teachers were briefed on the functions of the platform, including video segment selection and visualization, as well as setting discussion topics and quizzes. During the study, the GS teacher was using the recorded lessons on biological taxonomy while the math teacher was using those on percentiles. Teachers were able to cut video conferencing lesson recordings into short clips through the platform, and they set questions for the "Discussion" forum and "Exercises" as quizzes. Both teachers and students were allowed to participate in the discussion forum and exercises would be marked automatically by the platform for instant feedback to students.

Data collection and analysis

To investigate how teachers and students perceive and use the platform and whether the students' learning outcomes can be enhanced through the platform, we used the students' pre-and post-tests on subject knowledge as well as interviews with students and teachers on the usage of the platform. as the primary data source. For secondary data sources, we analysed a questionnaire on the usage and perception of the platform, as well as teachers and students' interactions on the platform.

The pre-and post-tests of subject knowledge were designed by the GS and Math teachers with the same level of difficulty and were administered before and after the implementation of the platform for both classes (n = 54; each class has 27 students). As a quasi-experimental design, students in either of the two classes completed both GS and math subject tests, so for the subject in which they did not use the platform, the students served as a comparison group. It is also worth noticing that two students' data were not included for further analysis because they neither used the platform nor completed the questionnaires.

For post-interviews, we conducted a 1-hour interview with each teacher and a 30-minute think-aloud interview (see Figure 3) with each of the four pairs of students from the two classes (n = 8) using a think-aloud protocol (Ericsson & Simon, 1984). Based on the questionnaire results on the usage and perception of the platform administered at the end of the intervention, stratified purposive sampling was used to yield the student interviewees for the second research question. Two criteria were used for stratified purposive sampling. The first one is the frequency of using the platform, which needs to be at least one time per week. Secondly, the varied perception of the functions of the platform using a 10-item, 4-point Likert scale, yielded students who perceived highly or poorly of the platform functions. Table 1 shows the profiles of the students interviewed.

Figure 3

Two students (captured on the bottom right) in a think-aloud interview

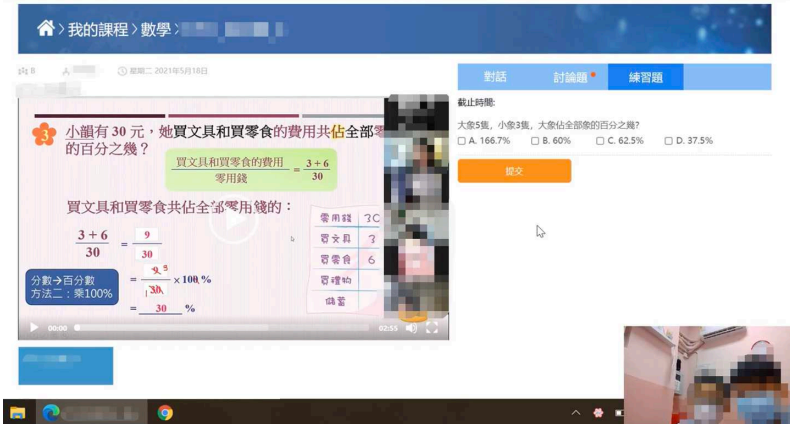


Table 1

Profiles of the interviewees (Pseudo names are used)

	GS				Math			
Name	Francis	Jason	Jill	Molly	Charlie	Leon	Winnie	Lily
Gender	M	M	F	F	M	M	F	F
Frequency of use (per week)	1	3	≥ 5	3	1	3	3	4
Time used per visit (minutes)	15-30	15-30	< 5	30-45	15-30	< 5	15-30	< 5
Mean for perception of the platform (out of 4)	3.60	3.80	3.00	3.00	3.10	3.80	3.00	3.00

To answer the first research question, paired-sample t-tests were conducted to see whether there was a significant increase in the pre-and post-test of each subject. Further, to see whether the platform has contributed to the students' enhancement of performance, an Analysis of Covariance (ANCOVA) was also conducted. For the second research question, firstly, descriptive results of the questionnaire on the usage and perception of the platform were presented. Then, the qualitative data were analysed through a grounded theory perspective. The researchers used open coding, axial coding, and selective coding to find the major themes from qualitative data (Corbin & Strauss, 2014).

Results

RQ1. To what extent does the VBVL approach impact students' learning outcomes?

First, a paired samples t-test was performed to compare their subject knowledge of General Studies in pre-test and post-test for both experimental and comparison group. For both groups, there was a significant difference in GS subject knowledge between pre-test (experiment: $M = 58.48$, $SD = 18.06$; comparison: $M = 51.44$, $SD = 15.31$) and post-test (experiment: $M = 75.37$, $SD = 20.63$; comparison: $M = 66.76$, $SD = 19.40$); experiment: $t(26) = 5.587$, $p < .001$; comparison: $t(24) = 5.414$, $p < .001$. For math's subject knowledge, both experimental and comparison group different significantly between pre-test (experiment: $M = 50.80$, $SD = 17.24$; comparison: $M = 38.33$, $SD = 16.98$) and post-test (experiment: $M = 61.00$, $SD = 9.90$; comparison: $M = 47.96$, $SD = 17.17$); experiment: $t(24) = 3.18$, $p = .004$; comparison: $t(26) = 2.91$, $p = .007$. The result shows that all students have improved learning outcomes significantly overtime.

Second, Table 2 presents the results of descriptive statistics and an ANCOVA for the experimental and comparison groups on subject knowledge's post-tests controlling for their pre-tests. Before carrying out ANCOVA, Levene's test results for all the dependent variables were checked, indicating no violation of the homogeneity of variance assumption. For GS, there is no significant effect of using the platform on post-test after controlling for pre-test, $F(1, 49) = .47$, $p = .497$. While for Math, there is a significant effect of using the platform on post-test after controlling for pre-test, $F(1, 49) = 4.97$, $p = .030$. The results suggest that Math experimental students improved more on learning outcomes than those in the comparison group.

Table 2

Experimental and comparison groups' performance in GS and Math subject tests

	Experimental Group			Comparison Group			ANCOVA		
		Pre	Post		Pre	Post			
	n	*M (SD)*	*M (SD)*	*n*	*M (SD)*	*M (SD)*	*F*	*df*	*p*
GS	27	58.40 (18.06)	75.37 (20.63)	25	51.44 (15.31)	66.76 (19.40)	0.47	(1, 49)	.497
Math	25	50.80 (17.24)	61.00 (9.90)	27	38.33 (16.98)	47.96 (17.17)	4.97	(1, 49)	.030*

*$p < .05$.

RQ2. How do teachers and students use the VBVL approach effectively in post-flipped classrooms?

Students' usage and perceptions of the platform

Table 3 shows the descriptive results of the questionnaire, with one student who did not complete in each of the classes. Most students used the platform 1 to 2 times per week (38% for both classes), and 3 to 4 times per week (31% for GS class and 38% for Math class). In the Math class, 6 students reported they have not used the platform compared to 1 student in GS class. Among those who have used the platform, most students used the platform for 5 to 15 minutes (52% for GS class and 45% for Math class), while 34% of students in GS class used more than 15 minutes each time compared to 35% in Math class. 13% of the students in GS class and 20% of students in Math class reported they used the platform for less than 5 minutes each time. Students from both classes perceive the platform positively with a mean score of 3.20 and 2.99 (out of 4) respectively.

Table 3

Descriptive results of the platform usage and perception by students (after using the platform)

	GS (*n* = 26)				Math (*n* = 26)			
Frequency of use (per week)	0	1-2	3-4	≥ 5	0	1-2	3-4	≥ 5
n (%)	1 (3.8%)	10 (38%)	8 (31%)	7 (26%)	6 (23%)	10 (38%)	10 (38%)	0 (0%)
Time used per visit (minutes)	< 5	5-15	15-30	≥ 30	< 5	5-15	15-30	≥ 30
n (%)	3 (13%)	12 (52%)	7 (30%)	1 (4%)	4 (20%)	9 (45%)	6 (30%)	1 (5%)
Mean for perception of the platform (out of 4)	3.20				2.99			

Teachers' and students' views on video segments

The video segments were of suitable length and focused on subject knowledge. Both GS and Math teachers utilized the video selection function to cut the lesson recordings into short segments. For the GS teacher, the length of video segments was between 44 seconds to 6 minutes and 42 seconds, while for the Math teacher, the length was cut to 2 minutes and 22 seconds to 5 minutes and 33 seconds. When asked about the rationale for selecting the video clips, both teachers emphasized that students would not watch the videos if they were too long. The Math teacher suggested that she would choose the clips based on the quizzes for students. While the GS teacher tried to choose the difficult parts that students could not master. For students, all of them thought the videos were neither too long nor too short, and were focusing on the key points in a lesson. Students all agreed that video segments are good resources for consolidation of knowledge and Lily said specifically that she could not focus when having video conferencing lessons, so it was good to review the lessons with a focus.

Students' views on visualization bubbles of classroom dialogue

For visualization bubbles, students appreciated how the dialogues were represented by visualization because it was good to navigate students' responses and teachers' questions. However, students had their own interpretation of what was important in these visualization bubbles. Lily and Winne guessed the dialogues in the middle of the video segments should be most important because the beginning of the segments was usually the introduction. Charlie and Leon thought if a bubble was bigger, which meant the teacher said a lot of things in this turn, must be the key point. Jill directly pointed out that a teacher should mark the important bubbles: "If that sentence is important, why don't the teacher just put a star next to it? We can do exercises directly by reviewing these starred sentences." However, Jill's partner Molly disagreed: "If we put this thing (the star), doesn't that mean we don't need to watch the video? If so, we don't need to use our brain." Although some students preferred an even more streamlined learning experience, some thought a neutral visualization stimulated their reflection on a lesson.

Teachers' and students' practice in the discussion forum

From the teachers' aspect, GS and Math teachers set discussion questions with distinct consideration. From the platform data, GS teacher's forums were more heated while Math teacher's forums were relatively quiet. The GS teacher spoke highly of the discussion forum, as it opened the opportunity for students to extend the discussion beyond the content taught in the video. On the platform, the discussion topics indeed aimed to extend the learning to a higher level of cognition. For example, she asked "Is a spider a kind of insect? If yes, please illustrate using the features of insects. If not, please say the reasons." This question requires application and analysis skills. While for the Math teacher, she doubted whether the primary school students were capable to discuss in the format of homework. Her discussion topics focused on the facts said in the video segments, for example, "what keyword would you circle, when you are answering question 4" and the answer of which can be found directly from the video. Most of the answers for the Math forum were similar and, in the interview, the Math teacher realised that she shall give some more challenging tasks that require higher-order thinking for discussion.

When students used the discussion forum, disagreeing on the public discussion forum was not preferred. Taking a closer look at the discussion forum of the GS teacher, the students indeed had different views on the discussion questions, for example, most students agreed that a spider is a kind of insect and said the features of the insects. All interviewees said they would not comment on others to make people feel embarrassed but would discuss face-to-face at school. Thus, it might not be students being reluctant to disagree, but could be using another form of discussion and collaboration. To promote interaction among peers, students agreed that there could be a "thumbs up / like" function in the discussion forum, or even emojis to express feelings other than words. A "private chat" function was also preferred by both teachers and students to communicate in a relatively private way to avoid embarrassment.

Students' use of quizzes to guide video viewing

In terms of quizzes, although all eight students interviewed thought exercise helped review subject knowledge, students in GS class and Math classes showed their patterns when completing the learning tasks. For GS students interviewed, all four of them indicated they would watch the video and view the visualization first, then participate in the discussion forum, and lastly, complete the quizzes and revisit the video with visualization if there were any mistakes. In contrast, for the students in Math classes, all four interviewed would jump to the quizzes first, after having some sense of the quizzes, they went back to watch the video and view the visualization. Quizzes guided Math students to revisit the video more purposefully and completed the exercise with guidance of video clips and visualization of classroom dialogues.

Discussion and implications

This paper study investigated the VBVL approach that attempted to reuse the video recordings through a post-flipped classroom pedagogy. Teachers were enabled to utilize the video conferencing lessons captured during emergency online teaching for mediation of learning loss. The proposed post-flipped classroom pedagogy, supported by the web-based platform with a combination of video selection, visualization of classroom dialogues, discussion forum and quizzes, has shown its strength in enhancing learning gains. For Math classes, the VBVL approach has shown significant improvement in learning outcomes compared to the comparison group, while for GS classes the difference was not significant. Although we can see the potential of using the VBVL approach for better learning, caution is needed here to conclude whether it is due to disciplinary differences or teachers' styles because of the small sample size.

In our study, video segment selection and visualization may enable students to better understand the content. In our study, both teachers carefully selected appropriate segments for student learning and used discussion forums and quizzes as tools to facilitate learning. Both teachers considered the length of the video, which is also welcomed by students reflected by their willingness to watch videos again. Students interacted with the visualization bubbles and reflected on the key points in the segments. Building on this first step, using quizzes or other types of tasks to prompt students may give them a sense of purpose, before watching a lesson that they had already experienced. It echoes with Alpert and Hodkinson's (2019, p. 35) research that students dislike "surprise playing" of videos and there should be a context for why videos need to be watched. It also corresponds to the active learning principles that students should engage with course content toward a learning outcome.

For the discussion forum and the quizzes, teachers can be prompted to set questions requiring higher-order skills, and to create private discussion channels for students. Firstly, a *review* of knowledge does not mean *recitation. S*tudents used the platform as a tool for knowledge consolidation and according to their usage questionnaire, students visited the platform more than required for homework completion. Active learning requires "doing things and thinking about what they are doing" (Bonwell & Eison, 1991, p. 1) and knowledge consolidation is not just about remembering the facts but application and creation through collaboration. When setting the discussion topics and quizzes, teachers can consider a variety of tasks that require both lower-level and higher-order thinking skills, giving students space to extend their learning.

Secondly, from the interviews, the platform has the potential to cultivate a more supportive atmosphere through non-verbal clues. Using "like" and "emojis" to express feelings may enhance positive affection in asynchronous negotiations (Gettinger & Koeszegi, 2015). Non-verbal clues may also provide the social and cognitive presence of students and teachers, which is addressed in the pedagogical challenges of ERT. In a culture where students do not want to share disagreements publicly, they can discuss with their peers through "private chat" or "chat in pairs" function before publishing to the forum. This is like "Think-Pair-Share", a collaborative learning strategy in which students are critical listeners and problem solvers with room to discuss privately before sharing publicly (Whimbey & Lochhead, 1986).

The present study broadens the perspectives on how to effectively reuse classroom video recordings with the VBVL approach. Of course, classroom recordings are not limited to those recorded for ERT and videos captured in face-to-face classrooms can also be used. The reported case study sheds light on using classroom video recordings for students' active learning. It also leads to important practical implications for designing video-based learning platforms integrated with multiple tools (e.g., visualizations, discussions, and quizzes) in post-flipped classrooms. Future research should consider updating the platform based on students' feedback, including upgrading the visualization design for young learners and setting stronger scaffolds for discussion and interaction.

References

Alpert, F., & Hodkinson, C. S. (2019). Video use in lecture classes: current practices, student perceptions and preferences. *Education and Training*, *61*(1), 31–45. https://doi.org/10.1108/ET-12-2017-0185

Alzahrani, M. G. (2017). The Effect of Using Online Discussion Forums on Students' Learning. *Turkish Online Journal of Educational Technology-TOJET*, *16*(1), 164–176.

Bergmann, J. & Sams, A. (2012). *Flip your classroom: How to reach every student in every class every day.* Washington, DC: International Society for Technology in Education.

Bonwell, C. C, & Eison, J. A. (1991). *Active learning: Creating excitement in the classroom.* Washington, DC: School of Education and Human Development, George Washington University.

Bozkurt, A., & Sharma, R. C. (2020). Education in normal, new normal, and next normal: Observations from the past, insights from the present and projections for the future. *Asian Journal of Distance Education*, *15*(2), i–x.

Chen, G. (2020). A visual learning analytics (VLA) approach to video-based teacher professional development: Impact on teachers' beliefs, self-efficacy, and classroom talk practice. *Computers & Education, 144*, 103670.

Chen, G., & Chan, C. K. K. (2022). Visualization-and analytics-supported video-based professional development for promoting mathematics classroom discourse. *Learning, Culture and Social Interaction, 33*, 100609.

Chen, G., Chan, C. K. K., Chan, K. K., Clarke, S. N., & Resnick, L. B. (2020). Efficacy of video-based teacher professional development for increasing classroom discourse and student learning. *Journal of the Learning Sciences*, *29*(4–5), 642–680.

Chen, G., Clarke, S., & Resnick, L. (2015). Classroom Discourse Analyzer (CDA): A discourse analytic tool for teachers. *Technology, Instruction, Cognition and Learning*, *10*(2), 85–105.

Cook, B. R., & Babon, A. (2017). Active learning through online quizzes: better learning and less (busy) work. *Journal of Geography in Higher Education*, *41*(1), 24–38.

Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage publications.

Ericsson, K. A., & Simon, H. A. (1984). *Protocol analysis: Verbal reports as data.* The MIT Press.

Ferri, F., Grifoni, P., & Guzzo, T. (2020). Online learning and emergency remote teaching: Opportunities and challenges in emergency situations. *Societies*, *10*(4), 1–18. https://doi.org/10.3390/soc10040086

Gettinger, J., & Koeszegi, S. T. (2015, June). More than words: the effect of emoticons in electronic negotiations. In *International conference on group decision and negotiation* (pp. 289–305). Springer, Cham.

Guo, P. J., Kim, J., & Rubin, R. (2014). How Video Production Affects Student Engagement: An Empirical Study of MOOC Videos. *Proceedings of the First ACM Conference on Learning@ Scale Conference*, 41–50.

Hew, K. F., Jia, C., Gonda, D. E., & Bai, S. (2020). Transitioning to the "new normal" of learning in unpredictable times: pedagogical practices and learning performance in fully online flipped classrooms. *International Journal of Educational Technology in Higher Education*, *17*(1).

Hodges, C. Moore, S. Lockee, B. Trust, T. and Bond, A. (2020). *The difference between emergency remote teaching and online learning.* EDUCAUSE Review. Retrieved 21 Nov. 2021 from: https://er.educause.edu/ articles/2020/3/the-difference-between-emergency-remote-teachingand-online-learning/

Kay, R., MacDonald, T., & DiGiuseppe, M. (2019). A comparison of lecture-based, active, and flipped classroom teaching approaches in higher education. *Journal of Computing in Higher Education*, *31*(3), 449–471. https://doi.org/10.1007/s12528-018-9197-x

Kizilcec, R. F., Piech, C., & Schneider, E. (2013, April). Deconstructing disengagement: Analyzing learner subpopulations in massive open online courses. In *Proceedings of the third international conference on learning analytics and knowledge* (pp. 170–179).

Lawson, A., Davis, C., & Son, J. (2019). Not all flipped classes are the same. *Journal of the Scholarship of Teaching and Learning*, *19*(5), 77–104.

Northey, G., Bucic, T., Chylinski, M., & Govind, R. (2015). Increasing student engagement using asynchronous learning. *Journal of Marketing Education*, *37*(3), 171–180.

Peachey, N. (2017). Synchronous online teaching. In M. Carrier, R. M. Damerow, & K. M. Bailey (Eds.), *Digital language learning and teaching* (pp. 143–155). New York, NY: Routledge.

Prince, M. (2004). Does Active Learning Work ? A Review of the Research. *Journal of Engineering Education*, *93*(July), 223–231.

Snyder, C., Paska, L. M., & Besozzi, D. (2014). Cast from the Past: Using Screencasting in the Social Studies Classroom. *The Social Studies*, *105*(6), 310–314. https://doi.org/10.1080/00377996.2014.951472

The United Nations Educational, Scientific and Cultural Organization. (2021). *Education: From disruption to recovery.* Retrieved 21 Nov. 2021 from: https://en.unesco.org/covid19/educationresponse/

Trust, T., & Whalen, J. (2020). Should teachers be trained in emergency remote teaching? Lessons learned from the COVID-19 pandemic. *Journal of Technology and Teacher Education*, *28*(2), 189–199.

Wang, J., & Antonenko, P. D. (2017). Instructor presence in instructional video: Effects on visual attention, recall, and perceived learning. *Computers in Human Behavior*, *71*, 79–89.

Whimbey, A., & Lochhead, J. (1986). *Problem solving and comprehension.* Englewood Cliffs, NJ: Lawrence Erlbaum.

Acknowledgments

This work was supported by the Policy Innovation and Co-ordination Office of the Government of the HKSAR (Grant No. 2017.A8.073.18C) and by Research Grants Council, University Grants Committee (Grants No. 17605221 and No. 17608318).