Pedagogical models for the facilitation of teacher professional development via video-supported collaborative learning. A review of the state of the art

José Luís Ramos, Alberto A. P. Cattaneo, Frank P. C. M. de Jong & Rui Gonçalo Espadeiro

Published online: 09 Aug 2021.

Submit your article to this journal ☑

Article views: 273

View related articles ☑

View Crossmark data ☑

Routledge
Taylor & Francis Group

Pedagogical models for the facilitation of teacher professional development via video-supported collaborative learning. A review of the state of the art
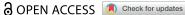
José Luís Ramos[a], Alberto A. P. Cattaneo[b] (ID), Frank P. C. M. de Jong[c] and Rui Gonçalo Espadeiro[d]

[a]University of Evora, Evora, Portugal; [b]Swiss Federal Institute for Vocational Education and Training (SFIVET), Lugano, Switzerland; [c]AERES Applied University Wageningen, The Netherlands/Open University, Heerlen, The Netherlands; [d]University of Evora, Évora, Portugal

ABSTRACT

The growing use of video technologies has revealed the need for pedagogical models to support collaborative learning as part of teacher professionalization processes. We conducted a state-of-the-art review of 120 empirical studies from 2003 to 2019 to identify pedagogical models for the facilitation of teachers' professional development via video-supported collaborative learning. The study identified four pedagogical models: observation and collaborative analysis of video-recorded professional practices, collaborative video-supported authoring, collaborative learning based on video content, and video-supported synchronous collaboration. The study provides an initial contribution toward the construction of an evidence-based video pedagogy. Such pedagogies can help to answer the continuing need for appropriate education and training for professionals in the areas of teacher education and professional development, higher education, and vocational education and training.

Introduction

In recent years, information and communication technologies (ICT)—and video technologies in particular—have provided a major contribution to so-called digital transformation. ICT has many different forms and myriad tools, platforms and services. These have become part of daily life, and also form an integral component of the education and training of many adults and young people worldwide. Global internet use is constantly increasing, with more than one million new users every day (We are social, 2019) and more than 4.5 billion people now use the Internet (We are social, 2020). Being permanently connected to the Internet allows people to communicate at anytime and anywhere, using platforms like YouTube, Facebook, Skype, Snapchat, Instagram, WhatsApp and others. As regards mobile devices, the situation is similar, with 5.19 billion users worldwide, and a penetration rate of 81% in Africa, 103% in the Americas and Asia-Pacific, 118% in the Middle East, and 128% in Europe (We are social, 2020), demonstrating that in some regions many individuals own more than one mobile device. In addition, the COVID-19 pandemic is seeing the emergence and rapid evolution of large-scale use of technology for remote learning, distance education and online learning (The World Bank, 2020).

This general pattern of technological development provides users with many affordances. Among these, of particular interest are the possibilities of visual tools, and especially video-based tools, as a support for a powerful pedagogy of collaborative learning (de Jong, 2015). Most of

CONTACT José Luís Ramos jlramos@uevora.pt Education and Pedagogy Department, Social Sciences School, University of Evora, Largo dos Colegiais, 2, Évora, 7000-645, Portugal.

the above-mentioned platforms provide embedded video tools; similarly, tablets and smartphones are equipped with high-resolution video cameras. This makes professional video capabilities easily accessible for everyone. All smartphone owners are thus potential filmmakers, and by disseminating their video projects over the internet, people can create their own audience numbering thousands or millions of viewers. Globally, the results of video usage in teaching and learning are encouraging, even in developing countries (Cattaneo et al., 2019a).

Numerous studies have highlighted examples of the importance of using video technologies in educational contexts (Gaudin & Chaliès, 2015). For instance, video-based learning has been used as a tool for teacher reflection and feedback, and student learning (Sablić et al., 2020) providing an understanding of "how students think by video-recording teachers' lessons" (Richards et al., 2020). It has been used for reflection on action "as a strategy to promote the agency of teachers" (Leijen et al., 2020). In addition, teacher use of video with different modalities has allowed for "the co-construction of teaching knowledge and the acquisition of digital competences and media literacy" (Masats & Dooly, 2011). Video-based learning has facilitated teachers' noticing (Kosko et al., 2020) as well as "cultivating novice teachers' practice using video vignettes for supporting multifaceted reflections" (Calandra et al., 2009). Finally, video recordings have been used to promote collaborative learning among teachers through "the study of video lessons" (Hervas et al., 2020).

Using videos to improve teaching practice has been investigated widely and has taken many forms over recent years. From video clubs to video editing, from video cases to video analysis tools, digital video has shown its potential for impacting on teaching practice, both in terms of teacher preservice education and in-service professional development (Rook & McDonald, 2012).

However, recent studies show that the use of video is still limited both in terms of frequency and methods (Christ et al., 2017; Gaudin & Chaliès, 2015). Educational research shows that most teachers do not know how to use video systematically and effectively in teaching (for example, Hobbs, 2006). Teachers who employ a "knowledge-telling pedagogy" approach very often get stuck on the use of slides as their main support for presentation. Even in higher education institutions (HEI), no adequate pedagogical and technical competences are provided to student teachers on how to use video-based communication tools for teaching, learning, the facilitation of reflective professional development and bridging education with working life (Ramos et al., 2018). In order to exploit the affordances of video for teaching and learning, it is crucial to obtain a deep pedagogical understanding of how this medium can be used in education. As recent reviews confirm, this need is even more pressing in the case of video use combined with collaborative learning pedagogy (Chen et al., 2018). There is a need to go beyond direct instruction using video and explore the potential of video capabilities for supporting collaborative learning (Zahn et al., 2010). Thus, the main goal of this paper is to build a sound pedagogical knowledge base on the use of video for supporting collaborative learning perspectives. This knowledge can subsequently inform innovative research initiatives and can be shared with the educational community.

Video-supported collaborative learning (VSCL) involves a combination of the use of video technologies and pedagogical approaches based on collaborative learning. In this context, and according to Beers et al. (2005), collaborative learning can be characterized as a range of social interactions focusing on the development of common ground and shared knowledge. These are constructed on the basis of negotiation and the exchange of knowledge. This may take the form of a dialectic conversation (for example, Arya et al., 2014 and Kuter et al., 2012). Such a discourse consists of the sharing of knowledge and ideas, working on the development of a collective idea and grounding concepts, thus achieving a better understanding than previously existed (de Jong, 2020a). In collaborative learning, a process takes place in which we move from the externalization of unshared knowledge to the integration of knowledge construction (Beers et al., 2005), in which groups are seen as a major source of knowledge construction with a social and interactive dimension (Miyake & Kirschner, 2014). This social dimension involves aspects such as interdependence, social and task cohesion, group potential and psychological security. In this process, learning ability in the sense of regulating content and community processes is vital for

familiarizing people with sharing knowledge, deepening individual and collective understanding and creating further insights (de Jong, 2015, 2020a; De Laat et al., 2000).

The use of digital video as a support for learning can enable students and teachers to access to video sources in constructive ways (Krauskopf et al., 2012), as is the case when video and collaborative learning principles are combined. The pedagogical benefits of this approach are propitious for professional development (Marsh & Mitchell, 2014). For example, collaborative reflection on professional practices can be established by making video recordings of teachers and other professionals. These can serve as a basis for promoting dialogue and sharing ideas, providing material for discussion and collaborative reflection, or when honing students' collaborative skills through their involvement in video production and authoring processes.

This study addresses the above-mentioned lack of research into collaborative pedagogical approaches to video use by conducting a review of state-of-the-art literature. The main research question guiding the study was the following:

What pedagogical models are there for facilitating learning or professional development via video-supported collaborative learning?

This main research question was operationalized by means of the following sub-questions.

1. What are the main characteristics in terms of fields (content areas) and type of participants?
2. What are the applied research designs and methodologies?
3. What video-based technologies are used?
4. What are the implicitly and explicitly stated VSCL pedagogies?

Methods

This section describes the procedures used to conduct a systematic review of the literature related to the research questions. It also includes a description of the data analysis. A systematic review can be broadly defined as a type of research synthesis performed by review groups with specialist skills. They retrieve evidence at the international level that is relevant to the research questions and appraise and synthesize their search results, aiming to inform practice, policy and in some cases, further research (Munn et al., 2018).

Procedure

A stepwise procedure was followed, involving three main steps for the selection of studies relevant for review.

Firstly, the databases for conducting searches were selected. We focused on the main educational science databases and also journals in the field of technology. The following databases were used: Education Resources Information Center (ERIC), Educational Research Complete (EBSCO), and Leibniz Institute for Psychology Information (PSYNDEX), PsycINFO/EBSCO.

Secondly, six researchers working in the field of learning psychology/pedagogy and teacher education developed the following research query, and applied it to the above-mentioned databases: (((video) AND ((Collaborative learning) OR (collaboration)) AND ((professional development) OR (teacher education) OR (teacher training) OR (vocational education) OR (professional education)))). The search results comprised a set of 699 records, which was reduced to 437 records after discarding duplicates (262).

Thirdly, as a basis for the inclusion criteria, the researchers agreed on the following aspects: content, quality assurance, language, and date. The content of included articles had to be explicitly related to pedagogical models for the facilitation of learning or professional development via video-supported collaborative learning. Articles that did not explicitly refer to such content were considered not relevant and were not included in the review. In order to ensure the

scientific quality of articles, only peer-reviewed studies were considered eligible. As regards languagevonly articles written in English were included. Finally, with regard to date, studies were considered which were published from January 2003 to December 2019. This long time span was due to the specificity of the research question: the number of studies needed to be large enough to reflect the use of video in collaborative learning. Similar systematic reviews of the literature have covered a time period of 10 to 15 years (for example Sauli et al., 2018).

Moreover, the following two specific conditions also had to be met: (1) articles should refer to and describe empirical research methods adopted and data-collection techniques associated with the study; (2) articles should be available in full-text format.

The 437 eligible records were randomly assigned to a team of reviewers for the application of inclusion criteria by screening paper abstracts. If this was found not to be sufficient, the full text was screened. A double check on excluded contributions was carried out to confirm that these papers did not meet the inclusion criteria. Applying the inclusion criteria to the set of 437 papers resulted in 317 records being considered irrelevant, and these were not included in the review. A total of 120 studies were fully reviewed (Figure 1).

These were randomly distributed among researchers. Each paper was first read, the article screened and then read again by the same researcher.

A coding scheme/matrix was filled in. This matrix had been jointly devised and agreed on by all researchers for the calibration of terms and criteria through the interpretation of fields for the categorization of the information extracted from articles. The matrix was stored in an online platform, making it accessible to all reviewers and allowing for simultaneous collaborative writing. This enabled further calibration, validity and reliability operations, as all researchers had access to all reviews. The code matrix included the following categories:

Area of study: identifying the main field of study involved in the paper to be reviewed. Examples were initial teacher education, in-service teacher education, training and professional development, vocational education and professional training (VET). When multiple categories were presented in the same paper, coding was carried out in accordance with the study's main focus.

Participants: those who were reported as research participants, actively involved in the selected studies.

Research method: the scientific processes used for the purpose of conducting research, specifically the approaches or type of method of research described in the paper. Examples were case studies, experimental, quasi-experimental, comparative, descriptive, narrative, ethnographic, and others (used for any remaining studies' not assignable to the previous categories).

Data collection: the processes and techniques for collecting data from participants in research. Examples: questionnaires, interviews and observation techniques.

Video technology used: the video technology systems used in the interventions referred to in research. Examples were video cameras for capturing and recording systems, video-display systems, embedded online video platforms, interactive video tools and video-annotation tools.

Modality of video use: the mode of use of video technologies: capture, recording, displaying/viewing, editing and live video.

Pedagogical perspectives and approach: the pedagogy that supports the use of video. Examples were collaborative peer coaching, dialogic feedback and microteaching.

Answering the research question: this was a full text field for reviewer explanation of how article content contributed toward answering the main research question of this study.

Data a nalysis

All analysis information was collected in the code matrix, constituting the basis for quantitative and qualitative analysis. Discrepancies in categorized interpretations, although rare, were discussed and resolved among the researchers before proceeding.

For sub-questions 1 to 3, descriptive statistics (absolute and relative frequencies) were used.

Concerning sub-question 4, data from the reviewing process were submitted for content analysis, using the procedure and categories proposed by Fraenkel and Wallen (2009): objectives

	Research question: What are the pedagogical models for the facilitation of teacher professional development via video-supported collaborative learning?
Data selection	Databases: Education Resources Information Center (ERIC), Educational Research Complete (EBSCO), Leibniz Institute for Psychology Information (PSYNDEX), PsycINFO/EBSCO.
Search query	Search query: ((((video) AND ((Collaborative learning) OR (collaboration)) AND ((professional development) OR (teacher education) OR (teacher training) OR (vocational education) OR (professional education))) Total of records identified, after search query N=699 Number of records removed (discarding duplicates) N= 262 Records screened for eligibility N= 437
Eligibility	Eligibility criteria applied: Only explicitly content topic related Only peer-reviewed studies Only studies published from January 2003 to December 2019 Only studies that refers empirical research methodologies/data collection techniques Only full text format available Number of records removed after eligibility criteria applied N=317
	Number of articles for reviewing N= 120

Figure 1. Procedures for the selection of articles eligible for reviewing.

(related to pedagogical models); unit of analysis (the 120 papers and related 1,320 analysis records); rationale (considering in particular modalities of video use and associated collaborative learning scenarios); coding categories.

Reliability/validity and qualitative data analysis

Concerning validity, a very good inter-rater agreement was observed among coding researchers (87.8% on average). Differences were resolved by conversational exchanges between reviewers.

As regards final qualitative data analysis, procedures for the data analysis of the articles reviewed included preparing data in a format suitable for export for submission using web-based data qualitative analysis software (WebQDA/https://app.webqda.net).

Following 'matrix analysis', deep content analysis of implicit pedagogical models was carried out, mostly based on combining video modality of use and a first set of categories associated with collaborative pedagogy. When needed for clarification, the original paper was discussed by reviewers.

Results

The results of the review of the literature are presented as follows, in accordance with the research questions: (1) main characteristics in terms of fields of study and type of participants; (2) applied research designs and methodologies; (3) video-based technologies used; (4) implicit and explicitly stated VSCL pedagogies.

Fields of study and type of participants

Quantitative data analysis revealed that most studies were carried out in the fields of teacher education (including in-service teacher education, professional development, and initial teacher education), higher education and, although to a much lesser extent, vocational education and training (Table 1). These categories represented 95% of the fields referred to in the studies reviewed. Other categories, such as adult learning and primary and secondary education, also appeared to be closely related to teacher education.

Type of participants also reflected *a similar distribution of fields*: in-service teachers and student teachers constituted the overwhelming majority of participants (71.6%), followed by students in HEI (10%). Other categories, like teacher educators and supervisors, students in primary and secondary education, teachers and students in vocational education and training, and adult learners, were involved to a lesser extent.

Applied research design and methods

A total of 89 studies (74.2%) involved qualitative research design, while 21 studies (17.5%) adopted a quantitative approach. Mixed research design was found in just 10 studies (Table 2).

Table 1. Fields of study and type of participants.

Dimensions of analysis	Categories	Number of studies (N = 120)	%
Fields of study	In-service teacher education, training and professional development	51	42.5
	Initial teacher education	42	35.0
	Higher education	14	11.7
	Vocational education and professional training	7	5.8
	Adult learning	4	3.3
	Elementary & secondary education	2	1.7
Type of participants	Student teachers	43	35.8
	In-service teachers	43	35.8
	Students in hei	12	10.0
	Teacher educators/supervisors	7	5.8
	Students—primary and secondary education	5	4.2
	Vocational students and trainees	5	4.2
	Teachers—vocational education	3	2.5
	Adult learners	2	1.7

Table 2. Research design and methods.

Dimensions of analysis	Categories	Number of studies ($N = 120$)	%
Research design	Qualitative	89	74.2
	Quantitative	21	17.5
	Mixed	10	8.3
Methods	Case study	42	35.0
	Survey	24	20.0
	Video analysis	21	17.5
	Descriptive	16	13.3
	Observation	5	4.2
	Ethnographic	4	3.3
	Interviews	4	3.3
	Action research	2	1.7
	Longitudinal studies	2	1.7

The most frequently reported qualitative research methods were case studies (35%), video analysis (17.5%) and descriptive methods (13.3%). In studies involving quantitative research methods, surveys were used in 24 studies (20.0%).

Data collection techniques

As regards data collection techniques (Table 3), most studies reported the use of a combination of two or more data collection techniques: this was observed in 75 of the 120 studies (62.5%). Data collection techniques mostly referred were video recordings in almost half of the studies (49.6%), surveys (29.8%), interviews (23.1%), observation (20.7%) and written accounts (17.4%).

Video technologies used and video modality of use

In the present paper, "video technologies used" refers to the video equipment used in research and the software, applications and web platforms specific to video technology systems. Five categories were determined, three of them related to the video equipment used, and two categories related to the software and applications mentioned in the studies.

The category of video recording systems included video technologies for the capture and recording image and audio, such as video cameras (Gröschner et al., 2014; McNally, 2016); video cameras integrated in other devices like portable computers, tablets/notebooks (Davidsen & Vanderlinde, 2014); flip cameras, audio recording devices, built-in and wireless microphones, mobile devices, such as smartphones with video camera (Arya et al., 2014).

Video display systems included the use of computer displays, TV display, and video-projection systems (Celikkan et al., 2013) for viewing and analyzing video recordings.

Video annotation systems included specialized professional video learning environments allowing for video annotation, such as YouDemo (Borowczak & Burrows, 2016), iVideo.Education (Cattaneo et al., 2019b), VideoAnt (McFadden et al., 2014; van der Westhuizen & Golightly, 2015) and video logs (Fields et al., 2015).

Table 3. Data collection and techniques.

Dimensions of analysis	Categories	Frequency	%
Data collection techniques	Video recordings	60	49.6
	Surveys/questionnaires	36	29.8
	Interviews	28	23.1
	Observation	25	20.7
	Written accounts	21	17.4
	Group reflections	15	12.4
	Audio recordings	6	5.0
	Field notes	4	3.3

A number of studies involved the use of video annotation tools, demonstrating the growing popularity of professional learning environments based on such tools (for example Aprea & Cattaneo, 2019; Borowczak & Burrows, 2016; Cattaneo et al., 2019a).

The category of video libraries included technologies for storage, institutional video repositories and video libraries (Duff et al., 2011; Jorm et al., 2019; So et al., 2009); online video platforms, such as YouTube (Dreon & Dietrich, 2009; Lai, 2016); social media platforms, such as Facebook (Harris, 2013); virtual 3D environments (Hämäläinen & Cattaneo, 2015); and specific environments like VIRCLASS (Larsen et al., 2008).

Live video systems included video technologies with an internet connection for two-way synchronous communication, such as web conference systems (Lai, 2016; Schmitt & Eilderts, 2018); video-conference call systems, such as Skype (Ernst & Clark, 2011); and one-way communication systems for video streaming in real time, like YouTube (Dreon & Dietrich, 2009).

Findings regarding video technology used are presented in Table 4. In 13 studies, more than one video technology was involved, in combination with other technologies. Predominance of video equipment for video capture and recording (60.8%) and video display systems (25.0%) was determined.

As regards modality of video use (Table 5) involving these technologies, four main modalities of use in the learning scenarios may be distinguished: video recording, video creation, video content display, and live video communication.

Video recording was used to a significantly greater degree than other modalities of video use in the fields of knowledge under observation. This category refers to the capture and recording of professional practices, regardless of both who carried out the action and whether the recorded situation was real or simulated.

The category designated as 'video recording' mainly involved teachers', trainers' and other professionals' recordings of their own or learners' practices to be analyzed and discussed later for self-observation and reflection or sharing in a group or a community of teachers or peers, tutors and supervisors. Sometimes this pattern of use was also found with regard to vocational education (Hämäläinen & Cattaneo, 2015; Öhman, 2018; Smith-Hansen et al., 2011) with the aim of fostering reflection on professional practices in a number of fields.

The second category, 'Video creation and editing', refers to the use of video embedded in a collaborative learning process which results in a video product or outcome: learners create their own videos (Berg, 2016), generally within the context of a student-centered pedagogy (Barfurth & Michaud, 2008). This modality differs from the first category, as the video results from a design activity (Zahn, 2017) and not only from capturing what happens in a real situation.

The third category, "video-based content" refers to the "traditional" modality of video use which constitute, for the user, "ready-made" content for different types of pedagogical use. Informational/knowledge content is structured in such a way that is not dependent on final users; they merely select it from digital repositories, if these are available, and use it in their specific educational context.

Table 4. Video technology used.

Categories	Frequency	% of total
Video recording systems	73	60.8
Video display systems	30	25.0
Video annotation systems	15	12.5
Video libraries	8	6.6
Live video systems	7	5.8

Table 5. Modalities of video use.

	Number of studies = 120	%
Modalities of video use	Video recording (79)	65.8
	Video creation and editing (22)	18.3
	Video-based content (11)	9.2
	Live video conferencing (8)	6.7

"Video-based content" includes a variety of uses like authentic viewing (Berkhout et al., 2012), demonstrations (Dreon & Dietrich, 2009) and video-based laboratory simulations (Grierson et al., 2012). The collaborative learning activities involved in this case are integrated when viewing the video, as in video-based laboratory simulation. Here, the activities are used to promote collaborative feedback, collegiality or collaboration among teachers, including the group planning of lessons (Grierson et al., 2012), or they can promote a dialogic teaching approach, "a model of active participation of students supporting students' collaborative knowledge-building, learning through inquiry and evaluating ideas" (Hennessy et al., 2018).

More advanced 'candid-content' use is found in environments like those used in the DIVER project carried out at Stanford University (Goldman et al., 2007; Pea, 2006). Here, participants observe, analyze and reflect on digital video recordings of learning and teaching, creating new perspectives by cutting video content into small relevant frames. This approach furthers the collaborative processes of focusing attention and agreeing on meaning in dialogue, based on a common ground of content reference.

Finally, the 'live video conferencing' category refers to the use of any tool, application or web environment that has technological features enabling live, synchronous video communication (Schmitt & Eilderts, 2018). This might occur in distance learning settings or project management (for instance, in online meetings).

Pedagogical models for the facilitation of professional development via video-supported collaborative learning

As for VSCL pedagogies, the analyses in this study were used to determine four main pedagogical models for the facilitation of professional development via VSCL (Table 6). The models identified are described in more detail below.

Model 1: Observation & collaborative analysis of video-recorded professional practices

The model most frequently found (in 78 studies, that is 64.9%, of the total selected for review) involved VSCL: activities entailing the collaborative observation and analysis of teachers' professional video-recorded practices (either their own or others'). This first model was used almost exclusively with a target group made up of teachers or student teachers. This model emerged through the identification and analysis of the discourse of researchers who frequently referred to "video clips," "video traces," "video cases" or "video clubs" to highlight certain characteristics of the types of video they worked with or the type of activities carried out (as in the case of the video club). These "linguistic artifacts" can be found in the original texts, and we used them as previous organizers or markers in describing the activities carried out within the framework of the observation and collaborative analysis model.

Video clips are short recordings of either teachers' own or other teachers' selected videos for the observation and collaborative analysis of teaching practices. Teachers' video clips were found

Table 6. Pedagogical models for the facilitation of professional development via VSCL.

Pedagogical models		Number of studies	%
Observation & collaborative analysis of video-recorded professional practices	Teachers' video clips	61	50.8
	Teachers' video cases	9	7.5
	Teachers' video clubs	7	5.8
	Teachers' video traces	1	0.8
Collaborative video-supported authoring		23	19.2
Collaborative learning based on video content		11	9.2
Video-supported synchronous collaboration		8	6.7

to present two intersecting dimensions: (1) video capture and recording of (2) a teacher's or other professional's practice.

The generic collaborative use of teachers' video clips has been found in a wide variety of educational and professional contexts, from initial teacher education (Baecher et al., 2012, 2018; Baecher & Jewkes, 2014; Bowlin et al., 2015; Foong et al., 2018; Kaendler et al., 2016; Kontkanen et al., 2016; Önal, 2019) to teachers' professional development (Arya et al., 2015; Baecher & Kung, 2014; Charteris & Smardon, 2013; Gröschner et al., 2015; Hennessy & Deaney, 2009; Ho & Tan, 2013; Leighton et al., 2018; Pearson et al., 2003) and vocational education (Hämäläinen & Cattaneo, 2015), among others.

The first approach of note is the video-stimulated recall (VSR) model as a collaborative supervision model. VSR involves a supervisor and prospective teachers collegially reviewing a previously-recorded video lesson or practice, or stages of a lesson, while identifying specific opportunities for discussion (Kelting et al., 2014). The VSR model was used for promoting dialogic reasoning, social interactions between supervisors and in-service-teachers, and improving prospective teachers' performance as regards specific professional competences. For example, Leighton and colleagues (2018) adopted collaborative VSR as "part of a 14-week curriculum unit to implement dialogic instruction by coach–teacher dyads while adopting a problem-solving approach to coaching." The authors go beyond the simple use of video-based resources to propose a combination of several digital tools to collaboratively address problems over three phases of the curriculum. The results revealed that "flexible use of multiple digital tools supports high-quality interactions between coaches and teachers" (Leighton et al., 2018, p. 10).

Teachers' video clips have also been used as part of a collaborative analysis approach with larger groups, for example by Hennessy and Deaney (2009), "to assist teachers in articulating the pedagogical rationale underlying their practice, and uniquely, to engage them in theory-building about strategic technology use" (p. 617). The authors adapted the 'Interconnected Model of Teacher Professional Growth (IPG)' (Clarke & Hollingsworth, 2002) and applied it, working on three components of video analysis. The "three inter-related components of collaborative video analysis consist of viewing and reflecting on recorded lessons, discussing what teachers did, why they did it and how successful it was for students." The authors showed how such collaborative analysis for knowledge-building affected competence development. It engaged teachers "in deep reflection, critique and debate," it increased metacognitive awareness, and it fostered concrete teaching practices. Above all, it produced lasting effects on the teachers' capacity for analytical and critical pedagogical thinking (Hennessy & Deaney, 2009).

The IPG model provides the basis for Lebak's (2015) study, where teachers video recorded their lessons and 'reflected individually on the lesson', prior to collaboratively viewing and reflecting upon the video-recorded lesson within a peer group." Also, in this case, the author claimed that "research indicates change in both beliefs and practice was an interactive process mediated by collaborative and self-reflection through participation in the video-supported process." (p. 695).

Kuter and colleagues (2012) used video to support collaborative learning and knowledge-building by adopting a three-phase collaborative coaching model, an approach inspired by microteaching (Allen & Clark, 1967; Allen & Ryan, 1969), while taking on board the collaborative discussion about video-recorded *simulated* teaching practice. The authors reported that this collaborative method yielded positive results in terms of raising trainees' awareness, and developing their reflection skills and mastery of pedagogical processes. In the authors' opinion, "video technology is a tool for fostering productive discussions and negotiation among trainees within microteaching" (Kuter et al., 2012). Video provided a supportive, critical, and evaluative environment for enhancing professional development through reflective dialogue and construction of meaning. Two other contributions reviewed as part of this study took inspiration from the microteaching approach, namely Milner-Bolotin (2018) and van der Westhuizen and Golightly (2015).

Borko et al. (2008) proposed a problem-solving cycle model (PSC). Inspired by a situational perspective on professional development and emphasizing the role of the community in teacher learning, the model involves the exploitation of multiple video recordings of a lesson with one

camera focusing on the teacher and another focusing on a group of learners engaged in small-group activities. This enabled the model to be used with three interconnected workshops: in the first, groups of teachers collaboratively developed a lesson plan using specific content. Each teacher video recorded their own lesson using two cameras, as described above. The two subsequent workshops involved analyzing and reflecting on teachers' practice and students' thinking, respectively, and "rely heavily on clips from the videotaped lessons" (p. 422).

Student teachers discussed the recordings in both small-group and whole-group contexts, "supported by teacher educators who first set up viewing of the selected excerpts on specialized content and pedagogical knowledge." The use of the "dialogic video cycle (DVC)," a new video-based teacher professional development program, represents a further development of Borko and colleagues' PSC model. "The main focus of the DVC is to encourage teachers to explicitly address the types of communication activities that verbally engage students in classroom dialogue, i.e., help them to elaborate on ideas" (Gröschner et al., 2015, p. 279).

As with the PSC, with the DVC the three inter-related workshops were organized by a facilitator who managed lesson-plan design, selected video-recorded excerpts and subsequent associated analysis, and led video-based discussions aimed at productive classroom dialogue. The study highlighted "the role and responsibility of the professional facilitator within a DVC program for developing and maintaining a professional community of teachers engaged in improving their classroom dialogue" (Gröschner et al., 2015).

Furthermore, the concrete examples of 'facilitation moves' which emerged provide illustrations of how a mindful facilitator encourages and guides participants in collaborative, community discourse and the analysis of teaching and learning practices. "Basically, the facilitator introduced knowledge about productive classroom dialogue, guided workshops, organized the videotaping of teachers' lessons and the selection of video clips, and led video-based discussions" (Gröschner et al., 2015).

Further examples of teacher video clips within the field of teachers' professional development included their use in promoting observation, analysis, discussion and reflection. Multiple pedagogical approaches were referred in the literature such as collaborative problem-solving (Kelting et al., 2014), co-learning (Tunney & van Es, 2016), peer assessment (Lai, 2016), self-reflection, group dialogue, reflection and feedback (Lebak, 2015; Pearson et al., 2003; Sterrett et al., 2014), group discussion for collective knowledge building (Imafuku et al., 2014; Näykki et al., 2017) collaborative practice, learning conversations (Youens et al., 2014) and dialogic instruction (Heintz et al., 2010). Finally, other examples of the use of teacher's video clips included embedding them within research approaches as action-research (Lebak & Tinsley, 2010) and data-collection strategy (Davidsen & Vanderlinde, 2014).

This first model also involved video case studies, such as the capture, recording and viewing of a video-recorded lesson given by an expert or experienced teacher who showcases or demonstrates "how teachers think" and how a particular teacher solves problems in a specific context. The use of "cases" (case-based teaching) has a long tradition in teacher education and has been used with teacher candidates and novice teachers for diverse educational purposes, including the use of "video-mediated cases" (Copeland & Decker, 1996).

The model is based on a carefully selected or designed "video case": a video lesson demonstrating authentic, exemplary practices, while providing an insight into the complex realities of the classroom in poorly-structured fields of teacher education and initial teacher education (Goeze et al., 2014). In this model, video cases are put forward as an approach for promoting reflection on practice through explicit and collaborative video-based case discussions between teachers and student-teachers, while simultaneously promoting analytical competence (Goeze et al., 2014; Arya et al., 2014; Gallant & Mayer, 2012; Knowles & Cooner, 2016; Zottmann et al., 2013).

Video cases may also involve "groups of learners working together in an authentic meaningful situated learning context, in which learners explore content while at the same time engaging in critical thinking and problem-solving" (Koc, 2011). In this model, the emphasis is on explicitly making the connection between theory and practice offered by digital video cases. This helped teacher students to create their professional identity, while fostering recognition of learners' characteristics (empathy), and improving motivation (Koc, 2011).

Another example of this model concerned teachers' video clubs. A video club "consists of a group of teachers" (Sherin & van Es, 2009) who use video capture and recording of their own and other members' lessons for observation, self-reflection, sharing and collaboration, providing feedback to each other on their practices in order to improve the quality of their teaching, and consequently that of their students' learning.

Teachers' video clubs have been used to help groups of teachers to build the capacity to firstly notice and then interpret specific and relevant classroom events (Van Es, 2012a; Van Es & Sherin, 2010). In these two steps we discern the two main components of 'professional vision' (Goodwin, 1994), when referring to teachers.

The starting point for teachers' development of professional vision has often been identified by the label 'noticing' (Mason, 2002; Sherin, 2007).This is defined as the teacher's "ability to attend to noteworthy features of instruction, reason about what is observed in meaningful ways, and decide how to respond [...] Noticing involves coming to see the details of observed phenomena and taking on different perspectives in order to gain deeper insight into what is observed [...]. Finally, noticing entails drawing connections between observed phenomena to develop a more robust and elaborate vision of instruction" (Van Es et al., 2017, p. 167).

Video clubs constitute a suitable context for stimulating the development of these capabilities by promoting and supporting teacher dialogue and productive discussions (Van Es et al., 2014), collaborative reflections (Cockburn, 2010), dialogic and constructive feedback, and peer assessment. In this respect, three key areas for the implementation of teacher video clubs were identified in the literature: "collegial and collaborative interactions; participation and discourse norms for productive collaborations; and focusing activity on teaching and student learning" (Van Es, 2012a, p. 183).

However, teachers' professional vision also demands the ability to apply an item of knowledge about effective teaching to classroom situations. The resulting components are therefore as follows: the capacity to notice, identify and discern, that is, directing and focusing one's attention on relevant elements and specific details; and the knowledge-based reasoning behind this, that is, the professional's cognitive processing of instructional events based on prior knowledge about pedagogy (Stürmer et al., 2013).

Research has shown that participating in a video club influences teachers' professional vision, and directly in the teachers' instructional practices (Sherin & van Es, 2009).

Video clubs also supported sustained focus on students' thinking and behavior (Van Es, 2012a, 2012b; Van Es & Sherin, 2010). Viewing videos on one's own and other teachers' professional activity constituted an effective practice for improving the quality of teaching as well an effective way to bring teachers together to analyze students' thinking and behaviors (Van Es & Sherin, 2010). Moreover, it contributed significantly to achieving a better understanding of students' pedagogical proposals, changes in teaching strategies and greater attention to their learning processes (Tripp & Rich, 2012a).

Some observations on video traces also emerged from the results. Although they were of marginal importance in comparison with the others, they are nevertheless worth mentioning due to their student-centered approach. Video traces (Stevens, 2007) are digital artifacts (including video, still images and discussion threads) created by teachers, student teachers or trainees using material from their own classroom practice for the collaborative viewing, discussion and analysis of teaching practices. Such videos and recorded analyses are called "traces" and "became the focus of further analysis and conversation". Feedback is provided by cooperating teachers or field supervisors. Collaborative discussion offered benefits for all the partners involved, as did experiences based on interaction between novice teachers, veteran teachers and university teachers (Bier et al., 2012, pp. 135–136).

Video traces are a representative and relevant piece of the history of a lesson—which are distinguished by the video club method—which are later the object of personal reflections and then shared and collaboratively discussed with other teachers, supervisors, coaches or mentors in order to provide constructive feedback.

Video traces are thus mainly useful for teacher education and professional development via VSCL, based on the combination of capture (recording), viewing (analysis) and shared reflections

on a representative segment of the video-recorded lesson. The collaborative nature of this approach emerges especially when the video trace is shared to start a discussion and obtain feedback from peers and tutors, in a written, visual or spoken form, or on online or off-line digital platforms or applications. In particular, the use of video annotation tools (Mu, 2010) is relevant here.

While the use of a visual support provides notable added value, a further opportunity is provided by the use of an annotation tool to directly comment on the video. Video annotation allows for note-taking directly within the video-player interface. This has been widely tested within the framework of teacher education, and the effectiveness of video annotation to promote reflective skills has been shown in several contributions from other professional fields (Cattaneo et al., 2020). Annotation tools help participants to communicate and collaborate, combining the affordances of written annotations (helping teachers objectivize their reflections through writing) with the availability of video recordings of authentic (or simulated) professional practices, and finally discovering sources for potential enhancement of teachers' professional vision and professional identity (Evi-Colombo et al., 2020) and that of professionals in general (for example, Cattaneo et al., 2020).

Across the selected papers, the effectiveness of this specific approach focused on different aspects of the collaboration stage, such as annotated feedback (Milner-Bolotin, 2018), assessment (van der Westhuizen & Golightly, 2015), collaborative discussions (Zottmann et al., 2013), and learning (McFadden et al., 2014).

Model 2: Collaborative video-supported authoring

The second model involves the collaborative creation of videos as a central element of collaborative learning and authoring (19.2%). The model is based on the conducting of "video projects" as a specific type of media project (Baacke, 1999; Stack, 2010; Tetloff et al., 2014). In this paradigm, video is used as a means of design, by which students engage in the active production of videos as a motivating and authentic collaborative task (Zahn et al., 2005).

The model is best used as a fundamental resource embedded within student-centered pedagogical perspectives, for example, project-based learning or inquiry-based learning. Here, students become producers and collaborators (Berg, 2016), as well as authors and developers in online communities of e-practitioners based on virtual learning environments (Larsen et al., 2008). Typical learning activities are problem-solving tasks, cooperation, negotiation, decision-making, interaction and dialogue among students and teachers, and self- and collaborative reflection. Video not only constituted a representation tool, but it also became an important learning tool and a medium for the collaborative building of cultural artifacts, in a framework of project-based learning and group work (Berg, 2016). The creation of video incorporated collaborative negotiations and decisions about planning, editing, narrative construction, viewing, narrative analysis, and critical thinking (Cavanagh & Peté, 2017; Robinson, 2009).

Creating videos as part of project-based collaborative learning activities promoted "deeper engagement with subject matter through hands-on activities" and involved "a variety of learning modalities as opposed to predominantly passive reading and listening" (Hernández-Ramos, 2007, p. 33) but it is also an ideal task for developing collaboration skills (Jorm et al. 2019).

In practical terms, collaborative video-supported authoring has sometimes been coupled with other ICT tools as Wikis, Padlets and others (for example, Berg, 2016; Schmitt & Eilderts, 2018), including interactive videos (for example, Cattaneo et al., 2019a).

Model 3: Collaborative learning based on video content

This model is rooted in collaborative learning activities carried out using video-based content; a number of studies contained references to collaboration and video-based content (9.2%), where video was used in a *traditional* way to deliver content to students (including student teachers),

deriving from very different sources and formats. In contrast with the previous models, here the video is explicitly designed and built in order to function as an instructional resource. In this sense, it also differs from the first model—when using simulated practice—as the content of the video in this third model is not necessarily related to professional practice but to other kinds of content (e.g. physical phenomena, a historical event, and so on). Indeed, in school-based education "video is often used to enrich regular lessons or as a supplement to teacher lectures and presentations to the class. In this case, video is a presentation medium used to display information to illustrate and dynamically enable the visualization of knowledge in order to foster better understanding" (Zahn et al., 2005, p. 2).

Thus, using video-based content is a resource for teaching and instructional purposes, video-based lessons, video courses, and video modules. Online digital video resources comprise a variety of video formats, such as demonstrations, tutorials, screen casting, and video lectures, as well as documentaries, chronicles, narratives, films, and others. Collaboration and video-based content was described as being in a standalone format or embedded in an online platform for lessons and courses, for individuals, groups and large-scale audiences (such as Massive Open Online Courses, MOOCs), as a resource either used sporadically and combined with other materials or used consistently throughout an entire course curriculum (when the course is video-based).

In the present study, our analysis also revealed that the possibilities provided by the instructional use of video-based content were mainly used to support collaborative learning and knowledge building through activities such as collaborative problem solving (Dimitracopoulou & Komis, 2005), sharing ideas and collaborative discussions (Dreon & Dietrich, 2009), knowledge building through dialogues and discussions (Hennessy et al., 2018), and authentic problem-based activities (Durley & Ge, 2019).

Using video content was thus shown to be conducive to fostering different kinds of collaborative learning processes, also for adult learners (Schneps et al., 2010), and to promoting collaborative discussions (Lepareur & Grangeat, 2018).

Model 4: Video-supported synchronous collaboration

The fourth model is based on collaborative learning practices found in online synchronous and interactive communication environments (6.7%). This pedagogical model involves the exploitation of synchronous communication among teachers and learners, using live video conferences (alternatively labeled as live streaming, videoconferencing and web conferencing). Specifically, the approaches adopted involves live means of communication and collaboration.

The use of video-supported synchronous collaboration has been reported in different fields of study, particularly initial teacher training and higher education, where it enables communication in real time and bridges theory and practice through videoconferencing, with participants based in different geographical locations (Schmitt & Eilderts, 2018).

In pedagogical practice, live videoconferencing has been employed in numerous ways. It has taken the form of interactive videoconferencing-supported learning (IVCSL) in higher education (Celikkan et al., 2013), or that of teaching demonstrations by experienced teachers targeted at teacher candidates (Ardley & Johnson, 2019). It has been also used as a cybermentoring strategy: a form of synchronous distance learning collaboration used to foster interactive learning and tutoring among preservice teachers and K-12 students, all of whom were mentored by classroom teachers and university faculty (Johnson et al., 2006).

In another situation, videoconferencing enabled live contact between training schools for teacher candidates and universities, fostering collaborative discussions and enhancing the professional learning of teacher trainees (Marsh et al., 2010).

Recently, it has proved capable of combining the affordances of live videoconferences with the asynchronous capabilities of web-based applications such as Wikis (Dredger et al., 2017) and Padlet (Schmitt & Eilderts, 2018).

Student teachers in initial teacher training also benefited from video-supported synchronous collaboration, when the classrooms where they practiced were connected live with the university,

where their supervisors and tutors observed the lesson. This arrangement enhanced both communication and collaboration (Schmitt & Eilderts, 2018).

In line with this, Marsh et al. (2010) reported video technologies being used such as video cameras—live video and streaming displayed on a four-way split screen—in both the university and the practice schools, providing prospective-teacher education, and creating collaborative learning opportunities for developing student-teacher observation skills and reflective practices. This approach "enhanced and accelerated the development of trainee teachers' professional knowledge through enabling reflective practice, facilitating collaborative learning and supporting the development of the language of pedagogy" (p. 742).

Similar experiences are reported by Johnson et al. (2006), who adopted a cyber-mentoring approach. Liang (2015) reported the traditional use of live video classroom observation, and Wang and Wiesemes (2012) described the use of live video conferences for teacher education. Another study reported the use of live video and video-conference systems in the field of adult learning for collaborative online musical composition (Biasutti, 2018). Finally, in the field of health sciences, an interactive videoconferencing learning system has been used to connect the clinical skills of teachers in the laboratory, and classroom theory for nursing students (Celikkan et al., 2013), while teacher professional development has used innovative "bug in-ear" technologies (Rock et al., 2014) (on-the-job ear-coaching).

Conclusions

In this paper, almost two decades of VSCL research was reviewed. Analysis showed that teacher education and professional development and higher education (HEI) were the main fields of study, and to a lesser extent VET and adult learning. The majority of studies reviewed involved mainly HEI student teachers and in-service teachers. Three quarters of the studies analyzed adopted a qualitative research design, and studies, surveys and video analysis were the predominant research methods. Video recordings, surveys, interviews, observations, written accounts and group reflections were the most widely used data-collection techniques.

Video recordings and video display systems were found to be the most widely used video technologies, followed by video annotation systems. Video recording was used in more than half the educational contexts. Video creation and editing were used in over a sixth of all educational contexts, followed by video-based content use while live video conferencing was used to a lesser extent. Recently, this pattern may have radically changed as the lockdown of schools worldwide due to the impact of Covid-19 was followed the schools' move toward online instruction. However, the video conferencing used by teachers is probably mostly used for lectures and is content-oriented, as shown in a study concerning online learning in VET during the lockdown period in the Netherlands (de Jong, 2020b).

The main research question concerned what pedagogical models were used in studies associated with collaborative learning supported by video use. Analysis revealed the benefits and the challenges presented by four pedagogical models that were determined for facilitating teacher education, professional development and vocational training via video-supported collaborative learning. The characteristics of these models are denoted by their respective designations, as follows:

(1) observation and collaborative analysis of video-recorded professional practices; (2) collaborative video-supported authoring; (3) collaborative learning based on video content; (4) video-supported synchronous collaboration.

The use of annotation tools may be relevant for video-based collaborative learning, both in experiences associated with the video recording pedagogical model and experiences with the video creation and editing model. At the technological level, this reveals the interesting but as yet little researched educational potentialities of Interactive Digital Videos—also known as hypervideos (see Sauli et al., 2018). Hypervideos—a video-based product combining "non-linear information structuring and dynamic audio-visual information presentations" (Stahl et al., 2005, p. 641)—emerged as a complement to pedagogical models but were used with different target groups. This confirms the flexibility of a tool that can complementarily combine two theoretical

approaches to inform HV-based designs: "the cognitive approach, with its focus on information processing, and the socio-cultural approach which highlights social interaction" and collaboration (Cattaneo et al., 2019a).

Each of the four models we identified includes different pedagogical conceptions and perspectives on modalities using video to support collaborative learning and knowledge building. For example, they allow teachers, educators and learners to observe and analyze practices using recordings of these practices. In the process, they can benefit from self- and group reflections and sharing knowledge and experiences. In addition, the use of video promotes dialogue and the discussion of new ideas, and creates bridges between theory and practice. Moreover, it fosters communication and collaboration through educational videos, and the collective creation of new videos as a result of synchronous learning with others.

Our analysis reveals a surprising diversity of pedagogical perspectives that supported interventions using collaborative video technologies, namely perspectives that give learners, be they teachers or students, a greater and more active role in formative processes (see the Appendix for a synthesis of video-based collaborative learning activities by pedagogical model).

The models identified in this review reveal that teachers and researchers have sought to explore, using collaborative learning perspectives, the "affordances of video technology" through the capture and video recording of events and practical situations, and through the creation of new content, for storage, further observation and collaborative analysis and reflection. This also involved the exploitation of video-technology capabilities in order to capture in a unique and singular way "the immediacy and vividness" of situated, concrete realities. These developments promote the acquisition and development of reflection and noticing in teachers and students (Marsh & Mitchell, 2014, p. 404), as well as in other participants in a range of professional fields.

The findings of this study corroborate the growing relevance of VSCL, especially for teacher education but also for professional development "as a strategy […] for observing teaching practices (their own or others') by sharing videos with their peer groups and engaging in collaborative reflective dialogues that develop from watching their videos into a video-centered collaborative reflection process" (Lebak & Tinsley, 2010, pp. 955–956). It therefore appears that VSCL offers a more intensive active cognitive elaboration of theoretical concepts than that found in teacher-centered lecturing. It also shows that the use of video offers a great opportunity to build a bridge between theory and practice in teacher education, professional development and vocational education and training (Youens et al., 2014). The findings show that video-supported collaborative learning was used in ways that brought benefits for teachers' professional communities, where "video-based reflections as well as collaborative learning opportunities seem to be crucial aspects for teacher learning" (Gröschner et al., 2015, p. 751).

At the same time, this review sheds light on the need for further research into the characteristics of VSCL pedagogical models, with a double aim: it should both deepen our perception of the distinguishing characteristics of each model and their effects on learning and professional development, and involve professional domains beyond the field of teacher education. With regard to the former, it was noted that sometimes the same terms are used across models to identify collaborative learning activities, without providing a precise description of terms employed. On several occasions, this led to difficulty in determining the instructional differences between them. With regard to the other fields, the predominance of teacher education as the field most frequently examined by VSCL studies was highlighted. Nonetheless, using VSCL pedagogy beyond teacher education, especially in vocational and professional education and continuous professional development, seems to offer an extremely promising opportunity for education, which is yet to be exploited by research. The same should prove true for primary and secondary education.

This review was carried out during the pre-Covid-19 period and provides a good portrayal of the state of the art during the period under review. Meanwhile, the impact of the Covid-19 pandemic on traditional classroom settings may not prove incidental. E-learning and distance education have provided a useful emergency solution to the problem in the form of synchronous video lecturing. Yet, this teaching modality lacks a number of collaborative pedagogical aspects

like peer feedback, discussion and small group dialogues, which the functionality of break-out rooms, for instance, cannot reproduce.

The chronological configuration of this study, together with all the other constraints deriving from the application of the inclusion criteria, constitutes limitations on the research. For example, the findings of this study could be enriched by extending the sample to include non-English research and including other pedagogical traditions.

Despite its limitations, in the aftermath of the impact of Covid-19 on education, the present study may help teachers and students in the move toward a greater degree of on-line education with a view to enriching the pedagogical approach by using video-supported collaborative learning and going beyond 'talking-heads' video lecturing.

The combination of collaborative pedagogies and video technologies can contribute to student engagement and active learning. This review provides evidence that video can be used in a way that increases the construction and activation of increased cognitive knowledge.

This study provides constructive pointers regarding potential opportunities and the value of the use of video in association with a powerful pedagogy like collaborative learning for teacher education settings. Moreover, its suggestions are easily transferable to a broader range of educational contexts.

Acknowledgements

Disclosure statement

Funding

Notes on contributors

José Luís Ramos (PhD) is Associate Professor of Educational Technology in the Social Sciences School of the University of Évora, Portugal. He has more than 30 years of experience on ICT introduction in the education field and his main research interests are teacher education in the uses of educational technologies and computational thinking in elementary and secondary education levels.

Alberto A. P. Cattaneo (PhD) is professor and Head of the research field "Educational Technologies in VET Programs" at the Swiss Federal Institute for Vocational Education and Training (SFIVET), Switzerland. His actual main research fields concern the integration of ICT in teaching-and-learning processes, reflective learning in VET, instructional design, multimedia learning—especially when it comes to using hypervideos—, teacher education and their professional competence development, in particular related to digital competence.

Frank P. C. M. De Jong (PhD) is Professor at Open University, Faculty of Education, Social and Collaborative Learning group, Heerlen, the Netherlands and at AERES Hogeschool—University of Applied Sciences of Wageningen—Wageningen, the Netherlands. His research areas are: knowledge building/creation and responsive learning; education in the context of transition; self-regulated learning, computer-supported collaborative learning;

professional development and learning ecologies. He is also a member of the Knowledge Building International (KBI), The Netherlands Educational Research Society (VOR) and co-founder and past chair of the European Association for Practitioner Research on Improving Learning (EAPRIL).

Rui Gonçalo Espadeiro is a PhD candidate and mathematics teacher in the ICT Competence Center of the University of Evora. His research interests are in the area of mathematic, teacher education and computational thinking in secondary education.

ORCID

Alberto A. P. Cattaneo 🔟 http://orcid.org/0000-0001-5155-1214

References

Aprea, C., & Cattaneo, A. A. (2019). Designing technology-enhanced learning environments in vocational education and training. In D. Guile & L. Unwin (Eds.), *The Wiley handbook of vocational education and training* (pp. 373–393). Wiley.

Ardley, J. (2009) Unanticipated findings: Gains by cooperating teachers via video-mediated conferencing. *Journal of Computing in Teacher Education, 25(3), 81-86 . 25*(3), 81–86.

Ardley, J., & Johnson, J. (2019). Video annotation software in teacher education: Researching university supervisor's perspective of a 21st-century technology. *Journal of Educational Technology Systems*, *47*(4), 479–499. https://doi.org/10.1177/0047239518812715

Arya, P., Christ, T., & Chiu, M. (2014). Facilitation and teacher behaviors: An analysis of literacy teachers' video-case discussions. *Journal of Teacher Education*, *65*(2), 111–127. https://doi.org/10.1177/0022487113511644

Arya, P., Christ, T., & Chiu, M. (2015). Links between characteristics of collaborative peer video analysis events and literacy teachers' outcomes. *Journal of Technology and Teacher Education*, *23*(2), 159–183.

Baacke, D.(1999). Projekte als Formen der Medienarbeit. In D. Baacke, S. Kornblum, J. Lauffer, L. Mikos, & G. A. Thiele (Eds.), *Handbuch Medien: Medienkompetenz - Modelle und Projekte* (pp. 86–93). Bonn: Bundeszentrale für politische Bildung.

Baecher, L., Graves, S. B., & Ghailan, F. (2018). Supervisor learning through collaborative video inquiry: It's not just for teacher candidates. *Contemporary Issues in Technology and Teacher Education*, *18*(3), 556–577.

Baecher, L., & Jewkes, A. M. (2014). TESOL and early childhood collaborative inquiry: Joining forces and crossing boundaries. *Journal of Early Childhood Teacher Education*, *35*(1), 39–53. https://doi.org/10.1080/10901027.2013.874387

Baecher, L., & Kung, S. C. (2014). Collaborative video inquiry as teacher educator professional development. *Issues in Teacher Education*, *22*(2), 93–115.

Baecher, L., Rorimer, S., & Smith, L. (2012). Video-mediated teacher collaborative inquiry: Focus on English language learners. *The High School Journal*, *95*(3), 49–61. https://doi.org/10.1353/hsj.2012.0007

Barfurth, M. A., & Michaud, P. (2008). Digital video technologies and classroom practices. *International Journal of Instructional Media*, *35*(3), 301–315.

Beers, P. J., Boshuizen, H. P. A., Kirschner, P. A., & Gijselaers, W. H. (2005). Computer support for knowledge construction in collaborative learning environments. *Computers in Human Behavior*, *21*(4), 623–643. https://doi.org/10.1016/j.chb.2004.10.036

Berg, A. (2016). Students as producers and collaborators: Exploring the use of padlets and videos in MFL teaching. In C. Goria, O. Speicher, & S. Stollhans, *Innovative language teaching and learning at university: Enhancing participation and collaboration*. Research-publishing.net. https://doi.org/10.14705/rpnet.2016.9781908416322

Berkhout, L., Hoekman, J., & Goorhuis-Brouwer, S. M. (2012). Observation instrument of play behaviour in a classroom setting. *Early Child Development and Care*, *182*(10), 1325–1333. https://doi.org/10.1080/03004430.2011.608429

Biasutti, M. (2018). Strategies adopted during collaborative online music composition. *International Journal of Music Education*, *36*(3), 473–490. https://doi.org/10.1177/0255761417741520

Bier, M. L., Horn, I., Campbell, S. S., Kazemi, E., Hintz, A., Kelley-Petersen, M., & Peck, C. (2012). Designs for simultaneous renewal in university-public school partnerships: Hitting the "sweet spot". *Teacher Education Quarterly*, *39*(3), 127–141.

Boldrini, E., Cattaneo, A., & Evi-Colombo, A. (2019). Was it worth the effort? An exploratory study on the usefulness and acceptance of video annotation for in-service teachers training in VET sector. *Research on Education and Media*, *11*(1), 100–108. https://doi.org/10.2478/rem-2019-0014

Borko, H., Jacobs, J., Eiteljorg, E., & Pittman, M. E. (2008). Video as a tool for fostering productive discussions in mathematics professional development. *Teaching and Teacher Education*, *24*(2), 417–436. https://doi.org/10.1016/j.tate.2006.11.012

Borowczak, M., & Burrows, A. (2016). Enabling collaboration and video assessment: Exposing trends in science preservice teachers' assessments. *Contemporary Issues in Technology and Teacher Education*, *16*(2), 127–150.

Bowlin, T. M., Bell, S. M., Coleman, M. B., & Cihak, D. F. (2015). Co-teaching and collaboration: preservice teachers' knowledge, attitudes, and perceived sense of efficacy in teaching students with disabilities. *Journal of the American Academy of Special Education Professionals, Fall, 2015*, 37–57.

Calandra, B., Brantley-Dias, L., Lee, J. K., & Fox, D. L. (2009). Using video editing to cultivate novice teachers' practice. *Journal of Research on Technology in Education*, *42*(1), 73–94. https://doi.org/10.1080/15391523.2009.10782542

Cattaneo, A. A. P., et al. (2018). An empirical test of three instructional scenarios for hypervideo use in a vocational education lesson. *Computers in the Schools*, *35*(4), 249–267.

Cattaneo, A. A. P., et al. (2019a). A model for designing hypervideo-based instructional scenarios. *Interactive Learning Environments*, *27*(4), 508–529.

Cattaneo, A. A. P., et al. (2018c). Designing instructional activities integrating hypervideo: An operative model. *Interactive Learning Environments*. Taylor & Francis Online.

Cattaneo, A. A. P., et al. (2019b). *Video pedagogy for vocational education. An overview of video-based teaching and learning.* European Training Foundation. https://doi.org/10.2816/720936

Cattaneo, A. A. P., et al. (2020). Take a look at this!". Video annotation as a means to foster evidence-based and reflective external and self-given feedback: A preliminary study in operation room technician training. *Nurse Education in Practice*, *44*, 102770.

Cavanagh, M., & Peté, M. (2017). Fashion students choose how to learn by constructing videos of pattern making. *British Journal of Educational Technology*, *48*(6), 1502–1511. https://doi.org/10.1111/bjet.12505

Celikkan, U., Senuzun, F., Sari, D., & Sahin, Y. G. (2013). Interactive videoconference supported teaching in undergraduate nursing: A case study for ECG. *Journal of Educational Technology & Society*, *16*(1), 286–294.

Charteris, J., & Smardon, D. (2013). Second look second think: A fresh look at video to support dialogic feedback in peer coaching. *Professional Development in Education*, *39*(2), 168–185. doi:0.1080/19415257.2012.753931 https://doi.org/10.1080/19415257.2012.753931

Chen, J., Wang, M., Kirschner, P. A., & Tsai, C. C. (2018). The role of collaboration, computer use, learning environments, and supporting strategies in CSCL: A meta-analysis. *Review of Educational Research*, *88*(6), 799–843. https://doi.org/10.3102/0034654318791584

Christ, T., Arya, P., & Chiu, M. M. (2017). Video use in teacher education: An international survey of practices. *Teaching and Teacher Education*, *63*, 22–35. https://doi.org/10.1016/j.tate.2016.12.005

Clarke, D., & Hollingsworth, H. (2002). Elaborating a model of teacher professional growth. *Teaching and Teacher Education*, *18*(8), 947–967. https://doi.org/10.1016/S0742-051X(02)00053-7

Cockburn, A. (2010). Crossing the divide: reflecting on the benefits of international collaboration. *Journal of Mathematics Teacher Education*, *13*(2), 95–98. https://doi.org/10.0.3.239/s10857-010-9148-6

Copeland, W. D., & Decker, D. L. (1996). Video cases and the development of meaning making in preservice teachers. *Teaching and Teacher Education*, *12*(5), 467–481. https://doi.org/10.1016/0742-051X(95)00058-R

Davidsen, J., & Vanderlinde, R. (2014). Researchers and teachers learning together and from each other using video-based multimodal analysis. *British Journal of Educational Technology*, *45*(3), 451–460. https://doi.org/10.1111/bjet.12141

De Jong, F. P. C. M. (2015). *Understanding the difference. Responsive education: A search for 'a difference which makes a difference' for transition, learning and education.* Stoas Wageningen|Vilentum University of Applied Sciences and Teacher Education. https://doi.org/10.13140/RG.2.1.3470.0562

De Jong, F. P. C. M. (2020a). *Knowledge In-(ter)-action. Responsive learning as knowledge building.* Aeres Applied University Wageningen and Open University Heerlen. https://doi.org/10.46884/2020.2

De Jong, F. P. C. M. (2020b). Wat is de impact van de COVID-19 lockdown en onderwijs op afstand op de mbo-student? [What is the impact of the Covid-19 lockdown and distance learning on students in post-secondary vocational education]. *Onderwijs en Gezondheidszorg*, *44*(5), 23–28. https://onderwijsengezondheidszorg.nl/jaargangen/2020/5-sep.html

De Laat, M., De Jong, F., & Ter Huurne, J. (2000). Supporting a community of practice: The role of workers as learners. In *EdMedia: World Conference on Educational Media and Technology* (Vol. *2000*, pp. 1619–1622). Association for the Advancement of Computing in Education (AACE).

Dimitracopoulou, A., & Komis, V. (2005). Design principles for the support of modelling and collaboration in a technology-based learning environment. *International Journal of Continuing Engineering Education and Lifelong Learning*, *15*(1/2), 30–55. https://doi.org/10.1504/IJCEELL.2005.006791

Dredger, K., Nobles, S., & Martin, J. M. (2017) Digital Poetry Practicum: Preservice English Language Arts Teachers' Dispositions of New Literacies. *Journal of Literacy and Technology*. *18*(1), 157–203.

Dreon, O., Jr., & Dietrich, N. I. (2009). Turning lemons into lemonade: Teaching assistive technology through wikis and embedded video. *TechTrends*, *53*(1), 78.

Duff, V., Sauer, W., & Gleason, S. C. (2011). A state for excellence: New Jersey boosts learning power with online video resources. *Journal of Staff Development*, *32*(5), 30–33.

Durley, H., & Ge, X. (2019). Social discourse influencing elementary teachers' cognition and metacognition for problem solving in open-ended professional development. *New Waves-Educational Research & Development*, *22*(1), 55–71.

Ernst, J. V., & Clark, A. C. (2011). Collaborative information and multimedia to assess team interaction in technology teacher preparation. *Journal of Technology Education*, *22*(2), 53–70. https://doi.org/10.21061/jte.v22i2.a.4

Evi-Colombo, A., Cattaneo, A., & Bétrancourt, M. (2020). Technical and pedagogical affordances of video annotation: A literature review. *Journal of Educational Multimedia and Hypermedia, 29*(3), 193–226.

Fields, D., Vasudevan, V., & Kafai, Y. B. (2015). The programmers' collective: Fostering participatory culture by making music videos in a high school Scratch coding workshop. *Interactive Learning Environments*, *23*(5), 613–633. https://doi.org/10.0.4.56/10494820.2015.1065892

Flitton, L., & Warwick, P. (2013). From classroom analysis to whole-school professional development: promoting talk as a tool for learning across school departments. *Professional Development in Education*, *39*(1), 99–121. https://doi.org/10.0.4.56/19415257.2012.719288

Foong, L. Y. Y., Nor, M. B. M., & Nolan, A. (2018). The influence of practicum supervisors' facilitation styles on student teachers' reflective thinking during collective reflection. *Reflective Practice*, *19*(2), 225–242. https://doi.org/10.1080/14623943.2018.1437406

Fraenkel, J. R., & Wallen, N. E. (2009). *How to design and evaluate research in education*. 7th edition.McGraw-Hill.

Gallant, A., & Mayer, D. (2012). Teacher performance assessment in teacher education: An example in Malaysia. *Journal of Education for Teaching*, *38*(3), 295–307. https://doi.org/10.1080/02607476.2012.668330

Gaudin, C., & Chaliès, S. (2015). Video viewing in teacher education and professional development: A literature review. *Educational Research Review*, *16*, 41–67. https://doi.org/10.1016/j.edurev.2015.06.001

Goeze, A., Zottmann, J., Vogel, F., Fischer, F., & Schrader, J. (2014). Getting immersed in teacher and student perspectives? Facilitating analytical competence using video cases in teacher education. *Instructional Science*, *42*(1), 91–114. https://doi.org/10.0.3.239/s11251-013-9304-3

Goldman, R., Pea, R. D., Barron, B., & Derry, S. (Eds.). (2007). *Video research in the learning sciences*. Lawrence Erlbaum Associates.

Goodwin, C. (1994). Professional vision. *American Anthropologist*, *96*(3), 606–633. https://doi.org/10.1525/aa.1994.96.3.02a00100

Grierson, L. E. M., Barry, M., Kapralos, B., Carnahan, H., & Dubrowski, A. (2012). The role of collaborative interactivity in the observational practice of clinical skills. *Medical Education*, *46*(4), 409–416. https://doi.org/10.1111/j.1365-2923.2011.04196.x

Gröschner, A., Seidel, T., Kiemer, K., & Pehmer, A. K. (2015). Through the lens of teacher professional development components: The 'Dialogic Video Cycle' as an innovative program to foster classroom dialogue. *Professional Development in Education*, *41*(4), 729–756. https://doi.org/10.1080/19415257.2014.939692

Gröschner, A., Seidel, T., Pehmer, A.-K., & Kiemer, K. (2014). Facilitating collaborative teacher learning: The role of "mindfulness" in video-based teacher professional development programs. *Gruppendynamik Und Organisationsberatung*, *45*(3), 273–290. https://doi.org/10.1007/s11612-014-0248-0

Hämäläinen, R., & Cattaneo, A. (2015). New TEL environments for vocational education–teacher's instructional perspective. *Vocations and Learning*, *8*(2), 135–157. https://doi.org/10.1007/s12186-015-9128-1

Harris, A. (2013). Peered and tiered learning: Action research as creative cultural pedagogy. *Educational Action Research*, *21*(3), 412–428. https://doi.org/10.1080/09650792.2013.815046

Heintz, A., Borsheim, C., Caughlan, S., Juzwik, M. M., & Sherry, M. B. (2010). Video-based response & revision: Dialogic instruction using video and web 2.0 technologies. *Contemporary Issues in Technology and Teacher Education*, *10*(2), 175–196.

Hennessy, S., & Deaney, R. (2009). The impact of collaborative video analysis by practitioners and researchers upon pedagogical thinking and practice: A follow-up study. *Teachers and Teaching*, *15*(5), 617–638. https://doi.org/10.1080/13540600903139621

Hennessy, S., Dragovic, T., & Warwick, P. (2018). A research-informed, school-based professional development workshop programme to promote dialogic teaching with interactive technologies. *Professional Development in Education*, *44*(2), 145–168. https://doi.org/10.1080/19415257.2016.1258653

Hernández-Ramos, P. (2007). Aim, shoot, ready! Future teachers learn to "do" video. *British Journal of Educational Technology*, *38*(1), 33–41. 00600x. https://doi.org/10.1111/j.1467-8535.2006

Hervas, G., Medina, J. L., & Sandín, M. P. (2020). Participants' views of the use of video in lesson study in higher education in Spain: An exploratory multiple case study. *Journal of Research on Technology in Education*, *52*(4), 461–473. https://doi.org/10.1080/15391523.2020.1734509

Ho, K. F., & Tan, P. (2013). Developing a professional vision of classroom practices of a mathematics teacher: Views from a researcher and a teacher. *Teaching Education*, *24*(4), 415–426. https://doi.org/10.1080/10476210.2012.727179

Hobbs, R. (2006). Non-optimal uses of video in the classroom. *Learning, Media & Technology*, *31*(1), 35–50. https://doi.org/10.1080/17439880500515457

Hyatt, J. (2015) Reflective communities: Mentoring teacher candidates during the (in) between spaces of the practicum. *Journal of Social Theory in Art Education*. *35*(1), *8*, 83–97.

Imafuku, R., Kataoka, R., Mayahara, M., Suzuki, H., & Saiki, T. (2014). Students' experiences in interdisciplinary problem-based learning: A discourse analysis of group interaction. *Interdisciplinary Journal of Problem-Based Learning*, *8*(2), 1–19. https://doi.org/10.7771/1541-5015.1388

Johnson, T. E., Maring, G. H., Doty, J. H., & Fickle, M. (2006). Cybermentoring: Evolving high-end video conferencing practices to support preservice teacher training. *Journal of Interactive Online Learning*, *5*(1), 59–74.

Jorm, C., Roberts, C., Gordon, C., Nisbet, G., & Roper, L. (2019). Time for university educators to embrace student videography. *Cambridge Journal of Education*, *49*(6), 673–693. https://doi.org/10.0.4.56/030576 4X.2019.1590528

Kaendler, C., Wiedmann, M., Leuders, T., Rummel, N., & Spada, H. (2016). Monitoring student interaction during collaborative learning: Design and evaluation of a training program for pre-service teachers. *Psychology Learning & Teaching*, *15*(1), 44–64. https://doi.org/10.1177/1475725716638010

Karppinen, S., Kallunki, V., & Komulainen, K. (2019). Interdisciplinary craft designing and invention pedagogy in teacher education: student teachers creating smart textiles. *International Journal of Technology and Design Education*, *29*(1), 57–74. https://doi.org/10.1007/s10798-017-9436-x

Kelting, T., Jenkins, J. M., & Gaudreault, K. L. (2014). I could really focus on the students. *Journal of Physical Education, Recreation & Dance*, *85*(8), 32–37. https://doi.org/10.1080/07303084.2014.946192

Knowles, A. J., & Cooner, T. S. (2016). International collaborative learning using social media to learn about social work ethics and social media. *Social Work Education*, *35*(3), 260–270. https://doi.org/10.1080/02615479 .2016.1154662

Koc, M. (2011). Let's make a movie: Investigating pre-service teachers' reflections on using video-recorded role-playing cases in Turkey. *Teaching and Teacher Education*, *27*(1), 95–106. https://doi.org/10.1016/j. tate.2010.07.006

Kontkanen, J., Kärkkäinen, S., Dillon, P., Hartikainen-Ahia, A., & Åhlberg, M. (2016). Collaborative processes in species identification using an internet-based taxonomic resource. *International Journal of Science Education*, *38*(1), 96–115. https://doi.org/10.1080/09500693.2015.1129469

Kosko, K. W., Ferdig, R. E., & Zolfaghari, M. (2020). Preservice teachers' professional noticing when viewing standard and 360 video. *Journal of Teacher Education*. https://doi.org/10.1177/0022487120939544.

Krauskopf, K., Zahn, C., & Hesse, F. W. (2012). Leveraging the affordances of YouTube: The role of pedagogical knowledge and mental models of technology functions for lesson planning with technology. *Computers & Education*, *58*(4), 1194–1206. https://doi.org/10.1016/j.compedu.2011.12.010

Kuter, S., Gazi, Z. A., & Aksal, F. A. (2012). Examination of co-construction of knowledge in videotaped simulated instruction. *Journal of Educational Technology & Society*, *15*(1), 174–184.

Lai, C. Y. (2016). Training nursing students' communication skills with online video peer assessment. *Computers & Education*, *97*, 21–30. https://doi.org/10.1016/j.compedu.2016.02.017

Larsen, A. K., Sanders, R., Astray, A. A., & Hole, G. O. (2008). E-teacher challenges and competences in international comparative social work courses. *Social Work Education*, *27*(6), 623–633. https://doi. org/10.1080/02615470802201671

Lebak, K. (2015). Unpacking the complex relationship between beliefs, practice, and change related to inquiry-based instruction of one science teacher. *Journal of Science Teacher Education*, *26*(8), 695–713. https://doi.org/10.1007/ s10972-015-9445-0

Lebak, K., & Tinsley, R. (2010). Can Inquiry and reflection be contagious? Science teachers, students, and action research. *Journal of Science Teacher Education*, *21*(8), 953–970. https://doi.org/10.1007/s10972-010-9216-x

Leighton, C. M., Ford-Connors, E., Robertson, D. A., Wyatt, J., Wagner, C. J., Proctor, C. P., & Paratore, J. R. (2018). Let's FaceTime tonight": Using digital tools to enhance coaching. *The Reading Teacher*, *72*(1), 39–49. https://doi.org/10.1002/trtr.1676

Leijen, Ä., Pedaste, M., & Lepp, L. (2020). Teacher agency following the ecological model: How it is achieved and how it could be strengthened by different types of reflection. *British Journal of Educational Studies*, *68*(3), 295–310. https://doi.org/10.1080/00071005.2019.1672855

Lepareur, C., & Grangeat, M. (2018). Teacher collaboration influence on inquiry-based science teaching methods. *Education Inquiry*, *9*(4), 363–379. https://doi.org/10.1080/20004508.2018.1428037

Liang, J. (2015). Live video classroom observation: An effective approach to reducing reactivity in collecting observational information for teacher professional development. *Journal of Education for Teaching*, *41*(3), 235–253. https://doi.org/10.1080/02607476.2015.1045314

MacEntee, K., & Mandrona, A. (2015) From discomfort to collaboration: Teachers screening cellphilms in a rural South African school. *Perspectives in Education*, *33*(4), 42–56.

Marsh, B., & Mitchell, N. (2014). The role of video in teacher professional development. *Teacher Development*, *18*(3), 403–417. https://doi.org/10.1080/13664530.2014.938106

Marsh, B., Mitchell, N., & Adamczyk, P. (2010). Interactive video technology: Enhancing professional learning in initial teacher education. *Computers & Education*, *54*(3), 742–748. https://doi.org/10.1016/j.compedu.2009.09.011

Masats, D., & Dooly, M. (2011). Rethinking the use of video in teacher education: A holistic approach. *Teaching and Teacher Education*, *27*(7), 1151–1162. https://doi.org/10.1016/j.tate.2011.04.004

Mason, J. (2002). *Researching your own practice: The discipline of noticing*. Routledge.

McFadden, J., Ellis, J., Anwar, T., & Roehrig, G. (2014). Beginning science teachers' use of a digital video annotation tool to promote reflective practices. *Journal of Science Education and Technology*, *23*(3), 458–470. https:// doi.org/10.1007/s10956-013-9476-2

McNally, J. (2016). Learning from one's own teaching: New science teachers analyzing their practice through classroom observation cycles. *Journal of Research in Science Teaching*, *53*(3), 473–501.

Milner-Bolotin, M. (2018). Promoting reflective physics teaching through the use of collaborative learning annotation system. *The Physics Teacher*, *56*(5), 313–316. https://doi.org/10.1119/1.5033879

Miyake, N., & Kirschner, P. A. (2014). The social and interactive dimension of collaborative learning. In R. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (2nd ed., p. 776). Cambridge University Press.

Mu, X. (2010). Towards effective video annotation: An approach to automatically link notes with video content. *Computers & Education*, *55*(4), 1752–1763. https://doi.org/10.1016/j.compedu.2010.07.021

Munn, Z., Peters, M. D., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, *18*(1), 143. https://doi.org/10.1186/s12874-018-0611-x

Näykki, P., Järvenoja, H., Järvelä, S., & Kirschner, P. (2017). Monitoring makes a difference: Quality and temporal variation in teacher education students' collaborative learning. *Scandinavian Journal of Educational Research*, *61*(1), 31–46. https://doi.org/10.1080/00313831.2015.1066440

Öhman, A. (2018). Twist and shape: Feedback practices within creative subject content of hairdressing education. *Vocations and Learning*, *11*(3), 425–448. https://doi.org/10.1007/s12186-017-9196-5

Önal, A. (2019). An exploratory study on pre-service teachers' reflective reports of their video-recorded microteaching. *Dil ve Dilbilimi Çalışmaları Dergisi*, *15*(3), 806–830. https://doi.org/10.17263/jlls.631520

Palmgren-Neuvonen, L., Korkeamäki, R.-L., & Littleton, K. (2017). Intercreating in the context of learner-generated DV production. *Thinking Skills and Creativity*, *26*, 13-23. doi:10.1016/j.tsc.2017.04.005

Pea, R. D. (2006). Video-as-data and digital video manipulation techniques for transforming learning sciences research, education and other cultural practices. In J. Weiss, J. Nolan, & P. Trifonas (Eds.), *International handbook of virtual learning environments* (pp. 1321–1393). Kluwer Academic Publishing.

Pearson, S., Chambers, G., & Hall, K. (2003). Video material as a support to developing effective collaboration between teachers and teaching assistants. *Support for Learning*, *18*(2), 83–87. https://doi.org/10.1111/1467-9604.00285

Pielmeier, M., Böheim, R., Schindler, A. K., Gröschner, A., Knogler, M., Jerabek, M., & Seidel, T. (2018). Fostering dialogic teaching–The "Dialogic Video Cycle" as a video-based professional development program to enhance classroom discourse. https://www.researchgate.net/publication/323399333_Fostering_dialogic_teaching_-_the_Dialogic_Video_Cycle_as_a_video-based_professional_development_programme_to_enhance_classroom_discourse.

Ramos, J. L., et al. (2018). *The video supported collaborative learning knowledge alliance Erasmus+ (EU)-project*. Conference Proceedings. http://ikit.org/summerinstitute2018/index.php/proceedings/ http://ikit.. Confere

Richards, J., Altshuler, M., Sherin, B., & Sherin, M. (2020). Orchestrating for seeing: How teachers see and help others see student thinking when self-capturing classroom video. In M. Gresalfi and I. S. Horn (Eds.), *The interdisciplinarity of the learning sciences—14th International Conference of the Learning Sciences (ICLS)* (Vol. 4, pp. 1942–1949). International Society of the Learning Sciences.

Robinson, S. (2009). Literacy lives here: Using video and dialogue to promote and celebrate adult and literacy education in the Canadian Western Arctic. *New Directions for Adult & Continuing Education*, *124*, 15–23. https://doi.org/10.1002/ace.349

Rock, M. L., Schumacker, R. E., Gregg, M., Howard, P. W., Gable, R. A., & Zigmond, N. (2014). How are they now? Longer term effects of ecoaching through online bug-in-ear technology. *Teacher Education and Special Education*, *37*(2), 161–181. https://doi.org/10.1177/0888406414525048

Rook, M. M., & McDonald, S. P. (2012, March). Digital records of practice: A Literature review of video analysis in teacher practice. In *Society for Information Technology & Teacher Education International Conference* (pp. 1441–1446). Association for the Advancement of Computing in Education (AACE).

Sablić, M., Mirosavljević, A., & Škugor, A. (2020). Video-based learning (VBL)—past, present and future: An overview of the research published from 2008 to 2019. *Technology, Knowledge and Learning*, 1–17. https://doi.org/10.1007/s10758-020-09455-5

Sauli, F., Cattaneo, A., & Van der Meij, H. (2018). Hypervideo for educational purposes: A literature review on a multifaceted technological tool. *Technology, Pedagogy and Education*, *27*(1), 115–134. https://doi.org/10.1080/1475939X.2017.1407357

Schmitt, E., & Eilderts, L. (2018). Connected classrooms: Videoconferencing in TESOL teacher preparation. *International Journal of Teaching and Learning in Higher Education*, *30*(2), 290–299.

Schneps, M. H., Griswold, A., Finkelstein, N., McLeod, M., & Schrag, D. P. (2010). SPORE series winner. Using video to build learning contexts online. *Science (New York, N.Y.)*, *328*(5982), 1119–1120. https://doi.org/10.1126/science.1186934

Sherin, G. M. (2007). The development of teachers' professional vision in video clubs. In R. Goldman, R. Pea, B. Barron, & S. J. Derry (Eds.), *Video research in the learning sciences* (pp. 383–395). First Published by Erlbaum.

Sherin, G. M., & van Es, E. A. (2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education*, *60*(1), 20–37. https://doi.org/10.1177/0022487108328155

Smith-Hansen, L., Constantino, M. J., Piselli, A., & Remen, A. L. (2011). Preliminary results of a video-assisted psychotherapist workshop in alliance strategies. *Psychotherapy (Chicago, IL)*, *48*(2), 148–162. https://doi.org/10.1037/a0022184

So, W. W., Pow, J. W., & Hung, V. H. (2009). The interactive use of a video database in teacher education: Creating a knowledge base for teaching through a learning community. *Computers & Education*, *53*(3), 775–786. https://doi.org/10.1016/j.compedu.2009.04.018

Stack, M. (2010). Video production and youth-educator collaboration: Openings and dilemmas. *McGill Journal of Education*, *44*(2), 299–318. https://doi.org/10.7202/039038ar

Stahl, E., Zahn, C., & Finke, M. (2005). *How can we use hypervideo design projects to construct knowledge in university courses?* Proceedings of the 2005 Conference on Computer Support for Collaborative Learning, 2005: The Next 10 Years! (pp. 641–646).

Sterrett, W., Garrett Dikkers, A., & Parker, M. (2014). Using brief instructional video clips to foster communication, reflection, and collaboration in schools. *The Educational Forum*, *78*(3), 263–274. https://doi.org/10.1080/1475939X.2012.719397

Stevens, R. (2007). Capturing ideas in digital things: The Traces digital annotation medium. In R. Goldman, R. Pea, B. Barron, & S. J. Derry (Eds.), *Video research in the learning sciences*. First Published by Erlbaum.

Stevenson, B., Länsitie, J., Kogler, C., & Bauer, P. (2015). Exploring co-creation of educational videos in an international collaborative context. *Journal of E-Learning & Knowledge Society*, *11*(2), 63–72.

Stürmer, K., Könings, K. D., & Seidel, T. (2013). Declarative knowledge and professional vision in teacher education: Effect of courses in teaching and learning. *British Journal of Educational Psychology*, *83*(3), 467–483. https://doi.org/10.1111/j.2044-8279.2012.02075.x

Tetloff, M., Hitchcock, L., Battista, A., & Lowry, D. (2014). Multimodal composition and social justice: Videos as a tool of advocacy in social work pedagogy. *Journal of Technology in Human Services*, *32*(1–2), 22–38. https://doi.org/10.1080/15228835.2013.857284

The World Bank. (2020). Remote learning, EdTech & COVID-19. https://www.worldbank.org/en/topic/edutech/brief/edtech-covid-19

Tripp, T. R., & Rich, P. J. (2012a). The influence of video analysis on the process of teacher change. *Teaching and Teacher Education*, *28*(5), 728–739. https://doi.org/10.1016/j.tate.2012.01.011

Tripp, T., & Rich, P. (2012b). Using video to analyze one's own teaching. *British Journal of Educational Technology*, *43*(4), 678–704. https://doi.org/10.1111/j.1467-8535.2011.01234.x

Tunney, J. W., & van Es, E. A. (2016). Using video for teacher-educator professional development. *The New Educator*, *12*(1), 105–127. https://doi.org/10.1080/1547688X.2015.1113348

Van der Westhuizen, C. P., & Golightly, A. (2015). Video annotation software application for thorough collaborative assessment of and feedback on microteaching lessons in geography education. *Journal of Geography in Higher Education*, *39*(3), 420–436. https://doi.org/10.1080/03098265.2015.1053802

Van Es, E. A. (2012a). Examining the development of a teacher learning community: The case of a video club. *Teaching and Teacher Education*, *28*(2), 182–192. https://doi.org/10.1016/j.tate.2011.09.005

Van Es, E. A. (2012b). Using video to collaborate around problems of practice. *Teacher Education Quarterly*, *39*(2), 103–116. http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ989786&site=ehost-live

Van Es, E. A., Cashen, M., Barnhart, T., & Auger, A. (2017). Learning to notice mathematics instruction: Using video to develop preservice teachers' vision of ambitious pedagogy. *Cognition and Instruction*, *35*(3), 165–187. https://doi.org/10.1080/07370008.2017.1317125

Van Es, E. A., & Sherin, M. G. (2010). The influence of video clubs on teachers' thinking and practice. *Journal of Mathematics Teacher Education*, *13*(2), 155–176. https://doi.org/10.1007/s10857-009-9130-3

Van Es, E. A., Tunney, J., Goldsmith, L. T., & Seago, N. (2014). A framework for the facilitation of teachers' analysis of video. *Journal of Teacher Education*, *65*(4), 340–356. https://doi.org/10.1177/0022487114534266

Wang, R., & Wiesemes, R. (2012). Enabling and supporting remote classroom teaching observation: live video conferencing uses in initial teacher education. *Technology, Pedagogy and Education*, *21*(3), 351–360. https://doi.org/10.1080/1475939X.2012.719397

We are Social.Think Forward 2020 (2020). Available at: https://wearesocial.com/uk/thinkforward-2020 (accessed: 08, July, 2020), Alphabeta.

We are social. (2019). Think forward: Trends shaping social 2019 (Report). https://wearesocialit.s3.amazonaws.com/think-forward-report-2019/WAS_ThinkForward_2019_spread.pdf

Youens, B., Smethem, L., & Sullivan, S. (2014). Promoting collaborative practice and reciprocity in initial teacher education: realising a 'dialogic space' through video capture analysis. *Journal of Education for Teaching*, *40*(2), 101–113. https://doi.org/10.1080/02607476.2013.871163

Zahn, C. (2017). Digital design and learning: Cognitive-constructivist perspectives. In S. Schwan & U. Cress (Eds.), *The psychology of digital learning*. Springer.

Zahn, C., Krauskopf, K., Hesse, F. W., & Pea, R. (2010). Digital video tools in the classroom: How to support meaningful collaboration and critical advanced thinking of students?. In *New Science of Learning*. (pp. 503–523). Springer.

Zahn, C., Hesse, F., Finke, M., Pea, R., Mills, M., & Rosen, J. (2005). *Advanced video technologies to support collaborative learning in school education and beyond*. International CSCL-05 Conference, 2005, Taipei, Taiwan, 9p.

Zhang, M., Lundeberg, M., & Eberhardt, J. (2011). Strategic facilitation of problem-based discussion for teacher professional development. *Journal of the Learning Sciences*, *20*(3), 342–394. https://doi.org/10.1080/10508406.2011.553258

Zottmann, J. M., Stegmann, K., Strijbos, J. W., Vogel, F., Wecker, C., & Fischer, F. (2013). Computer-supported collaborative learning with digital video cases in teacher education: The impact of teaching experience on knowledge convergence. *Computers in Human Behavior*, *29*(5), 2100–2108. https://doi.org/10.1016/j.chb.2013.04.014

Appendix

Video-supported collaborative learning activities.

	(Video clips) Collaborative analysis with large groups (Flitton & Warwick, 2013); dialogic instructional practices and collaborative exploration of a multiplicity of perspectives (Heintz et al., 2010); collaborative supervision (Hennessy & Deaney, 2009; Kelting et al., 2014); collaborative problem-solving (Kelting et al., 2014); collaborative coaching, integrating the collaborative discussion about video-integrated recorded simulated instruction model teaching practice (Kuter et al., 2012); online peer assessment and reflective practices (Lai, 2016); self-reflection, group collaborative dialogues and group reflections (Lebak, 2015); collaborative practices for classroom discourse within the Dialogic Video Cycle (Pielmeier et al., 2018); observation, feedback, analysis and reflections (Tripp & Rich, 2012a, 2012b); promoting collaborative practice, reciprocity and learning conversations (Youens et al., 2014)
	(Video cases) Reflections on practice collaborative video-based case discussion (Copeland & Decker, 1996).
	(Video clubs) Teacher dialogues and discussions, collaborative reflections (Cockburn, 2010), group discussions for collective knowledge construction (Imafuku et al., 2014); observation, self-reflections, sharing ideas and collaboration; discussion and collaboration within a group of teachers (Van Es, 2012a); facilitation of collegial and collaborative interactions, participations and discourse norms for productive collaborations (Van Es, 2012a, 2012b)
Observation and video-supported collaboration	(Video Traces) Collaborative discussions (Bier et al., 2012; McFadden, 2014), collaborative analysis and feedback (Bier et al., 2012; Zottmann et al., 2013).
Collaboration and video-supported authoring	Group working and peer assessment (Borowczack, 2016); collaborative conversations and dialogues (Hernández-Ramos, 2007); sharing and group reflections (Hyatt, 2015); co-creation of educational videos (Stevenson et al., 2015); collaborative storytelling and collaborative learning diaries (Karpinnen, 2019); group discussion, dialogues and feedback (MacEntee, 2015); joint collaborative making of storyline (Palmgreen, 2017); collaborative negotiations and decisions about planning and narrative construction (Robinson, 2009);
Interactive video (Hypervideo)	Combining the cognitive and the socio-cultural approach (which highlights social interaction and collaboration) (Cattaneo et al., 2019a); learning-by-design experiences for collaboration for the creation of hypervideo in small groups (Cattaneo et al., 2018b); Collaborative annotation (Boldrini et al., 2019; Sauli et al., 2018);
Collaboration and video-based educational content	Collaborative problem-solving (Dimitracopoulou & Komis, 2005); sharing ideas and collaborative discussions (Dreon & Dietrich, 2009); collaborative knowledge building through dialogues and discussions (Hennessy et al., 2018); authentic problem-based activities for discussions and collaborations (Durley & Ge, 2019).
Video-supported synchronous collaboration	Sharing personal stories, narratives and discussions of teachers' ideas (Ardley, 2005); group exploration of online spaces for collaboration and bridge theory and practice (Dredger, 2017); group discussions (Zhang et al., 2011)