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The collaborative construction of chronotopes during computer-supported collaborative professional tasks

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Abstract In this paper, we use the concept of chronotope to analyse the co-construction of spatial and temporal frameworks during collaborative interaction. A chronotope is a genre of movement or pacing in the space that participants adopt over the temporal duration of an activity. We look in particular at the conjunction point of time and space as revealing how collaboration works and what role is played by technology. Six sessions during which 10 teachers prepared a pedagogical scenario to be implemented in school were filmed and qualitatively analysed. The tempo of the activity was found to vary considerably depending on various factors, such as the features of the tools used, the aims of the activity, and the skills employed by the participants to achieve them. Three different tempos were identified, which we named, using a musical metaphor, Adagio, Andante, and Allegretto. Some representative excerpts of each of these tempos, and of the moving from one tempo to another, are selected and discussed. Our results allow an in-depth understanding of coordination within a group of teachers working on planning a common educational scenario for their classrooms with the mediation of a software tool.

Keywords Chronotope · Heterotopia · Teachers · Video analysis · Socio-constructivism · Bakhtin · Software supporting face-to-face interaction

Introduction

What relation is there between group work and perception of space-time while using technology? How are space and time co-constructed during collaborative tasks supported by software? We know that introducing professional tools impacts practices in many ways. In fact, the use of a tool involves the use of specific procedures and triggers particular

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"professional visions" (Goodwin 1994). In this paper, we claim that the use of technology may also impact the perception and the management of space-time configurations, in particular during collaborative activities. Space and time have already received attention from psychologists in general, as well as from CSCL researchers. The collaborative construction of space has been an object of attention in particular for researchers analysing groups of users working in virtual space and of users combining multiple technologies, for instance, software integrating text-chat with a shared workspace (Dillenbourg and Traum 2006; Muhlpfordt and Wessner 2005; Soller and Lesgold 2003; Stahl 2009). Space is not just a passive aspect of the context, but it is actively constructed and emerges as a result of users' interaction. The notion of a subjectively and interactively constructed time has also been suggested by psychologists from different fields. For instance, when analysing team work, McGrath and Tschan (2004) highlighted how people conceptualize time within prescribed and personal timeframes: Time is measured in different ways and enters into social-psychological phenomena at multiple levels, in different functional roles, and as different types of processes. Within CSCL, the temporal dimension has often been studied as an element impacting performance. In particular, time management and perception have become objects of study in relation to the effects of asynchronous communication and interaction in Web-forums (Dewiyanti et al. 2007; Scardamalia and Bereiter 1994). Also, many researchers have pointed out that allowing different timing and tempos fosters richer communication and more sophisticated thinking (Baker and Lundt 1997; Ligorio 2001; Sarmiento and Stahl 2008). Similarly, within the CSCL framework the effects of interacting in a Web-based virtual space were analysed (Avouris et al. 2004; Harrison and Dourish 1996). The physical or virtual space in which people meet and discuss, turns out to correspond to a space for thinking and reasoning (Wegerif 2007), for empowering and enabling specific ways of communicating and interacting.

This paper looks at the intersection between time and space, focusing on the role technology plays in determining the quality of this intersection. The situation we observed concerns a group of teachers planning a pedagogical scenario to be implemented at a later time in their classrooms. Our main goal in the analysis we report here is to understand how the co-construction of time-space may play a role in the professional coordination and in the collaboration within the group. We believe the process of collaboratively constructing a time-space framework will give information about group coordination around computer-mediated activities. The features of the activity performed are such that resorting to representations of both past and future situations is crucial. While planning a computer-enhanced pedagogical scenario for their students, teachers constantly bring in their experience with their classroom and their representations of how the scenario will impact their classrooms. For our analysis, we use the concepts of "heterotopia" and "chronotope," framed within a socio-constructivist approach, as discussed in the following paragraphs.

Co-constructing space-time

According to the socio-constructivist approach, people interactively construct the realities in which they live, developing symbolic, sense-filled "possible worlds," while they act in their physical, social, and cultural environment (Bruner 1986). Part of this continuous construction process takes place when people negotiate the contexts in and with which they interact while participating in various activities. The construction of the context is in fact "shaped by the activities of the moment" (Duranti and Goodwin 1992), in line with the objectives that people have set themselves and the activities they are involved in. The spaces for interaction and the times for activity are negotiated in a coordinated way.

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Participants in a given interaction can use various techniques to outline the spatial confines of the event in which they are taking part. The process of co-construction of the space-time frame is, thus, a psychosocial process strongly interweaved with the co-construction of knowledge (Ligorio et al. 2008). In fact, in accordance with distributed cognition theory, while carrying out an activity, people project structures of intentionality onto the context, which thus becomes an integral part of human thought and action (Hollan et al. 2000). Therefore, cognition and context constitute an integrated system within interaction:

> I speak of an action or utterance as occurring 'in' a context, and this conventional way of talking suggests that the particular action is a 'dependent' variable, while the context is the 'independent' or determining variable. But this view of how an action is related to its context is likely to distract the reader—as it has distracted me—from perceiving the ecology of the ideas which together constitute the small subsystem which I call 'context.' [...] It is important to see the particular utterance or action as *part* of the ecological subsystem called context and not as the product or effect of what remains of the context after the piece which we want to explain has been cut out from it. (Bateson 1987, p. 348)

The way participants segment the context of an activity, highlighting certain elements and leaving others in the background, is a product of the interaction between the players and the context. The spatiotemporal coordinates of this interaction become essential in defining the "window" of significant context. Schegloff (1972) brilliantly demonstrated how a simple description of even the most ordinary state of affairs depends on the space-time frame chosen by the speaker:

> Were I now to formulate where my notes are, it would be correct to say that they are: right in front of me, next to the telephone, on the desk, in my office, in the office, in Room 213, in Lewisohn Hall, on campus, at school, at Columbia, in Morningside Heights, on the upper West Side, in Manhattan, in New York City, in New York State, in the North east, on the Eastern seaboard, in the United States, etc. Each of these terms could in some sense be correct... were its relevance provided for. (p. 81)

The choice of context in which to situate those notes thus depends on a multitude of factors that make a certain segment of that context relevant for that particular moment of the interaction.

Kirsch (1995) showed how the space-time perspective is co-constructed by participants in close correlation with their expertise concerning the activity in progress. Their level of experience not only conditions their use of language and the introduction of technical terms, but even "tunes the perceptual systems of experts" (Kirsh 1995, p. 36), meaning that experts see their working environment differently than others. By effectively and efficiently structuring the context, experts are able to focus on the salient points and use the context as a resource for their action. Moreover, experts are often socialised to a profession and have interiorised its ways of working, even when outside the direct working experience. Goodwin's study (1994) of the classification of colours in an archaeological dig revealed how this process involved not only categorisation based on experience, but also the specific tools of the profession which socially structure the archaeologist's perception and the implementation of procedures learned in order to use such tools, which are themselves defined by professional tradition and renegotiated as appropriate during the activity. By structuring the context, professional practice enables the players to decide what conceptual and material elements of the space are relevant and worthy of attention, and at what times.

Suchman (1987) also highlighted how the organisation of a situated action is a property that emerges from the interactions moment by moment. The interaction is, thus, a system that comprises both the players and the circumstances in which the action takes place, as well as the way that people use space and time to develop an intelligent course of action.

The social and cultural matrix of the context is an aspect that is also stressed by Activity Theory, particularly as reformulated by Cole and Engeström (1993). From this theoretical perspective, the context is co-constructed by its participants and is the result of the attribution of meaning deriving from complex multiple interactions among subjects or between subjects and the symbolic and material tools available within the spatiotemporal confines of the event. The meaning is co-constructed on the basis of the cultural categories available in the historical context.

In short, the co-construction process also incorporates the space-time dimension and is inevitably sensitive to the characteristics of the historical and cultural context as well as the participants' skills, intentions, expectations, and ways of interacting. In our opinion, these dimensions have not been sufficiently investigated in the context of computer-mediated interactions, nor have their effects on collaboration within a group of professionals. We thus intend to place this aspect in the forefront, with the aid of some conceptual and theoretical tools that we will clarify next.

Heterotopia and chronotopes

The spatiotemporal aspects of situated activity systems can be described by using two concepts, one borrowed from Foucault (1967) and the other from Backtin (1981). The concept of "heterotopia" reveals how the segmentation of reality leads to the construction of heterogeneous spaces that the participants in the activity use strategically as a resource for their actions. Heterotopia was described by Foucault (1967) as "juxtaposing in a single real place several spaces, several sites that are in themselves incompatible". The examples chosen to illustrate this concept are theatres, cinemas, libraries, or ships, the latter of which, being a "piece of wandering space, a place without place" (Foucault 2006, pp. 27–28), is Q3 defined by the author as the epitome of heterotopia. This concept, which led Foucault to predict the birth of a "heterotopological science," if applied to our context—teachers using software to plan activities in the classroom—enables us to consider the school as a highly complex heterotopia in which heterogeneous physical, relational, organisational, cultural, and virtual spaces overlap and alternate. As in a cinema, where the audience and screen spaces overlap, or in a library, where the physical space overlaps with both the timeless space of the written pages and the "historicised" space of the culture laid down within those pages, so in a school we can see a complex overlap of heterogeneous spaces. These spaces exist both in the classroom and in other working spaces—laboratories, textbooks, computer labs, or informal meeting places such as the corridors or the playground.

From a purely psychological viewpoint, heterotopia can be read through reference to the "thinking space" (Perret-Clermont 2004, 2006), defined as a place which is not purely cognitive, but physical, mental, relational, social, and cultural all at the same time, within which thought is situated. In this sense, the variety of spaces offered by a learning and professional context is a relevant resource for the construction of thought. In addition, for a significant learning experience, the availability and co-construction of different levels of physical and symbolic thinking spaces are important.

The participants in any interaction are always situated in a multitude of spaces, which are structured according to the activities performed. For a better understanding of the process of co-construction of the spatiotemporal dimension, Duranti and Goodwin (1992)

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suggested analysing transitional moments, such as shifts from one activity to another within the same activity system. Following this suggestion, we found Backtin's concept of chronotope (1981), which he had taken from Einstein's relativity theory and adapted to literature theory, to be very useful for our scopes. In fact, this term lent itself well to describing the strong interconnections between time and space in literary texts.

A chronotope describes the particular space-time configuration that can be found in a novel and it is closely linked to the literary genre. Each genre, in fact, has its own chronotope: For example, a Greek adventure novel is characterised by a uniqueness of time and space, creating interchangeable sequences of events that leave no trace on the hero (Boje 2007).

Whereas for Bakhtin, the chronotope indicates the ways in which the "narrative genres move the scene of action from place to place, and less focally, the pacing of this movement and of typical scene" (Lemke 2004), in our perspective a chronotope designates the ways in which the ongoing activity makes different spaces within a heterotopia, which are relevant at different times. In other words, the chronotope recounts the movement in the space that the participants adopt over the temporal duration of an activity.

Bakhtin elaborated a complex taxonomy of the various possible kinds of chronotope in literature. We claim the concept of chronotope may also be very useful to analyse real-life situations, but specific and original chronotopes need to be found. In a situation such as a collaborative design of a pedagogical scenario, during which professionals are striving to achieve a common goal while using a new professional tool—a software suite—what type of chronotopes would emerge? If, in narratives, the change of actions is marked by moving from one scene to another, in real professional situations—such as the one we analyse—the change from one scene to another can be obtained by changing the semiotic resources used. The result is that participants may physically remain exactly in the same space and time, but symbolically they move between several space-time configurations. What we intend to analyse in this paper is how these changes of scene happen, how the co-construction of space-time may impact the collaborative work of professionals, and what role is played by technology.

Bakhtin has already contributed greatly to the understanding of the social nature of learning. Koschmann's work (1999) has been seminal in this sense: He stressed how knowledge building implies a multiplicity of voices coming into contact and he showed how close this idea is to the dialogicality described by Bakhtin. Koschmann recounts the potential advantages of adopting dialogicality as a conceptual basis for ongoing work in CSCL. Stahl (2006) shows how dialogicality and multivoiceness are particularly useful in group work. Here the present situation can be understood only through the contextualization of each utterance by looking back to preceding utterances to which it responds, and forward to anticipated responses of a projected audience, in accordance with the structure of human lived temporality (Heidegger 1927/1996). Dialogism and multivoiceness still infuse our perspective because we consider chronotopes to be built dialogically and through many voices.

The study: Teachers using computers for professional development

This study involved a training course for a group of secondary school teachers, during which they familiarised themselves with a software suite designed to support face-to-face interaction. The aim of this activity was to jointly develop a shared educational scenario on career guidance, to be subsequently implemented in the classroom. The course required six sessions, with the voluntary participation of 10 teachers, all women, from different schools,

who were pursuing a Master's degree in career guidance. Once they are awarded the Master's, the teachers should be able to offer career advice and guidance to their students and will take on the role of career teacher in their school. The use of a software program and the planning of a classroom activity were proposed as a Master's training assignment with a strong effect on the acquisition of professional skills, both technological and concerning career guidance. During the six training sessions, the teachers became familiar with the software package and worked in groups in order to develop a pedagogical scenario using the software, in which the topic of further education and careers was treated as a problem-solving activity. In the first three sessions, the objectives were discussed and the various tools in the software package were illustrated. The last three sessions were devoted to the development of the pedagogical scenario that students had to perform in their classroom which would help them to solve the problem of what to do after school.

The six sessions were analysed by observing the participants' movement while pursuing the aims and the objectives of the activity as they "navigated" and moved between space-time frames.

Objectives

As already stated, our main objective is to identify the particular chronotopes emerging during the collaborative construction of a software-enhanced pedagogical scenario. We think this type of investigation is important for a number of reasons. First of all, we believe the chronotopes found in narrative may not be directly applicable in real-life situations, where original and new chronotopes may emerge. Secondly, we wish to underline the collaborative construction of chronotopes, particularly during transaction moments. Thirdly, there may be a reciprocal impact between the quality of chronotopes and that of collaboration. Finally, the analysis of chronotopes and of the collaborative process through which they are built may reveal interesting aspects of the mediation role played by technology in such a highly complex profession as teaching.

In this study, we considered both the physical and the virtual spaces of the action, becoming relevant at different times and capable of giving shape to complex configurations. The activity we analysed is, in fact, characterised by the interweaving of virtual and real spaces, never considered as distinct or conflicting, but rather as partly overlapping and, perhaps, able to generate new, original chronotopes.

The technology used: CoFFEE[1]

CoFFEE stands for Collaborative Face to Face Educational Environment. It is, therefore, an environment that supports face-to-face interaction, not long-distance interaction. The ideal situation for the use of CoFFEE is when participants are sitting next to one another to discuss an assignment, and make use of the package to support their discussion. Its potential is best expressed in the framework of educational scenarios constructed to take account of both curricular aspects and methodological indications deriving from the psycho-pedagogic socio-constructivist perspective (Ligorio et al. 2009).

CoFFEE is a suite of various applications, each of which has specific features regarding different aspects of the educational process, from planning to assessment. It also has a

[1] The CoFFEE (www.coffee-soft.org) software suite was developed within the European LEAD project (www.lead2learning.org), funded as part of the sixth framework programme, with the participation of Dutch, Italian, French, and British researchers.

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number of tools allowing different communication formats and activities. In this paragraph, we will briefly describe only the tools used during the activities that were the object of analysis:

- The Graphical Tool is a shared virtual whiteboard where conceptual maps can be drawn in groups. Each user can add contributions, which appear on the shared whiteboard as a text box that can be dragged around the screen and linked to other contributions by lines. The contributions can also be labelled—the labels being called thinking types—thus highlighting their individual socio-cognitive function. The most commonly used labels include: question, suggestion, agreement, disagreement, summary, new information. As shown in Fig. 2, a small window in the top left-hand corner of the whiteboard contains a miniature of the map, while the main space contains only a portion of the same map. By means of a button at the top of the screen, the user can, at any time, enlarge or reduce the map visualized in the main space. In this way, users can focus on some portion of the map and simultaneously have a sense of the entire map.
- The Chat Tool is a space in which contributions are displayed in chronological order and preceded by the contributor's name. CoFFEE allows users to label the entries to the chat. Labels can be the same as used for the Graphical Tool, but new labels can also be designed. They are always differentiated by colours. The Chat can be used in combination with other tools, for instance with the Co-writer, as in Fig. 1.
- The Co-writer is a tool used to write collaborative texts. Selecting a name from the participants list, that user is enabled to write. The writer's name appears in the bar above, while a text box containing the typed-in text appears in the space below. This tool is used when the groups have a representative at the computer writing, for instance, a summary of what has been decided during a work group or the result of a group brainstorming session (Figs. 2 and 3).

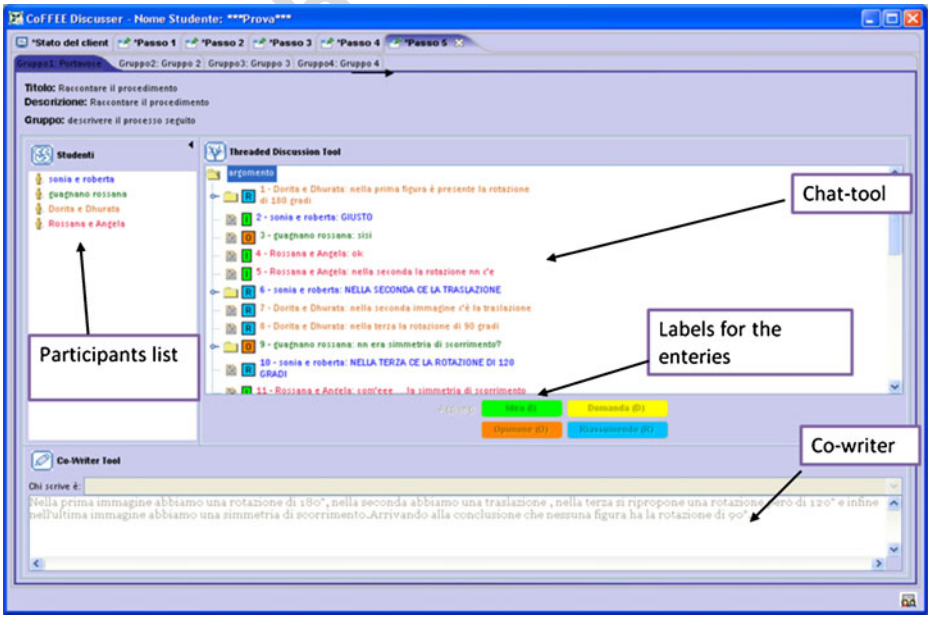

Fig. 1 Chat tool and Co-writer in the same screen

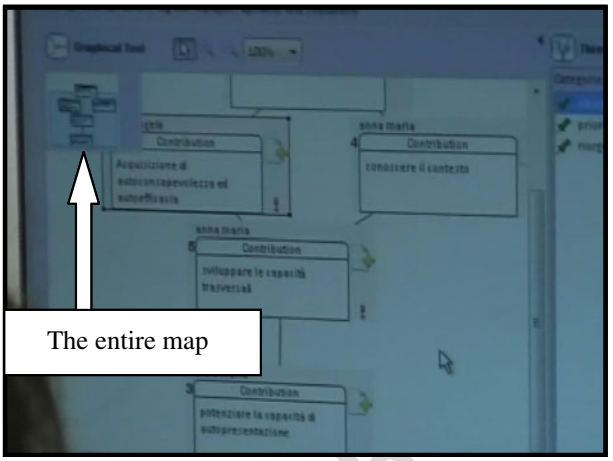

Fig. 2 Conceptual map of the pedagogical scenario

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Data collection

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We filmed each of the six sessions in which the teachers first became familiar with CoFFEE and then developed the career guidance pedagogical scenario. The videos were supplemented with the collection of field notes written by the researcher through participant observation. The field researcher did not act merely as an observer, but also played an active part in the planning and implementation of the activity. For this reason, it was not always easy to write down contextual reflections in real time, and so when possible, another trained researcher would take part in the activity. In some cases, due to the unexpected active involvement of both researchers, field notes were taken down up to 24 h after the session.

The collected data was first viewed immediately after the activity, in order to make any necessary corrections to the data collection strategy or to modify and complete the plan for the upcoming session.

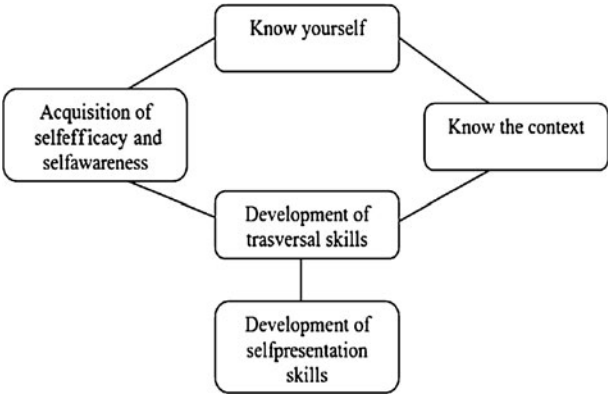

Fig. 3 Translation of the map

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The data corpus

Three types of data were collected:

- CoFFEE logs saved onto an external memory at the end of each session, comprising six logs reporting the output of the activity at the computer;
- Films of all the activities that were carried out. As each session lasted about 2 h, a total of about 12 h of film were recorded;
- Field notes, taken during the interaction or up to 24 h thereafter.

Data analysis

The data were analysed using a qualitative ethnographic methodology (Goodwin 1994, 2000). The first step of this analysis was to review all the session films, field notes, and CoFFEE logs. This phase aimed to identify "changes of scene." Once moments were identified, the second phase consisted of a further analysis to obtain explanatory dimensions enabling the reconstruction and representation of the situation in terms of space-time co-construction. This phase was carried out using the theoretical constructs discussed above; specifically chronotopic and heterotopic constructs were tracked down and dimensions considered of interest were annotated. A third phase required speech transcription using the Jefferson (1984) notation system and the analysis of film stills of particular moments in which relevant chronotopes and heterotopias were captured. Phases two and three were closely connected so that they were often performed in parallel. The entire analysis was carried out by two researchers, who first worked independently to select the pertinent episodes, and then compared and agreed on their final choices. The selected episodes involved at least one of the following configurations: a) the physical space-time; b) the space-time of the conversation; c) the space-time produced by the paper materials used and produced in the classroom, which can be considered as technologies in their own right; d) the CoFFEE space-time, which can be further broken down according to the specific tool used.

Results: Chronotopes as musical compositions

The chronotope of a complex activity, such as the one we analyse here, is a composite, dynamic reality in which the various spaces of a heterotopia enter into play while also regulating the tempo of the activity. In this sense, it seems legitimate to compare the chronotope to a musical composition. The chronotopes were, in fact, found to have different tempos and allow different participation paths for each individual. To stick with the musical metaphor, the participants can be considered as soloists performing within a symphony—or a polyphony, as Bakhtin would have called it—each one with their own tempo, which is, however, determined by the context as a whole (Trausan-Matu et al. 2007). Some excerpts we selected concerning the co-construction of the space-time configurations are presented below. The order with which the results are presented does not follow a temporal sequence; in fact, the findings could have been presented in a different order.

Adagio

The features of the software suite seem to have a strong effect on the tempo of the activity. An interesting example is provided by an episode occurring in the third session, during

which teachers are outlining a conceptual map—using the Graphical Tool available in CoFFEE—to synthesize the objectives of the pedagogical scenario they are planning. The aim of this activity is to reach a comprehensive and shared representation of the scenario they are going to propose, at a later time, to their students. The teachers work in dyads on the same computer and negotiate their actions on the map in these dyads, but often they communicate with their other colleagues, both verbally and through the chat available at the bottom of the screen. The ongoing discussion mainly concerns how the concepts represented on the map are linked to each other. As shown in the photograph below, the CoFFEE configuration provides a small window at the top left-hand corner, in which the map can be seen in miniature. The full screen does not give a full view of the map; to see it all they must scroll up and down using the sidebar. Therefore, the top and the bottom of the map do not appear simultaneously on the screen, but at different times.

Reported below is an excerpt of the interaction occurring when the teachers are discussing which concepts to include in the map.

EXCERPT 1. Looking at the map

1. Annamaria: let's put this after they know the context
2. Ida: yes (1.0) 'develop transversal skills'[2] let's try it
   ((ten seconds of silence during which one of the teachers changes the map according to what has just been suggested))
3. Researcher: are you happy with that?
4. Mariangela: but can't we see it a bit bigger?
5. Ada: "eight and four"[3] (0.5) should be combined then
6. Researcher: do you all agree on combining four and eight?
7. How about their position - are they OK like that?
8. Annamaria: what I don't find helpful is "develop
9. transversal skills" with "develop self-presentation skills"
   ((five seconds of inaudible voices))
10. Annamaria: shouldn't one be the consequence of the other?

[2] Typed phrases are placed in single quotation marks.
[3] Phrases read from the computer screen are placed in double quotation marks.

The teachers are examining the links and the sequence of the concepts included on the map, discussing what should be before and "after" (line 1) and what should be grouped together. The computer screen is the place where their suggestions are "embodied." In fact, as we can see in line 5, they use the numbers of the contributions in the map to refer to the concepts being discussed. Part of the communication and reasoning is constructed referring to the map, which represents here a relevant semiotic resource for the interaction. The focus of the discussion is "there," on the computer screen, and a strong connection seems to be active between what they are reasoning in their minds and the screen. The graphical representation of their ideas on a map allows the teachers to reconsider what they are doing. The screen displaying the map is the place where they can see their collective thinking taking shape. This particular configuration has space for silence (see between lines 2 and 3 and in line 5), which seems to be a time for thinking. When Annamaria in line 10 says "shouldn't one be the consequence of the other?" she is verbalizing her effort to check the match between the concept on the map and what the group is trying to do. This intervention seems to stem from the possibility to see on the map what they have been discussing. The map, in this case, is not simply the representation of the group work, but rather it is a stimulus to reconsider what has been discussed. In other words, Annamaria used the static space-time frame of the map to deepen her understanding of the shared objectives of the scenario to be planned. The general impression is of a slow tempo alongside an intense stream of thoughts, which each participant develops in close relation with what is

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happening on the screen in front of her. The type of discourse seems almost to punctuate what they are doing, making explicit the reasons behind their actions. The teachers seem to be committed to a rather deep analysis of the map, using it mainly as a tool for reflection. The researcher plays an important role in this process. He is looking for consensus, asking if everyone agrees with the actions taken, as in lines 3 and 6. Here the researcher is functioning as a conjunction point between the map and the group. He is supporting the collective negotiation about how the map should be. In this sense, he is not only the expert of the software but also a sort of agent responsible for making sure everyone is participating and is aware of the changes and what these changes imply.

Mariangela's intervention (line 4) briefly brings to attention an apparently technical aspect concerning the management of the screen space. In fact, she does not ask Ida (the colleague setting next to her and using the same computer) to enlarge the map, but she addresses the question to the whole audience by physically turning toward the rest of the group. Not asking her neighbour, but involving everyone instead, may be an indicator revealing she is not simply asking technically how to enlarge the map; she is socializing a problem regarding the appropriateness of the virtual space for the ongoing activity. Considering whether the software configuration active at that moment is the best for what they are doing may be another feature slowing down the tempo. Mariangela is proposing a "bigger" visualization of the map as a way for the group to better think about the contents of the map. A new representation of the map can offer a space for a renegotiation of what they previously agreed upon. By organizing the concepts into a map, the teachers had to define the links between them, which drove them to an evaluation of the concepts, even though they had already been approved. In fact, they found themselves reconsidering the concepts and their sequence.

This leads us to define a specific chronotope evoked by the use of a slow tempo and a restricted computer space. In musical terms, this would be an Adagio: a temporal expansion occupied mainly by talking through the actions performed individually, but with a common goal to construct a shared product, that is, the map. Collaboration at this point is mainly based on a need for coherence, comparing what "should be" possible collective thinking with what actually "is" on the screen. However, what "should be" is stated by an individual voice (Annamaria) and she needs to find out if this is also a collective feeling and not only her own impression. This is a delicate process, requiring time and a fine-grain space to visualize what is under discussion. The technology here works as a sort of flexible mirror, on one side reporting what the group thinks and, on the other side, making it easy to change and re-discuss it. Therefore, the Adagio is the chronotope for understanding the correspondence between what is "there"—on the computer screen—and what is in the collective thinking, through individual voices.

Andante

In the fourth session, we found a different chronotope, caused mainly by the sudden need to speed up the activity and reach a conclusion. The limited time available induces a change in the participation configuration so as to enable the objective of the activity to be achieved quickly.

In this session, the teachers are working on planning a sequence of activities to be carried out at a later time with their students. The objectives they agreed upon in the previous sessions are working as a starting point for the activity in this session. At the moment of the episode we have selected, teachers are individually sitting in front of a computer. Each of them is reading the sequence of activities in real time, while Loretta—

one of the teachers—is updating it by using CoFFEE Co-writer. Each entry she makes is negotiated verbally, with the involvement of all the participants.

In the sequence reported below, the teachers are realizing that the negotiation of one of the points is taking too long and it is time to agree upon it as quickly as possible. Therefore, an Adagio tempo is triggered by the suggestion made by one of the participants. She suggests renegotiating some of the activities included in the scenario planned for the students, even if the group has originally agreed upon it. At this point, the feeling that a faster pace is needed emerges, along with a change of the focus, from the details of the single activities included in the scenario to the general, main objectives. Consequently, it is necessary to move from the discussion about a specific activity within the scenario to a general definition of the scenario itself. In this way, while Loretta sums up what has already been written, two teachers leave their workplaces and walk toward her. Soon the other teachers do the same, all gathering around Loretta. This movement is symbolically meant to restrict the initially wide interaction space that included all the computers, to focusing only on one computer and one specific piece of information. Therefore, the group goes from a common space distributed on each individual computer to a space concentrated on one computer and one of the tools available within CoFFEE (see Figs. 4 and 5).

EXCERPT 3. Rough planning

1. Loretta: we need to finish the second session because ..
2. (1.5) I want to understand
   ((she is reading aloud what she is writing in the Co-writer while two other teachers move towards her workstation))
3. Loretta: here too we need to ask to [elaborate
4. Researcher: [give them what? Half
5. an hour to work on the internet and the rest of the time to
6. get this map done
7. Loretta: of the course we are no longer following the ideal
8. plan of action
9. Researcher: I see we changed… or at least I thought we'd
10. decided
11. Loretta: [the ideal plan of action
12. Researcher: [to talk about the ideal plan of action
    ((meanwhile Annamaria is walking towards Loretta))
13. Annamaria: of the ideal plan of action, yes
14. Loretta: so ok, I'll remove "the path followed" and I'll
15. add the ideal plan of action
16. Annamaria: but when they give out these handouts here
    ((pointing at Loretta's screen with)) ((Figure 4))
17. they should always describe the methodology they use,
18. that's how I would put it (0.5) as non-negotiable
19. Loretta: OK, I like that
    ((Annamaria and Ida talk to each other for two seconds; not audible))
20. Mariangela: at the end of the day there are two products
21. Ida: so half an hour (.) Let's work it out
22. Loretta: OK this will take two hours and a half (0.5) this
23. is a two-and-a-half hour session (.) so for this point,
24. I'd say that when looking at it we, I mean, we can work
25. out a rough timescale
    ((five minutes of discussion follow on some specific questions related to the students' handouts))
26. Loretta: right. So however it needs to be done, I mean
27. right now we're simply preparing a rough plan, clearly::
28. then::

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Fig. 4 Loretta raises a problem

At the start of this excerpt, Loretta and the researcher are trying to build what they call "the second session" (line 1), which is the second step of the pedagogical scenario that they are developing for the students. Loretta is now focusing on the "second session," taking for granted that there is an agreement about the first session that requires students to prepare two products (see line 20): a) a handout based on the material they found on the Internet about careers and possibilities after high school; b) a map or a diagram describing how they found that information ("the path followed," line 14). For Loretta, at this point, it is no longer clear whether the scenario should still include the "ideal plan of action" (lines 7 and 8)—obviously discussed earlier—which consisted of requesting students to build a map about their decision-making strategies regarding what to do after high school. Teachers are at a crossroads: on one side, they feel they need to bring the work to a close (line 1), and to do this they just have to decide the time to be allotted to students (see lines 4–5 and 21–22); on the other side, they want to be sure the scenario they are preparing makes sense for their students. This concern is triggered by Loretta's request to "understand" (line 2), which sets up a symbolic bridge between the previous work the group has done, during which the activities of the first session were decided, and the work they are going to undertake regarding the "second session" from which follows the searching of a consistent sequence

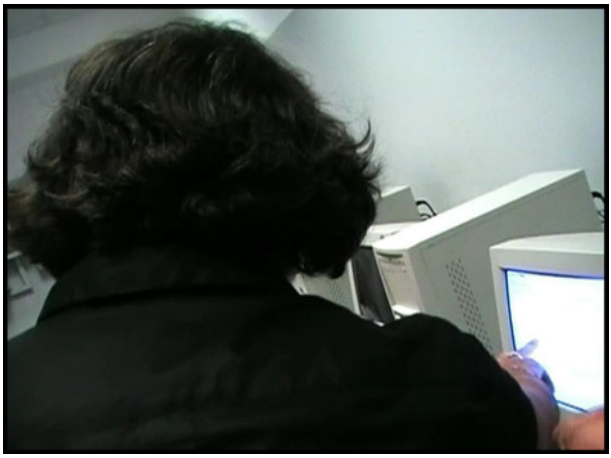

Fig. 5 Annamaria points at Loretta's screen

of the activities. Loretta is dealing at the same time with the feeling of running out of time, hence the need to complete the work and "to understand" (line 2) the sense of the whole scenario. The result is a strain to find a compromise between these two conditions, which leads to a collaborative reconstruction of the purpose of the scenario. In fact, in the second part of the excerpt, we can see that the meaning assigned to the scenario changes from being a tool to set a detailed sequence of actions to be carried out in the classrooms—assumed by the need to specify the timing (line 21–22)—to being a roughly sketched tool, meant to guide the work in the classroom while at the same time remaining flexible and changeable (line 27).

A crucial intervention to decide which one of the two options ("ideal plan" vs. "path followed") should be preferred is that of Annamaria, when she states that students "should always describe the methodology they use" (line 17). This argument persuades Loretta to change the written plan (line 19). This is not a trivial change, but rather it opens to discussion what has already been decided and somehow challenges the general objectives of the scenario under preparation for the students. A full and broad agreement is needed, and this urges the teachers to get up from their workstations and physically gather around the "point" from which this discussion has emerged—Loretta's workstation, as she is the one managing the Co-writer. Each teacher could still visualize the Co-writer on their own screen, but the new problematic point needs a symbolic restriction of the discussion space, so they all physically move to the "space" in which the problem is represented at that time. In this way, the initial need to wrap up the drafting of this part of the scenario is fulfilled thanks to a double acceleration, both of the thinking space, which becomes focused on a higher-order problem (what this activity is meant for), and of the physical interaction space, concentrating around Loretta's workstation. The overall impression is that a "closing" configuration in a limited space is more efficient to work at a higher level: defining the objective pursued step-by-step in the scenario that they are designing.

Another aspect worthy of discussion is the role of the researcher in this excerpt. Initially he is supporting Loretta in her need to close down the ongoing activity; in fact, he is making a clear reference to the missing information—the time allotted to students (lines 6–8). However, later he quickly realizes something else is happening and that the point is no longer about time, but about the goal of this activity. He clearly marks a change from what has already been agreed upon, to what is going to take place (lines 11 and 12). The researcher goes from offering a scaffold to the most central teacher (the one using the Co-writer) to acting as group advisor, as the use of the "we" (line 9) indicates. We may infer that this change supports the shift from a reasoning spread through all the computers to a critical review of the ongoing work by rethinking and reconsidering the previous work.

Initially, the main semiotic resource for the interaction was the virtual space created by the Co-writer and used as a shared space available on each computer. In the second part of the excerpt, as a consequence of the acceleration of the pace, participants gathered around the computer where it was possible to introduce changes and initiate a face-to-face discussion, limiting the interactive space with their physical presence. It is the need to wrap up the ongoing activity and their awareness of a crucial point at stake—the whole sense of their activity—that allowed an Andante chronotope to come to life here.

Allegretto

On a few occasions, we found that the participation configuration around CoFFEE was particularly effective in speeding up the interaction. We came across an example at the start of the fourth session, when Mariangela was delegated to note down on the Co-writer the activities

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that were to be conducted in class with the students. While discussing this verbally, the teachers could also see the outcome of the discussion taking shape on the screen in real time. It was a situation during which the teachers were using various semiotic resources all at once: the ideas and contributions emerging from verbal discussion; the notes Mariangela was writing down on the Co-writer, which worked as a sort of re-elaboration of what they were discussing verbally; and the personal notes some of them had written down on a sheet of paper. Although each of them was facing their own computer, they were all connected, both through the Co-writer (all of them could see what Mariangela was writing) and through the verbal discussion about what should be written there, with Mariangela in charge of writing. In Fig. 6, Loretta (indicated by the arrow) is reading from her own computer screen, while Mariangela (turned toward her) is updating the Co-writer by adding her colleagues' comments. Mariangela asks Loretta a question about a previous suggestion she has made, and Loretta answers with a generic assent. Only when Loretta reads on her screen what Mariangela has just typed, does she seem to really grasp the point. Therefore, the computer screen is working as an extra layer, besides the verbal discussion, sustaining a more efficient circulation of the information and helping the participants to understand each other's point of view.

Below we report the transcript of the few minutes concerning this episode.

EXCERPT 6. Combining on- and offline

```
1. Mariangela: here, let's do a (0.5) what do you predict:: (0.5)
2. Loretta what were you saying?
      ((she is turning towards Loretta, see figure 6))
3. Loretta: no (.) it's OK (.) survey of students' needs and their
4. expectations::
5. Mariangela: without se[parating them
6. Loretta:               [aah! (.)
      ((she suddenly turns towards Mariangela, see figure 7))
7. Mariangela: so what do you predict
```

At the outset of this excerpt, Mariangela is trying to really understand Loretta's point of view. In fact, Loretta had made a comment a few minutes earlier, and Mariangela is now attempting to type in that comment. To make sure she has understood what Loretta wanted to say, she asks Loretta for further clarification (line 2). Loretta does not really get Mariangela's question, so she replies repeating the concepts she previously stated (lines 3

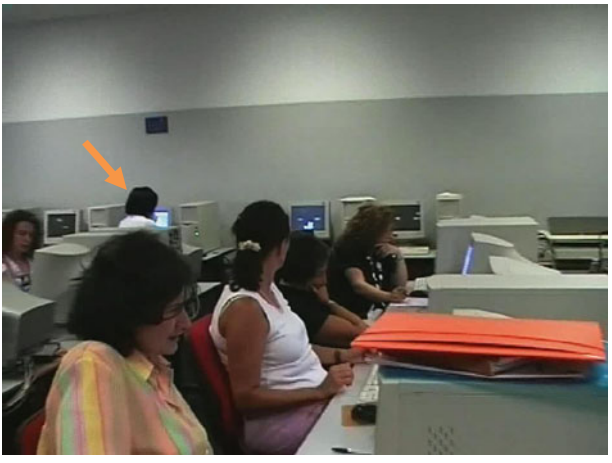

Fig. 6 Mariangela turns to Loretta

and 4), misinterpreting the question which is not about the contents—students' survey and their expectations—but it was rather about how she thinks these contents are related to each other. It is only when she sees what Mariangela writes that she understands the real meaning of the question. At that point, she suddenly turns toward Mariangela and she exclaims "aah!" (line 6). By turning from her computer screen toward Mariangela, she locks eyes with Mariangela who, in turn, has already been trying to make eye contact with her (Fig. 6). At this point, the space of discussion is enlarged: It no longer includes only the Co-writer plus verbal communication, but also nonverbal communication. This new enlarged space is crucial to clarify what is going on in the virtual space of the Co-writer. A symbolic link can be traced between Loretta's remark (lines 3 and 4), the notes Mariangela is reporting with the Co-writer, and the verbal and nonverbal interaction between the two of them. Within this space, a new type of collaboration is activated, marked by the effort to really understand each other's point of view. This type of collaboration is oriented toward the construction of what some authors call intersubjectivity (Ligorio et al. 2008; Matusov 2001). In this case, it is joined by a rapid integration of the multiple communication channels in use at the moment.

In this participation configuration, the tempo of the activity and interaction is very quick. This is possible because of the sharing in real time both within and outside the computer. In fact, although the teachers are sitting apart, they share the same text. They see in real time the various entries and changes made by the person who is writing on behalf of the entire group. In this way, reading the text becomes a collective activity that blurs the distinction between reading and writing—comments made while reading are transformed into notes for the Co-writer—as well as between virtual and face-to-face space (Fig. 7). Q5

The episode we just commented on is also an interesting case of technology strongly affecting the tempo of the interaction. This influence does not depend so much on the intrinsic features of our software or of the tool used at that time (the Co-writer), but rather on the peculiar interweaving between the affordance of the tool and the specific situation. In fact, "a technology gets its form and meaning in interaction, and its influence on human behaviour is not fixed or stable" (Overdijk and Van Diggelen 2008). In our case, the aim permeating the situation—designing an effective pedagogical scenario for the students—is guiding the way that the tools are used, integrating and empowering face-to-face interaction. The Co-writer was not merely a tool with which to write a summary; it also

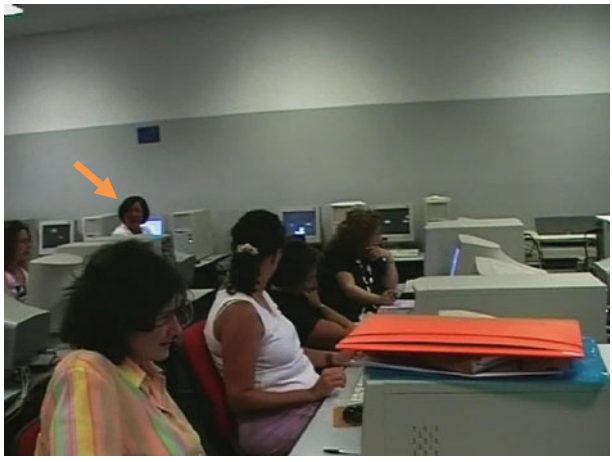

Fig. 7 Loretta has understood

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acted as an important semiotic resource with which to define and develop the participants' contributions to the discussion. The emerging gap between the individual reading and the collective discussion on what has been written opens new collaborative spaces within the group of teachers. Therefore, the Allegretto chronotope is characterised by a quick appearance, by merging several symbolic resources, and by bridging individual and collective thinking in a very rapid tempo.

Conclusions

The analyses presented here enabled us to investigate how the time and space of a computer-mediated training activity are co-constructed by the participants in the activity, and managed and coordinated while it is in progress. We analysed a group of 10 teachers who attended 6 training sessions to familiarise themselves with a software suite designed to support face-to-face interactions. The main scope of these sessions was to jointly design a pedagogical scenario to be used at a later time with their students, as an aid to educational and career guidance. During our analysis of the interactions, we identified three different types of space-time configuration, each with its own tempo and speed. We have summarised them in Table 1.

Of course, each one of these chronotopes conveys much more information than that reported in this table. In fact, we borrow the musical metaphor only to focus the aspects we

t1.1 **Table 1** Synopsis of the three chronotopes

t1.2 Chronotopes	Adagio	Andante	Allegretto
t1.3 Main features	- Activities perceived as complex	- Activities perceived as complex	- Activities perceived as simple
t1.4	- Possible inexperience (new tools or new activities)	- Possible inexperience	- Expert participants
t1.5	- Inefficient participation configuration	- Flexible configuration of participation	- Efficient configuration of participation
t1.6	- No time restriction	- Not much time available	- Not much time available
t1.7	- Need to explore semiotic resources	- Familiar semiotic resources	- Well-known semiotic resources
t1.8 Possible results	- Slow flow of action	- Acceleration of the action flow	- Fast flow of action
t1.9	- Deep reflection	- Shallow reflection	- Effective and fast solution/aims reached
t1.10	- Wide exploration of the context	- Concentration on a few conceptual/contextual elements	- Becoming competent in interacting with the context
t1.11	- Changes in the activity performed or new activities proposed	- Appropriation of new context or new activities or new configuration of participation	- Collaboration as a means for an intersubjective understanding of each other's points of view by integrating multiple communication tools
t1.12	- Collaboration as a means to monitor coherence in the activity	- Collaboration as a means to gather an overview of the activities and a holistic meaning	

found useful in exploring the time-space co-construction, such as: a) the depth and the size of the space of interaction, b) the features of the chosen tools and the technical skills of the participants when using them, c) how participants move around the computer and within the digital space, d) the objectives of the activity in connection with the skills that the participants used to achieve them, e) the capability of each participant to use material and symbolic recourses as well as the other participants. These aspects can merge in different ways, generating specific chronotopes.

Adagio is a chronotope in which the exploration and manipulation of the available physical and symbolic spaces tends to be slow and highly focused on the here and now. This happens for various reasons. First, it may be that the management of some symbolic spaces—such as that generated by the graphical tool—requires an in-depth reflection on both the purely technical aspects and the cognitive aspects. Second, the slowness can be explained by the degree of accuracy that the participants wish to reach in achieving their objective and by its intrinsic complexity. Obviously, a lack of computer skills also slows down the tempo. The selected channel of communication seems to have an individual character, making the interaction between the participants highly marginal and instrumental vis-à-vis the individual activity.

Andante is a chronotope where the participation configuration is characterized by an acceleration. This acceleration occurs as a consequence of participants' perception of the need to improve the efficacy of the interaction. Most of the resources available are felt as new and unexplored, therefore, the interaction follows a close weave that enables participants to move from wide spaces—the workgroup as a whole—to smaller ones—a specific computer screen and a specific piece of information displayed in it.

Allegretto identifies a chronotope with a particularly quick-paced participation configuration that enables a given task to be carried out in a relatively short time. The technology provides symbolic spaces where participants see their ideas obtaining a "body", which can be easily and quickly shaped and changed. The simultaneous presence of different channels of communication results in a high level of interactivity, producing a sort of transfer from one channel to another: for example, what is written on the computer screen is read out loud, generating new resources that lead to changes and adjustments of the products "in" the computer.

These three mechanisms for managing the tempo of participation depend on the process of appropriation of the various new elements introduced by an activity such as this: the use of a software suite, the collaborative planning of a scenario, and the presence of a researcher. By looking in details in each chronotope, we also found that different types of collaboration are taking placing among the participants. In fact, chronotopes are not given—neither by the tools nor by the situation. They seem to be collaboratively built on the site, taking into account many dimensions, including the technological settings, the situated aims, and participants' intentions and knowledge. To date, our analysis does not enable us to establish whether the frequency of the three configurations changed during the sessions: This would require a diachronic analysis of the available data, which would be excessively long. However, we will certainly look into this in the future. In any case, we can confidently assert that the chronotopic analysis revealed some crucial elements of the construction of different symbolic space-times where different types of computer-supported collaboration are possible and where different types of bridges between individuals and the group can be found.

Regarding the chronotopes, we still analysed other interesting features relevant for an in-depth understanding of space-time management. A future space-time—the classroom at the time when the scenario will be applied with the students—is constantly included. By

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definition, planning concerns an activity that will take place in a different space and time. Therefore, chronotopes can be analysed at two intertwining levels: First, the movements of the participants through the physical and symbolic spaces in the here and now of the interaction, and second, their symbolic projections into the past and the future, often made through verbal implicit and explicit references.

Indeed, during some of the analysed interactions, the participants sometimes projected themselves into the past, remembering relevant events, and sometimes into the future, imagining the events they were planning. Thus, chronotopes do not strictly concern the interaction as it happens, but also possible future and past worlds. Therefore, the space-time of the imagined future activity and the recalled past activity interweave with the present space-time.

Moreover, the inseparable bond between time and space creates symbolic spaces and resources that enrich interaction. Consequently, the representation of the group work that emerges is filled with a series of technical and psychosocial skills, enabling the management of complex, diversified interactions within which the computer becomes a true cognitive partner that helps to establish the tempo and opens up new thinking spaces. This boosts reflection on the activity in progress and improves planning skills; in other words, the "here and now" of a group activity involving teachers becomes a junction between past experiences and imagined events in the future.

From this perspective, and to stay with our musical theme, the teacher can be looked upon as an orchestra conductor. She prepares the instruments, gets to know the soloists, consistently and skilfully manages the tempos and spaces of the interaction, and at the same time allows space for improvisation suggested by what is going on "right now" and "right there". She is aware that the real music is found in the harmony of the whole and not in the production of individual sounds.

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AUTHOR QUERIES

AUTHOR PLEASE ANSWER ALL QUERIES.

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Q2. 'Kirsch (1995)' is cited in text but not given in the reference list. Please provide details in the list or delete the citation from the text.
Q3. 'Foucault 2006' is cited in text but not given in the reference list. Please provide details in the list or delete the citation from the text.
Q4. A citation to Figs. 2 and 3 was inserted here so that figure citations are in sequential order. Please check if appropriate.
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