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# The use of digital video annotation in teacher training: the teachers' perspectives

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**Abstract**

The use of digital video offers interesting opportunities in teacher training, particularly the possibilities provided by video annotation, whereby people can add and share comments and opinions on the same videos, even from different places. This exploratory study aims to examine teachers' perspectives of this technology, taking into account both their explicit and implicit evaluations. Different methods of using video annotation for training are compared, one based on its individual use, another supported by various types of tutorship. The data were collected and analysed first through a quantitative phase, followed by an in-depth qualitative phase. It is pointed out that to make this technology fully operational it is important to address the cultural and psychosocial aspects that control the emotional conditions which arise when one's teaching behaviour is being observed and assessed.



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*Key words:* video annotation; tutorship; teacher training; microteaching

## 1. Introduction

In recent years self-reflection has been placed at the centre of the teacher training debate, in the wake of a tradition going back to the work of Dewey (1933) and, more recently, to the studies of Schön (1983; 1987), which argue that the key to successful learning lies in teachers' capacity to analyse and reflect upon their teaching practice (Farrell, 2004; Jay et al., 2000; Liston & Zeichner, 1990; Valli, 1997; Warden, 2004). Being able to review one's own teaching behaviour, and share and discuss viewpoints with tutors or experts, can create added potential for the development of teaching expertise (Jacobs, Kawanaka, & Stigler, 1999; Knoll & Stigler, 1999; Putnam & Borko, 2000; Wilson & Berne, 1999).

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To support teachers self-reflection, many techniques and instruments have been provided: portfolios (Adamy & Milman, 2008; Zubizarreta, 1994), self-reports and autobiographies (Powell, 1985), and diaries and reflective journals (Francis, 1995; Jarvis, 1992). The use of video technologies represents an important strategy. Microteaching (Allen & Clark, 1967; Allen & Ryan, 1969) was the first noteworthy methodology that used videos to allow teachers to reflect on their practice. Nowadays, several authors claim that using video for the review of teaching behaviour is a useful and promising practice (Bryan & Recesso, 2006; Rich & Hannafin, 2009a; Santagata & Angelici, 2010; Snoeyink, 2010; Wright, 2008). Furthermore, recent meta-analyses demonstrate the effectiveness of training programmes based on the video recording of teaching experiences' (Hattie, 2009). During recent years new video methodologies for examining and improving reflective practices have been realized. These emphasize the potential of sharing and discussing video recordings with a peer group, and include the MATH project (Lampert & Ball, 1998), the MILE project (Goffree & Oonk, 1999), the "video study groups" (Tochon, 1999), the "lesson study" (Lewis, Perry, & Hurd, 2004), the "video Clubs" (Sherin & Han, 2004), and the "video cases for mathematics professional development" (Seago, 2004; Sherin, 2004).

Notwithstanding these initiatives, the best context and conditions for exploiting this technique and the teachers' perspective of it have still to be studied. In the literature, it is commonly acknowledged that the effective spread of innovations is not so much related to their actual characteristics but rather to the user's idea of the perceived benefit in adopting them (Moore & Benbasat, 1996). Rogers (1983) identifies five key characteristics of technological innovation which influence potential users to adopt them: relative advantage, that is, the extent to which the innovation is perceived as an improvement over previous systems; compatibility, which is the measure of how well the innovation aligns with the users' values; complexity, which relates to the difficulty of using the innovation; observability, meaning how visible the innovation's results are to others; and trial ability, which relates to the level at which the innovation can be tested before being adopted (see also other technology acceptance models which are on similar lines, e.g. Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003).

## 2. Video annotation tools

The advent of digital video has opened up new technological possibilities as regards digital editing and the sharing of videos on the Web. Among these, video annotation has quickly become one of the most common ways of analysing activities in many fields, including education (Amobi, 2005; Preston, 2008); this is because video annotation tools offer the great advantage of entering comments and bookmarks directly in the video frames, and also from remote locations. Nowadays, an increasing literature underlines the use of video annotation as a way to strengthening teachers' ability to learn about their own teaching (Bryan & Recesso, 2006; Rich & Hannafin, 2009a; Santagata & Guarino, 2010; Seago, 2004).

A wide range of video annotation tools are now available to support specific activities; these are both offline and online, open-source and commercial, and general purpose and specialized (Rich & Hannafin, 2009b). Most of these tools feature a simple graphic-based interface with an integrated viewing area and a space to allow users to add and edit on a similar line comments on the videos (see Figure 1 below).

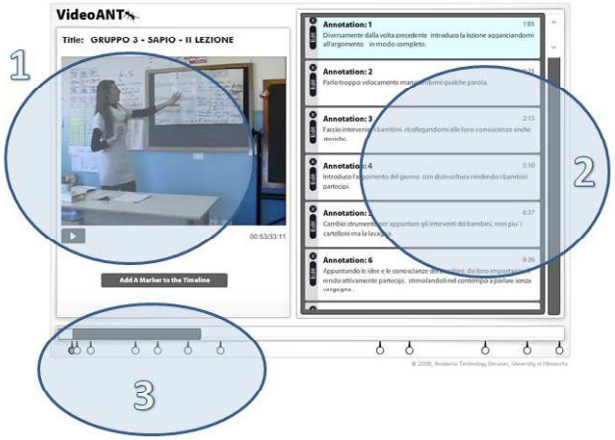


Figure 1. VideoANT, a video annotation tool produced by University of Minnesota used in our experiment (available at: http://ant.umn.edu/). As with many other video annotation tools it is organized in three different areas: 1) video viewing, 2) textual annotation, 3) timeline and the command panel (play, forward, back, stop).

## 3. Aim of the research

The purpose of this study is to understand what teachers think about video annotation as a support for training practice, taking into account the underlying motivations behind teachers' explicit declarations.

To study teachers' views we resorted to literature on the adoption of technological innovations, following the approach of Rogers (1983) and Davis (1989) in which three dimensions were distinguished:

1. *Utility*, in the sense of assessing the advantages and perceived utility in terms of skills development, according to Davis (1989).
2. *Ease-of-use*, which refers to the perceived ease-of-use (Davis, 1989) and the perceived level of user-friendliness (Rogers, 1983).
3. *Appeal*, meaning a feeling which has emotional associations related to desirability, serenity, engagement, and similarly, the expression of a consistency between the technology and one's own values, needs and experiences (Rogers, 1983).

We considered teachers' views on three different approaches to tutorship based on video reviewing and video annotation: firstly, a friendly approach, where the video annotations are carried out by a trusted expert chosen by the teacher himself, here defined as the "*mentor* situation"; secondly, where the video annotations are carried out by three colleagues randomly chosen from the school, here defined as the "*community* situation"; and thirdly, where the annotations are carried out by an academic expert, here defined as the "*expert* situation". These situations will be compared to video annotation in situations of traditional *face-to-face* training and of purely *personal* use – without any tutorship.

On this basis the following hypotheses were formulated:

- H1. Teachers prefer the use of video annotation to support their training rather than *face-to-face* training.
- H2. Teachers prefer the use of video annotation supported by tutors rather than a purely personal annotation.
- H3. Within the sphere of tutored video annotation, the *community* solution is preferred.

With regard to H3, it is evident nowadays that the Web community-based solution arouses high expectations in terms of professional development, as we see for teachers who have started documenting and sharing their class experiences on video clips (Huppertz, Massler & Ploetzner, 2005; Rich & Hannafin, 2009a; So, Pow, & Hung, 2009).

## 4. Methods

### *4.1. Study Design*

We used a mixed methods explanatory sequential design, according to Creswell and Plano Clark's classification (Creswell & Plano Clark, 2011); so we first collected and analysed quantitative data, and then we used a qualitative approach (a focus group) in order to explain and interpret the quantitative results (see Figure 2).

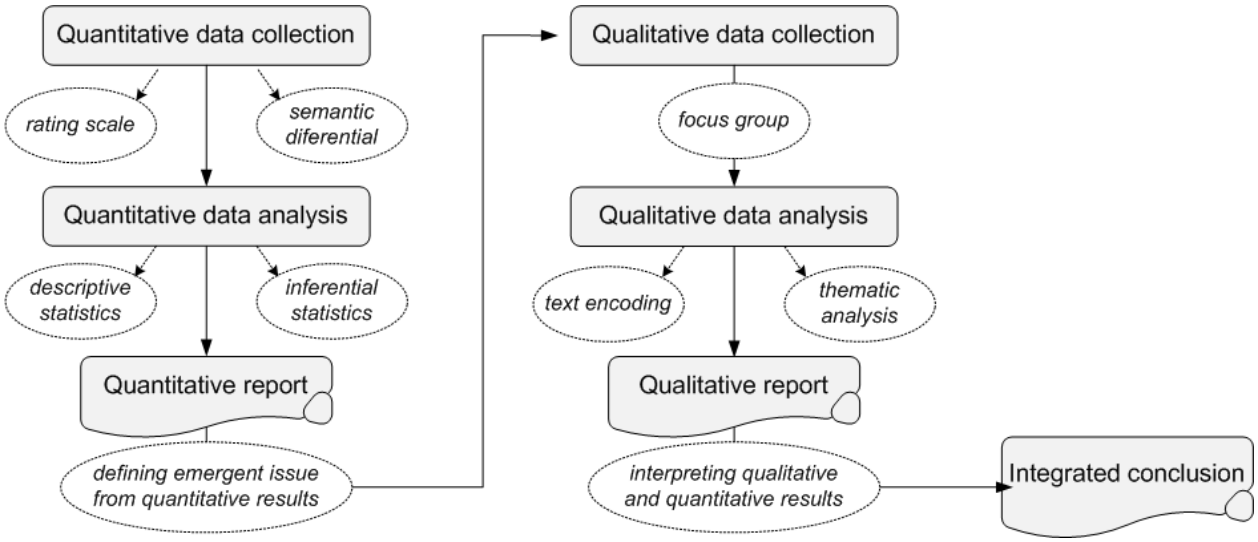


Figure 2. Diagram of the study design.

### *4.2. Measure*

For the quantitative phase, we collected data on each selected dimension (utility, ease-of-use, appeal) at two different evaluation levels:

- *Explicit evaluation* by using a rating scale (RS) with a range from 1 to 5 on a 5-point Likert scale.
- *Indirect evaluation* (*or connotation*), by using a semantic differential (SD) scale aimed at capturing the attribution of meanings and feelings associated with the object being evaluated, according to Osgood, Suci, and Tannenbaum (1957). Both the RS and the SD were designed on an ad hoc basis for this study (see Appendix 1 and 2).

For the qualitative phase, we used an *in-depth focus group* (Bloor, Frankland, Thomas, & Robson, 2001) to understand the implicit motivations and attain a socially shared interpretation.

### *4.3. Sample*

The research study was carried out in two schools, which have worked together on innovative projects regarding education and teaching, in Quartu S. Elena, a Sardinian town in the Province of Cagliari (Italy), in a below average cultural context.

Unlikely, because of the complexity of the experiment, the majority of teachers declined the proposal, so it was not possible to use a randomized sample.Of a total of 60 teachers, the final sample was formed of 13 subjects who voluntarily agreed to take part at the experiment, sharing their video recorded experience with others.

However this sample reflects the charactistics of the majority of the school teachers: it was formed only of women, mainly between the ages of 35 and 40 with 6–10 years teaching experience, 5-year specialized degrees, and positive teacher training experiences, fairly familiar with technology but without any experience of digital video.

The classes chosen for the video recorded lessons were from the first to third year at Primary School (six- to nine-year-old children), and there was an average of about 20 children in each class (SD = 2), and with at least one pupil with special needs in each class.

The community members were chosen randomly from within the two schools. The role of the expert was played by one of the three authors not personally known by the teachers.

### *4.4. Procedure*

Some meetings were held before the experiment to clarify the roles of the different subjects involved. The actions at this stage involved:

- Defining a shared lesson plan for the tutee and common criteria of evaluation: communication clarity, cognitive appropriateness, and capability to manage the classroom's climate.
- Choosing a trusted mentor for each tutee and assigning a group of three teachers, forming the review community, to each tutee.
- Familiarizing the subjects with the video annotation system and organizing technical support during the experiment.

For simplicity it was decided to use one video camera with a fixed shot of the teacher during her interaction with the class. The lessons to be filmed were 20-minute long dialogic lessons on a new topic pertinent to the school curriculum. It was explained that these dialogic lessons should be recorded and video annotated independently by the teachers themselves, and also by the tutors (mentor, community, expert).

The quantitative and qualitative phases of the procedure were carried out as described below.

1. Quantitative phase (15 days):

Firstly, the teachers were required to evaluate their face-to-face professional training by means of the SD and the RS.

Secondly, the lesson was video recorded and uploaded in the VideoAnt environment. A copy of the video lesson was provided to each of the subjects for their respective video annotation, that is, to the teachers (tutee), mentors, community, and experts.

All the subjects were asked to insert their own video annotations autonomously, without knowing those made by the others (with the exception of the community that worked together).

Each teacher (tutee) reviewed and video annotated their own video right away and expressed their evaluation of this experience through the SD and RS tools.

At two to three day intervals the tutee received the video annotations from the mentor, the community, and the expert, in a randomized order.

In each case the tutees re-examined their own videos, focusing their attention on the comments of their mentors. After each feedback experience the tutees filled in the SD and RS tools.

2. Qualitative phase (1 day):

This phase involved a focus group and the three following actions:

a. A presentation of the quantitative data results and the main issues.
b. A discussion to explore meanings and interpretations.
c. A further discussion on the motivations and the resulting interpretative summary.

The observations that emerged were gathered manually by the moderator and the assistant during the focus group. The focus group was also video recorded at the same time.

The summary of the discussion was presented and further expanded in discussion with the participants; subsequently, the moderator and the assistant listened to the whole recording once again, and another summary was formulated (Bloor, Frankland, Thomas, & Robson, 2001; Stewart, Shamdasani, & Rook, 2007).

## 5. Results of the quantitative phase

The first goal of our research was to compare the teachers' views on the two general forms of experimented video annotation, self video annotation and tutored video annotation, with face-to-face training (see H1 and H2).

An overview of the results in Table 1 shows that the distribution of the averages for both measures (RS, SD) tends towards higher values in favour of video annotation for the utility dimension and, on the contrary, in favour of face-to-face training for the dimensions of appeal and ease-of-use (although the averages regarding SD for this dimension are very close).

The ANOVA test for the utility dimension proved to be significant, $F(2, 10) = 10.146$, $p = .001$, $\omega 2 = .46$; teachers attribute a significantly higher level of utility to tutored video annotation ($\Delta M = 1.21$ $p = .008$) and a slightly lower, but still significant level to self video annotation ($\Delta M = .827$ $p = .031$). However, there are no significant differences between the average scores when scores for self and tutored video annotation are compared.

Briefly the first research hypothesis (H1) is confirmed only with regard to the utility dimension. The second hypothesis (H2) has not been confirmed because there is no significant difference between tutored video annotation and self video annotation across the averages of the three dimensions.

Table 1. Means, Standard Deviations, Scores for ANOVA and comparisons between the average scores of the variables relating to the different types of training (N = 13)

| Variables | Experimental situation<br>Face-to-face training | Self video annotation | Tutored video annotation | F | ω2 |
|---|---|---|---|---|---|
| Utility (RS) | $2.63_a$ | $3.46_b$ | 3.85cb | 10.146*** | .46 |
| | (.64) | (.76) | (.99) | | |
| Utility (DS) | 5.74 | 6.34 | 6.02 | 3.032 | .07 |
| | (.54) | (.35) | (1.32) | | |
| Appeal (RS) | 4.11a | 3.65a | 3.04b | 4.664* | .38 |
| | (.82) | (1.14) | (1.14) | | |
| Appeal (DS) | 6.08 | 5.92 | 5.90 | 2.037 | .17 |
| | (.97) | (.42) | (.99) | | |
| Ease-of-use (RS) | 3.33 | 3.10 | 2.92 | 3.032 | .20 |
| | (.57) | (.72) | (.69) | | |
| Ease-of-use (DS) | 5.23 | 5.55 | 5.28 | 1.665 | .10 |
| | (.89) | (.87) | (1.16) | | |

Note. * = $p <$ .05, *** = $p <$ .001. Standard deviations appear in parentheses below means. Means with differing subscripts within rows are significantly different at the $p <$ .05 based on Bonferroni corrections post hoc paired comparisons.

As regards tutored video annotation, the research study also aimed to analyse the perception of utility, appeal, and ease-of-use of the three different forms of tutorship (mentor, community, expert), starting from a preliminary hypothesis of a preference for the community situation (H3). Table 2 below shows the average data related to the utility, appeal, and ease-of-use measures used to undertake the explicit evaluation (RS) and the indirect evaluation (SD) of the three tutoring situations.

Table 2. Means, Standard Deviation Scores of ANOVA and comparisons between the average scores of the variables referring to the different types of tutorship (N = 13)

| Variables | Experimental situation | | | | |
|---|---|---|---|---|---|
| | Mentor video annotation | Community video annotation | Expert video annotation | **F** | **ω2** |
| Utility (RS) | 3.85a | 2.96b | 3.58ac | | |
| | (2.07) | (.96) | (.90) | 5.067* | .32 |
| Utility (DS) | 6.03 | 5.80 | 6.21 | 4.664 | .20 |
| | (1.14) | (1.58) | (1.23) | | |
| Appeal (RS) | 3.79 | 3.60 | 3.77 | 2.625 | .18 |
| | (.72) | (.79) | (.71) | | |
| Appeal (DS) | 6.01 | 5.57 | 6.10 | 3.459 | .15 |
| | (.73) | (1.41) | (.83) | | |
| Ease-of-use (RS) | 3.42 | 3.27 | 3.70 | 1.506 | .11 |
| | (.68) | (.72) | (.57) | | |
| Ease-of-use (DS) | 5.27 | 5.23 | 5.39 | 2.704 | .18 |
| | (.92) | (1.59) | (.96) | | |

Note. * = $p < .05$, *** = $p < .001$. Standard deviations appear in parentheses below means. Means with differing subscripts within rows are significantly different at the $p < .05$ based on Bonferroni corrections post hoc paired comparisons.

As can be observed in Table 2, the distribution of the averages is similar for both measures (RS, SD), and the averages are lower in the case of community-based video annotation than in the two other tutored conditions (mentor and expert), particularly in the utility and ease-of-use dimensions. We find a significant difference when the scores for comparing the utility dimension (RS) attributed to expert video are compared with those for the community video annotation in favour of the expert situation $F(2, 10) = 5.067$, p = .04, ω2 = .32 , (ΔM = .615, p = .04).

Therefore, hypothesis H3 was not confirmed because there are no significant data favouring the community-based video annotation approach.

## 6. Results of the qualitative phase

In order to further understand the teachers' perspectives, a focus group was established with the aim of interpreting the quantitative results according to the methods highlighted by Bloor, Frankland, Thomas, and Robson (2001) and Kinzinger, (1994). Data were coded and analysed manually to explore the motivation behind the quantitative results. The first question addressed to the teachers dealt with the evaluation of tutored or non-tutored video annotation as a training method, compared with face-to-face training (H1, H2).

The analysed data show that the video annotation experience was, on the whole, evaluated by all the teachers involved as positive and useful. The following statements by two different teachers are emblematic of this shared understanding:

*Actually, I experienced all four situations positively, starting with self video annotation, because watching myself was a significant experience,… it especially made me realize that in many respects, I see myself differently from how I expect myself to be when I'm teaching children.*

*…watching myself was useful to evaluate every part of the lesson explanation, it was powerful because it acted on specific aspects and now I can judge whether I should change some attitudes and in what way.*

On the other hand, most of the teachers declared that they consider that using tutored video annotation is a less easy and sustainable training method than either face-to-face training or self video annotation.

Two participants maintained that the benefits of tutored video annotation can be achieved in a more economic and spontaneous way by further fostering the daily and informal sharing of teaching activities between colleagues. One of them stated:

*I seem to gather, from what's being said, that face-to-face training, at any rate, does not involve the reflection and questioning that this new situation involves. I do not completely agree with this idea, because teachers already call themselves into question and look around for new ideas on a daily basis, this just needs to be further encouraged.*

The problems attributed to tutored video annotation are partly the same as those typically attributed to technology, which are mainly related to lack of time and equipment, but some also specifically refer to the limitations imposed by the constraints of the recordings and the lack of spontaneity of the situation (teachers and students can be inhibited by the video camera).

The other issue addressed by the focus group dealt with the different types of tutorship supporting video annotation (H3). Consistent with the quantitative data, community tutorship is confirmed as the least suitable of the three types of tutorship compared in the experiment. Most of the teachers perceived that the community's support in video annotation is basically unacceptable.

*I didn't like the community very much because it wasn't very coherent and also because a colleague had to be judged….*

Only three teachers confirmed the potential of this form of tutorship, highlighting the opportunity for peers to exchange views as a useful form of reflection and openness to different points of view. They added that within a more prepared context

*Maybe even the community [approach] could work out if [the] observation criteria were better shared.*

The teachers' evaluations of the opportunities offered by the external observers revealed a clear split in their opinions, giving rise to two different lines of thought. About half the teachers preferred mentor tutorship, because the mentor is a privileged witness of the tutee's actual competence, and also the most qualified in that specific context.

*….knowing the tutee is very important, because sometimes the recording gives you a distorted picture of reality. If you know the person you can evaluate him/her keeping in mind his/her personality, thus rendering the use of video annotation with a mentor more sustainable. In fact, it helps if whoever is observing knows the pupils well, knows what goes on in the class, and whether there are students with problems.... experts could interpret the context wrongly.*

The other half of the teachers supported the expert as tutor for exactly the opposite reason, that is, precisely because the expert is a complete stranger to the specific context, and their evaluation has a more significant and enriched value. Moreover, not knowing the tutee directly renders their contribution even more valid because it is objective and unbiased.

*….in mentor tutored video annotation we tend to think that evaluations are driven by the fact that the mentor knows us, it's more confidential, but the very fact that he does not know me at all and he's a teacher training expert renders his evaluation more unbiased, and so I value and listen more to what he says and consequently I reflect more. If we had to make a scale of preferences, this would be the most important type.*

### *6.1. Focus Group: Additional elements*

From the observed and analysed interactions two more important variables emerge: the emotional element experienced by tutees, and the tutors' analysis and communication skills.

Most teachers expressed the view that their experience was emotionally conditioned by the awareness that they were being assessed; four teachers declared feeling anxiety, embarrassment, fear and difficulty; and, two admitted being conditioned by the evaluation given by the tutor (positive vs. negative feedback) when expressing their own evaluation of the procedure being tested, as can be seen in the following statement:

*It was a difficult experience due to the fears everybody, including myself, has of being judged….thinking retrospectively I realize that every time I found an annotation I didn't like, the first impact was really strong…..because everybody seeks approval from others, at first I perceived the comments that caught me unprepared [were] slightly hostile.*

The tutors' personal skills in expressing their feedback had an important role from the teachers' perspective. About half of them emphasized the importance of these personal skills in view of the already mentioned lack of a shared evaluation system and code for the whole process.

Mentor and expert tutorship was particularly appreciated because, irrespective of the contents, more challenging language and communication forms could be used than in the peer community tutorship. The following observation is an example of these elements:

*I think that mentors and community colleagues should be trained, because even though this was an experiment, there was felt to be a lack of basic analysis and communication skills among tutors.*

After reflecting on the barriers and critical elements mentioned above, at the end of the focus group discussion, the teachers were asked to sum up the aspects that could most contribute to increasing the utility, appeal, and ease-of-use of video annotation.

They agreed on:

- Sharing and negotiating the observation criteria: as emphasized above, because according to the teachers, their inadequate knowledge of what they were being evaluated on increased their uncertainty and anxiety in facing external feedback.
- A shared definition of the lesson's goals and the tutor's knowledge of the class (in any form): lack of common goals and not knowing the context of the class is a significant critical factor.
- Specific training on tutorship skills: specific communication skills, related also to the medium used, are fundamental for being an effective tutor.

## 7. Conclusions

This study aimed to understand the teachers' perspective of using video annotation techniques in teacher training. Three hypotheses were formulated: teachers prefer the use of video annotation to support their training rather than *face-to-face* training (H1); teachers prefer the use of video annotation supported by any type of tutoring rather than a purely personal annotation (H2); and, within the sphere of tutored video annotation, teachers would prefer the solution involving a community of colleagues (H3).

None of these hypotheses was wholly confirmed. The first research hypothesis was confirmed only with regard to the utility dimension; video annotation is substantially perceived as more useful than face-to-face training because of its more powerful impact on teaching performance, but it is less appealing and has less ease-of-use in the teachers' everyday practice.

As far as the second hypothesis is concerned, no significant difference was found between tutored video annotation and self video annotation. This is probably because the added value of the constructive interpersonal support is balanced by the risk of the negative emotional implications, as is evident from the numerous statements in focus groups.

Also the third hypothesis was not confirmed; out of the three hypothesized types of tutorship considered in the experiment (trusted mentor, community of colleagues, external expert), the one represented by the community of colleagues turned out to be the least desirable: in this case the feelings of embarrassment and anxiety relating to the evaluated results was not adequately balanced by high confidence in the evaluators themselves.

The small size of the sample and the exploratory nature of this study do not permit generalizations to be drawn out about teachers' perspectives on the use of this technology. The low level of the teachers' competence in using video may have conditioned the teachers' evaluations since previous technological experience may be a relevant variable (Atkins, 1998; Friel & Carboni, 2000; Krajcik et al., 1996; Santagata & Angelici, 2010).

We do not know what would happen in different, more advanced contexts, with subjects more familiar with the technology, and after specific training to better enable the methodology to be mastered and shared. However, our data are sufficient to bring to light the presence of the emotional dynamics aimed at safeguarding personal self-esteem and at reducing exposure to personal risks, a dimension that should receive more attention in further research. The teachers explicitly acknowledged the importance of technological innovation and were ready to accept forms of remote observation and interaction with external expert tutors, but generally they were concerned about comments received from colleagues and preferred not to expose their teaching behaviour to an open audience.

In the technological innovation process, apart from technological and logistical problems, psychological sensitivities about the perception that sharing experiences are a risk to one's self-esteem also arise, and this critical element can assume more complex connotations in conditions of remote interaction.

Other studies should focus on effective initiatives to change the cultural framework and address the psychological defence mechanisms relating to the observation of one's professional behaviour by colleagues, as well as on the communication skills that e-tutors should develop in order to be able to reduce anxiety during a computer mediated interaction.

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## Appendix A. The Rating Scale (RS)

Please mark the extent to which each statement corresponds to what you experienced in the video annotation just experimented. Please, use the 5-point scale from 1 = not at all to 5= completely

*Utility items*

1. Improvement of class management skills
2. Improvement of teaching style
3. Improving communication
4. Discovering unconscious aspects of one's behaviour

*Appeal items*

1. Artificiality
2. Pleasure
3. Embarrassment
4. Anxiety

*Ease-of-use items*

1. Technological complexity
2. Time consuming
3. Energy expenditure
4. Emotional and relationship difficulties

Note: The structure of the rating scale was verified through the factorial analysis of the main components, (eigenvalue over 1, varimax rotation) and the analysis of the reliability level (Cronbach's alpha) of each extracted dimension.

The final RS version was made up of 12 items, 4 for each dimension, and its level of reliability (Cronbach's alpha) was more than .70 in all the applications: α mean of utility = .84 (.02); α mean of appeal = .74 (.05); α mean of ease-of-use = .78 (= .03).

## Appendix B. The Semantic Differential (SD)

Please, state your opinions of the *video annotation just experimented* on the scale below

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *desirable* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *undesirable* |
| demanding | 1 | 2 | 3 | 4 | 5 | 6 | 7 | effortless |
| easy | 1 | 2 | 3 | 4 | 5 | 6 | 7 | difficult |
| important | 1 | 2 | 3 | 4 | 5 | 6 | 7 | insignificant |
| effective | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ineffective |
| *intriguing* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *boring* |
| *lively* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *monotonous* |
| sustainable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | unsustainable |
| incisive | 1 | 2 | 3 | 4 | 5 | 6 | 7 | weak |
| *warm* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *cold* |
| beneficial | 1 | 2 | 3 | 4 | 5 | 6 | 7 | detrimental |
| *rewarding* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *frustrating* |
| light | 1 | 2 | 3 | 4 | 5 | 6 | 7 | tiring |
| soft | 1 | 2 | 3 | 4 | 5 | 6 | 7 | hard |
| productive | 1 | 2 | 3 | 4 | 5 | 6 | 7 | unproductive |
| natural | 1 | 2 | 3 | 4 | 5 | 6 | 7 | artificial |
| deep | 1 | 2 | 3 | 4 | 5 | 6 | 7 | superficial |
| cheap | 1 | 2 | 3 | 4 | 5 | 6 | 7 | expensive |
| *discreet* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *intrusive* |
| useful | 1 | 2 | 3 | 4 | 5 | 6 | 7 | useless |
| *natural* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *uncomfortable* |
| linear | 1 | 2 | 3 | 4 | 5 | 6 | 7 | complicated |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| stimulating | 1 | 2 | 3 | 4 | 5 | 6 | 7 | passive |
| *calm* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *anxious* |

Note: the different font styles used indicate the bipolar adjectives according to the dimensions: utility; appeal, ease-of-use.

The structure of the semantic differential was verified through factorial analysis of the main components, (eigenvalue over 1, varimax rotation) and the analysis of the reliability level (Cronbach's alpha) of each extracted dimension.

The SD was made up of 24 items, 8 for each of the three key dimensions of the research study, and its level of reliability was more than .70 in all the applications (α mean of utility = .77 (= .02); α mean of appeal α= .80 (= .04); α mean of ease-of-use α= .87 (= .05).