HELDA
HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

UNIVERSITY OF HELSINKI

https://helda.helsinki.fi

Using chronotope to research the space-time relations of learningand education: Dimensions of the unit of analysis

Ritella, Giuseppe

2021-12

Ritella , G , Rajala , A & Renshaw , P 2021 , ' Using chronotope to research the space-time relations of learningand education: Dimensions of the unit of analysis ' , Learning, Culture and Social Interaction , vol. 31 , 100381 . https://doi.org/10.1016/j.lcsi.2020.100381

http://hdl.handle.net/10138/338743
https://doi.org/10.1016/j.lcsi.2020.100381

cc_by
publishedVersion

Downloaded from Helda, University of Helsinki institutional repository.

This is an electronic reprint of the original article.

This reprint may differ from the original in pagination and typographic detail.

Please cite the original version.

Learning, Culture and Social Interaction 31 (2021) 100381

Contents lists available at ScienceDirect

Learning, Culture and Social Interaction

journal homepage: www.elsevier.com/locate/lcsi

Using chronotope to research the space-time relations of learning and education: Dimensions of the unit of analysis

Giuseppe Ritella [a,*], Antti Rajala [a], Peter Renshaw [b]

[a] Faculty of Educational Science, P.O. Box 9, 00014, University of Helsinki, Finland
[b] School of Education, St Lucia Campus, The University of Queensland, 4072, Australia

ARTICLE INFO

Keywords:
Chronotope
Unit of analysis
Dialogism
Space-time

ABSTRACT

In this paper, we examine the emergent concept of chronotope and its deployment for the examination of space-time relations in research on learning and education. Chronotopes have been defined in terms of socially emergent configurations of space-time, where space and time are considered as interdependent social constructions. Chronotope is seen as a conceptual and analytical tool that allows reaching a sociocultural and dialogical understanding of human action and interaction in space-time. We argue that the existing chronotopic research has not been sufficiently explicit concerning how units of analysis are selected and conceptualized. To facilitate a wider adoption of this concept, we introduce and discuss four dimensions of chronotopic units of analysis (foregrounding processes, dialogicality, material-discursive features of space-time, and interdependency of space-time). We illustrate these dimensions by discussing how they were implicitly or explicitly included in the conceptualization of the unit of analysis in exemplary studies. In particular, we show how including one or more of these dimensions enabled to make "visible" educationally relevant phenomena and to discuss significant aspects of pedagogical practice. In all, our article contributes to make explicit and discuss the methodological foundations for using chronotope to research the space-time relations of learning.

1. Introduction

Selecting and conceptualizing the unit of analysis is a crucial step for research because it defines the boundaries between what is considered or ignored by the research, making some things visible and others impossible to see (Hutchins, 2010; Säljö, 2009). Units of analysis are usually intended as the fundamental objects or processes to be described and interpreted in research (Wertsch, 1995). Some scholars distinguish units of analysis from units of data (Toiviainen, 2003). While the latter is a pragmatic-technical construction that defines how data are segmented for the analysis, the former addresses the theoretical-methodological framing through which objects or processes are examined in the research process. In this paper, the emphasis is on the theoretical-methodological understanding of units of analysis in research adopting the concept of chronotope.

Chronotopes in research on learning and education have been defined as socially emergent configurations of space-time, where space and time are considered as interdependent social constructions (see Bakhtin, 1981). Although the literature is not extensive, chronotopic analysis is contributing to research on a growing range of educationally relevant topics. For example, Ritella, Ligorio, and Hakkarainen (2017), in a study of a media design project course, "made visible" the students' assumptions about the space-time of the

* Corresponding author.
E-mail addresses: giuseppe.ritella@helsinki.fi (G. Ritella), antti.rajala@helsinki.fi (A. Rajala), p.renshaw@uq.edu.au (P. Renshaw).

https://doi.org/10.1016/j.lcsi.2020.100381
Received 15 August 2018; Received in revised form 18 October 2019; Accepted 17 January 2020
Available online 28 January 2020
2210-6561/© 2020 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

learning activity and how this influenced their interpretation of the task. The chronotopic analysis focused on instances when the students negotiated their interpretations of the task, inferring the normative space-times (space-time as should be) and possible space-times (space-time as could be) associated with each instance of task interpretation. The students' assumptions about the space-time of the pedagogical activity contributed to how they decided which "version" of the task they should accomplish. We and others have been using the concept of chronotope also to examine teachers' allocation of classroom time to different students in response to testing arrangements (Renshaw, 2014), learning across multiple online and offline contexts (Kumpulainen, Mikkola, & Jaatinen, 2014), the process of educational diagnosis (Davies, 2015), learners' identity development (Ligorio, Loperfido, & Sansone, 2013), the exploration and appropriation of educational technology (Ritella, Ligorio, & Hakkarainen, 2016), and emergent opportunities for literacy learning in classroom interactions (Bloome, Beierle, Grigorenko, & Goldman, 2009).

While chronotope is being deployed to re-examine these different aspects of space-time relations in educational research, attempts to systematize its usage for empirical research and develop its methodological basis are still underdeveloped. In particular, the problem of conceptualizing units of analysis in chronotopic research has not been explicitly addressed in the literature. The issue at stake is not just to select the units of analysis, but to conceptualize them according to the theoretical framework of the research. Indeed, as argued by Säljö (2009) the definition of a unit of analysis corresponds to selecting a conceptualization of a phenomenon that corresponds to a theoretical perspective or framework. If we adopt a dialogical theory of identity, for example, our conception of the individual will be radically different from a study that adopted a neuro-cognitive approach. Thus, two studies could use the same label to name very different units, and thus make visible different things. A general point here is that what is considered as an appropriate unit of analysis connects tightly to the theoretical perspective adopted in a given research project (Säljö, 2009), as well as to the research purpose and the conditions posed by the research site of each study (Matusov, 2007). The existing studies on chronotope, including our own, seldom make their conceptualization of the unit of analysis fully explicit, so it is often difficult to grasp how chronotope helps researchers to "make visible" new phenomena related to learning and education. Some studies (e.g. White, 2014) implicitly consider chronotope as a unit of analysis in itself, while others (e.g., Ritella, 2018) claim that multiple units of analysis can be used in chronotopic research. We believe that an explicit discussion concerning the units of analysis used in chronotopic research might contribute to clarify the value of the notion and facilitate a wider adoption of the concept.

We argue that using the concept of chronotope implies an analytical interest in examining space-time frames. However, in itself chronotope does not provide a clear answer to the question: what are the units (entities or processes) to be examined by chronotopic research? Depending on the specific research interest of each study the answer to this question might differ, so that different dimensions might be foregrounded in each investigation. Furthermore, we argue that the existing empirical research has not been sufficiently explicit concerning how units of analysis are selected and conceptualized in chronotopic research. To facilitate a wider adoption of this emerging concept, in this article, we introduce and discuss four dimensions of chronotopic units of analysis (foregrounding processes, dialogicality, material-discursive features of space-time, and interdependency of space-time). We illustrate these dimensions, by discussing how they were implicitly or explicitly included in the conceptualization of the unit of analysis in exemplary studies. In particular, we show how including one or more of these dimensions in the conceptualization of unit of analysis enabled the authors of these studies to make "visible" a range of educationally relevant phenomena and to discuss significant aspects of pedagogical practice.

In sum, building on the idea that units of analysis define what is made visible and invisible in a research study (Hutchins, 2010), we address the following question: How does the theoretical conceptualization of the units of chronotopic analysis contribute to make educationally relevant phenomena visible? In Section 2, we will briefly introduce the notion of chronotope. In Section 3, through a discussion of empirical examples taken from published studies, we show that these dimensions enable to shed light on some educationally relevant phenomena related to space-time relations. Finally, in Section 4, we will draw our conclusions.

2. Introduction to the concept of chronotope

Chronotope was initially devised by Bakhtin for the examination of the space-time frames of literary texts. The typical configurations of space-time expressed in a novel, Bakhtin (1981, 1986) argued, shape the meanings of the novel and contribute to specifying identity development and the scope for agency of the protagonists. One crucial insight that emerged from Bakhtin's analysis of Dostojevski's complex psychological novels was the openness and unfinalizability of experience across space and time. Chronotope, in line with Bakhtin's conceptualization of "voice" and "dialogicality", seeks to address the responsivity, anticipation and multivocality inherent in human action and interaction that is not bound to the current situation.

The intended scope of chronotope for Bakhtin was broader than analysis of literature, pointing to the establishment of a cultural analysis of space-time in everyday life (Bakhtin, 1981; Holquist, 1982). People rely on the concepts of space and time in their daily lives, when arranging objects on their desks, arranging dates and meetings by means of calendars and clocks and so on. Thus, space and time cannot be considered only as scientific concepts in physics. A conception of space-time is required that goes beyond physical phenomena. Newton's absolute space, or Einstein's spacetime are not sufficient nor appropriate to explain how students and teachers frame space-time during a learning activity, nor why they bodily enact institutionally prescribed configurations in space and time (e.g., sitting every day at the same desk). Spatial-temporal features are central in educational episodes and activities: the episode or event involves actions and interactions occurring between protagonists in some order, in certain places and at a certain time (a moment, an hour, day, week, year, or era). Furthermore, different culturally mediated ways of conceiving space and time are imbued with meanings and values (van Eijck & Roth, 2010). In this sense, chronotope can be seen as an analytical tool explicating the variety of ways in which the relation of people and events in their worlds can be understood (Morson & Emerson, 1990).

However, Bakhtin provided only brief sketches of how the concept could be applied in domains other than literature. The

translation of the concept in educational research is still an ongoing task, which requires both theoretical and methodological reflections. To accomplish the translation of the concept, it is possible to build on Bakhtin's point that the chronotopes identified in literary texts can be considered as the artistic elaboration of the experiences of space-time that people make in everyday life, which can be either actual or imagined (Vadeboncoeur, 2005). Following this line of thought, an (educational) event or experience obtains its meaningfulness by how it structures and is structured in and by space-time.

The concept of chronotope enables one to examine a range of issues relevant for research on learning and education, for example, how different ways of framing space-time relations in educational situations are implicated in pedagogical and curriculum processes, learning outcomes, and identities. Each research study foregrounds different features of space-time relations according to the specific focus of each study, thus conceptualizing the units of analysis in different ways. Nevertheless, we have identified four (implicit) dimensions of the units of analysis that have been fruitful for making visible educationally relevant phenomena in chronotopic research. Our work is not meant as a normative, definitive list, but as an attempt to make explicit how the conceptualization of units of analysis in chronotopic research might contribute to show the value of this notion.

3. Specifying and conceptualizing unit of chronotopic analysis in educational research: four dimensions

In this section, we summarize the four dimensions that we identified, discussing their theoretical grounding and their relevance for the selection and conceptualization of units of analysis in chronotopic research. In each subsection, we briefly discuss one dimension using illustrative examples taken from our own studies and from other empirical investigations using this concept. One problem we faced in our reading of the previous research was that scientific reports typically do not explicitly specify the unit of analysis. Thus, our discussion should be considered as a post-hoc reconstruction of how – in our interpretation – the units of analysis have been conceptualized in the original studies used as examples. The dimensions can be summarized as follows:

I. foregrounding processes;
II. foregrounding dialogical nature of human activity;
III. foregrounding material organization and discursive negotiation of space and time; and
IV. foregrounding interdependent unity of space-time.

3.1. First dimension: foregrounding processes rather than entities

This dimension is grounded in dialogical and sociocultural theoretical traditions, where processes rather than entities have been considered as units of analysis. Lemke (2000), for example, suggested that "things", "organisms", "persons" and "institutions" are static notions if not conceived in terms of the relational processes in which they are involved. This argument is based on the processual ontological stance of dialogical and sociocultural research, which considers reality, not as constituted by permanent substances, but by emerging formations that are considered as the ever-changing product of relations. Wertsch suggested that the roots of this conceptualizations can be found in the writings of Bakhtin, Vygotsky, Leont'ev, Bourdieu, Burke, Dewey, Habermas, Mead and others, who all focus on "concrete, dynamic human action existing in real spatiotemporal and social contexts." (Wertsch, 1995, p. 62) Bakhtin (1986), indeed, emphasized that all social and psychological phenomena are processual in nature (Morson & Emerson, 1990). Accordingly, chronotopic investigations tend to foreground the processual dimension, and thus have been focusing on lived experiences or concrete events. These have been examined in terms of the chronotopic dynamics through which people interpret and arrange space-time of their lives and their activities and are simultaneously being constrained and enabled by the emerging space-time configurations in their activity and meaning making.

This processual dimension of chronotopic analysis is well exemplified in Leander's (2001) study that examined the production of time-space representations and associated student identities in pedagogical discourse during a school field-trip. Drawing on the concept of chronotope, the study showed how multiple past, present and imagined future time-spaces were invoked in the participants' moment-to-moment discourse. Through an in-depth examination of teachers', parents' and students' discourse, Leander "made visible" the different discursive framings of space-time that had significant implications for student's identity, agency, and power. We foreground from Leander's complex analysis one excerpt that exemplifies how the processual nature of the unit of analysis shed a new light on the interconnection between the construction of hybrid space-time frames and the students' identity, agency and power as they are voiced in discourse. In the excerpt, Leander analyses the talk taking place on the bus during the school trip. In order to trace the "hybridization of space-time", he segments the discourse based on the occurrence of shifts in space-time. For example, when the content shifts from the space-time of a personal narrative taking place many years before to the space-time of the meeting with a reverend during the current school trip, Leander detects a new segment of discourse. The first step of the analysis reveals how the meaning that Vicki (a parent) is conveying to the children arises from the hybridization of space-time. Indeed, Vicky alternatively juxtaposed the invocation of the moment of Martin Luther King, Jr.'s assassination to a series of different space-times such as the group meeting with a reverend during the trip, to receiving a photograph of that meeting in the future, etc. There is one particular moment that shows how the unfolding meaning of her discourse is strictly connected to the hybridization of space-times:

> "Now, what are you going to do about a neighbor who's suffering?… I think you all have a big job to do when you come back. You all are now a club, or an organization - I don't know what you call yourselves, but do something now to organize, and we'll

> be there to help you -1 mean I'll come over and do whatever I can do, and, I'll help you figure out how to organize yourself, even if it's only about your own personal change … I want/all to re-sing what y'all were singing when we were marching, because this is our freedom bus going home right now? And it's up to you all to get off this bus and let people know what this trip was about."
>
> (Leander, 2001, p. 655)

Leander suggests that Vicki's claim "This is our freedom bus going home right now" indexes the production of a hybridized space-time grounding, in which "freedom bus," "home," and "right now" assume meanings that are constructed across the multiple embodied and symbolic activities that are invoked. The rapid articulation and repetition of space-time representations in discourse positions participants across the (space-time) situations, rather than within each invoked space-time in isolation. The journey to a future "home," a symbolic space that signifies political change and personal sacrifice, is hybridized across 1961 and 1998 space-times. In this way, Vicki positions the students as active citizens having agency and power to make a difference in the larger society. Vicki's discourse is contrasted with the teacher's discourse (Debbie), which places the students within the time-space of school and accordingly positioned them in terms of clearly demarcated identities defined with respect to failure or success in school. Thus, Leander argues that the way in which teachers and parents frame space-time and the way in which they position the students in discourse are strictly interwoven. In other words, issues related to identity, power and agency are expressed in discourse exactly through the hybridization of space-times.

The unit of analysis of this study was not explicitly specified, but examining the text, we infer that the unit of analysis is conceptualized as "the act of (discursive) production and hybridization of space-time." We use this phrase to capture how the author identified segments of discourse where space-time was blended and hybridized in the process of positioning students in different ways. The analytical interest is on the process through which space-time is co-constructed, which has - the author argues - significant implications for student identity, agency, and power. If the author had considered each space-time invoked in discourse as a given reality, for example counting the occurrence of the invoked space-times, or measuring the co-occurrence between each single space-time invoked and units of meaning emergent from discourse, the process through which these space-times were actively merged with one another to express novel meanings, as Vicki did in the quoted excerpt, would have been invisible. In this sense, we argue that the author has fruitfully adopted a unit of analysis that foregrounded discursive processes and allowed a deeper understanding of the role that space-time frames can play in educational discourse.

3.2. *Second dimension: foregrounding the dialogical nature of learning and education*

This dimension is grounded in Bakhtin's dialogical theory, which constitutes the basis of chronotopic research. In this theory, dialogical relations are posited to permeate every manifestation of human life and activity (see e.g., Bakhtin, 1984). A dialogical analysis typically focuses on dynamic systems of relations between multiple interdependent and interacting properties that are irreducible to each other (Salgado & Clegg, 2011, p. 430). In this perspective, systems are not seen as static and deterministic but in the process of formation as well as subject to contestation and change. Thus, a dialogical analysis attends to the presence of multiple perspectives and often foregrounds tensions, conflicts, disagreements, and discrepancies between perspectives, evaluations and accounts (Linell, 2009). In a Bakhtinian perspective, the human condition is inherently characterized by non-coincidence of stance, understanding, and consciousness (see also Daniels, 2001). In a dialogic analysis generally, and chronotopic analysis specifically, the formation of order is considered an accomplishment that requires explanation and justification whereas disorder is considered a natural state of affairs that does not need to be explained (Morson & Emerson, 1990).

As argued above, different conceptualizations of the same unit of chronotopic analysis can provide different opportunities to address dialogicality. Two studies from an ethnographic research project that examined primary school students' technology-mediated collaborative writing of a musical script provide illuminating contrasting examples on the matter. In both of the studies, according to our interpretation, the unit of analysis was the students' collaborative writing activity, but depending on the authors' different research questions, it was conceptualized in a slightly different way, foregrounding different dimensions.

Kumpulainen et al. (2014) used time stamps metadata of the students' chat contributions as a unit of data to make inferences about the collaborative writing activity. In particular, they used descriptive statistics to conduct a quantitative analysis of how the students' collaborative writing activity was distributed across settings and time. In addition, a content analysis of students' questionnaire responses provided information about the students' views and values regarding the writing activity. The findings of this research are interesting as they foreground important aspects related to the process of collaborative writing, showing that emergent blended practices of writing appeared to break away from traditional learning practices. The ubiquitous and wireless connectivity provided the students with opportunities for long-term intellectual development and creative participation in the collaborative activity, leading to a ubiquitous, multimodal, and multidimensional, technology-mediated creative learning process.

In a later analysis, Kumpulainen and Rajala (2017) examined the students' chat interactions in the same project. Here, the unit of analysis was again the collaborative writing activity but it was conceptualized differently. In particular, the activity was conceptualized in terms of three spheres of activity (i.e., the institutional, relational and personal spheres) to which focal events were dialogically related. This conceptualization attended to the presence of multiple perspectives and accounts as well as tensions and conflicts between them, foregrounding especially the dialogical dimension. The discourse analysis focused on each of the three spheres of activity to examine how the students created meanings, social relationships and other accomplishments in their interaction. For example, in relation to the institutional sphere of activity, the analysis of the chat interactions showed that the flow of the students' collaborative writing activity across different times and settings was not always seamless. Instead, it was characterized by a number of

tensions and value conflicts that the students had to navigate and negotiate, which emerged when their activity moved across different formal and informal contexts characterized by diverse rhythms, rules, and spatial constraints. The study also attended to what Bakhtin calls heterochrony referring to the possibility of multiple simultaneous space-time frames (i.e., of school and of home) that are in play in a given situation Overall, the findings of the study shed light on the complexity and dynamic nature of the students' activity that was dialogically related to different layers and time-space contexts. This complex dialogicality was not made visible in the first study that used a different conceptualization of the collaborative writing activity as the unit of analysis, foregrounding other dimensions of analysis such as the unity of space and time (see Section 3.4) and the processual nature of writing (Section 3.1).

The way in which the latter exemplary study foregrounded the dialogical nature learning allowed to "make visible" further phenomena in the data. Through examination of how different chronotopic relations come into contact, compete and form dialogic relations with each other in ongoing social interaction it is possible to show how varying opportunities and tensions are created for engagement, learning and identity (Kumpulainen & Rajala, 2017; Brown & Renshaw, 2006; White, 2014; Leander, 2001; see also, Morson & Emerson, 1990).

3.3. Third dimension: foregrounding the material organization and the discursive negotiation of space and time

This twofold dimension is grounded in the premise that – according to a dialogical understanding – the representational (textual) and the material (embodied) world operate relationally and indexically (Leander, Phillips, & Taylor, 2010). Accordingly, chronotope has been used to conceptualize space-time considering both discursive and material aspects of space-time relations. Space and time are often considered as social constructions negotiated in dialogical interaction (see Section 3.2 of this article), but in many chronotopic studies material relations are not be obliterated from the analytic focus.

An example, where the unit of analysis was conceptualized to include both the poles of this dimension is the study by Ritella et al. (2016) who examined the exploration of the environment and the use of different material and semiotic tools, such as an educational software suite, by a group of teachers learning an educational software suite. As a unit of analysis, the authors of this study identified the "exploration events." According to this study, some features of these events are crucial for collaborative problem solving. One prototypical event was discussed in-depth to show how specific features of collective explorative events were crucial for a fruitful reframing of the problem-space and allowed to advance the solution of the collaborative problem-solving task. The authors did not limit the analytic focus to the examination of discourse, but also analyzed bodily positions, gaze, gestures, the use of available virtual and material tools, etc. For example, the study found that by changing the position in the physical space (moving away from the computer where a concept map was visualized), and by increasing physical closeness with her colleagues, a participant re-framed the (semiotic) problem space, exploring it from a different perspective. This coordinated movement of the body and the discourse enabled a more in-depth understanding of the problem. Such collaboration resembles instances of "exploratory talk" (Mercer & Wegerif, 1999; Wegerif, 1996), as participants engaged critically and constructively with each other's ideas to advance the creation of knowledge. The analysis of exploratory talk serves well for a comparison because it also was developed within the dialogical framework and it was developed to label a type of talk having high potential for learning. What the chronotopic analysis was able to foreground in this study is consideration of the space-time of the learning context in its physical, social and virtual dimensions. In other words, the study made visible that the coordination between 1) the exploration of ideas and 2) the exploration of the virtual, social and physical space-time context, is fruitful to advance problem-solving processes. Adopting a chronotopic perspective, future research might show - for example - that some ways of exploring the different tools available in the context might be associated with more fruitful exploration of ideas compared to other ones (for a further discussion of this study see also Ritella, 2018). In this way, including both discursive and material analysis of space-time relations "makes visible" the intricate interactions between the material positioning of body and tools, and discursive processes such as exploratory talk. These aspects of space-time relations are invisible when the unit of analysis overlooks material relations.

3.4. Fourth dimension: foregounding the interdependent unity of time and space

A foundational insight of Bakhtin (1981, 1986), which constitutes the ground of this dimension, was that space and time are interdependent social constructions which should be studied as an integrated whole. As argued by Ritella (2018), at the theoretical level such interdependence should be considered in terms of potentiality. It is possible that in some situations learners might spatially arrange some documents on their desks to successfully speed up the accomplishment of a task (occurrence of interdependence of space and time in terms of duration) but it is also possible that some changes of the spatial organization of the objects on a desk might not have any effect on the temporal development of the activity (occurrence of independence of space and time). The theoretical claim, often implicit in studies using chronotope, is that interdependence is possible, at least under some conditions. Therefore, research on space-time typically considers the possibility of interdependency, and adopts units of analysis that can make such interdependence "visible." The argument here is that at least some of the units of analysis devised in chronotopic research have been enabling us to identify the interdependence of space-time which might occur in the local sites of investigation.

Ligorio and Ritella (2010) analyzed how participants in an in service teacher training program used their bodies to enact a multiplicity of arrangements of virtual-physical-social space-times associated with qualitatively different learning processes: some configurations were associated with in-depth reflection, others with quick task completion, others with effective collaboration realized through the flexible use of the virtual space. Pace was shown to be an indicator of qualitatively different interrelations between time and virtual/physical space. In this study, the authors detected the so called "changes of scene" (the unit of data of the study), that is, moments when the space-time arrangement was transformed through embodied movements across physical, symbolic and virtual

spaces. While the change of scene allowed the segmentation of the data in a useful way, the actual focus of the researchers was on examining a specific type of human action that Ritella (2018) labelled as "enactment of space-time." The ontological assumption here was that a unitary process exists through which people create space-time arrangements, which in turn have implications for the learning process. This study is in line with the action approach proposed by Wertsch (1995) of specifying human action as the unit of analysis. However, the specific analytic interest of the research required a more specific unit of analysis than the general one of "human action." This process of enactment of space-time (considered as a specific type of embodied action), therefore, was considered as the unit of analysis.

This study is enlightening for discussing the interdependency between space and time. Indeed, specifying a unit of analysis sensitive to both space and time in a coordinated way revealed how spatial relations could have an impact on temporal relations, and vice-versa. In particular, the researchers identified one specific configuration of space-time enactment that they called "andante." A specific feature of this configuration was that of an acceleration of the action flow that was often accomplished by changing the spatial positions of the bodies around the computer and in relation to the other participants, and/or by reorganizing the virtual objects visible on the computer screen. The authors present an in-depth analysis of one instance of this type of space-time enactment when time constraints pushed the participants to find novel ways to organize the space of their collaboration, and in turn the new organization of space allowed a faster flow of action. In the described interaction, the participants were planning a sequence of activities to be carried out later with their students. Initially, each participant was individually sitting in front of a computer. Each of them was reading the list of activities in real time, while one of them—Loretta—was updating the list by using a collaborative writing tool. Each entry she made into the text was negotiated verbally, with the involvement of all the participants. However, the teachers realized that the negotiation was taking too long. Therefore, they gathered around the computer where Loretta was writing the text and initiated a face-to-face discussion, limiting the interactive space with their physical closeness. This new configuration seemed to be efficient for a quicker completion of the task which shifted from analyzing each entry of the list, to discussing the overall purpose of the pedagogical activity. This case shows well that further insights on learning processes can be gained by looking at the intersection between space and time. If the unit of analysis of this article would have been either the "enactment of space" or "the enactment of time", this kind of interdependence between space and time would have been invisible to the researchers.

4. Conclusions

The present article contributes to the discussion of the methodological foundations for using the emergent concept of chronotope to research learning and education from the perspective of space and time. It specifies and discusses four dimensions of analysis which were relevant for the selection and conceptualization of units of analysis in studies using chronotope. We have observed that many of the initial iterations of chronotopic analysis in research on learning and education, including our own, have been heuristic, and some authors even state explicitly that they use the concept more as a heuristic rather than a rigorous methodological tool (e.g. Rajala, Hilppö, Lipponen, & Kumpulainen, 2013). Furthermore, space-time frames work as an often implicit and invisible ground for activity (Morson & Emerson, 1990) that is not easy to observe, requiring sophisticated methods of analysis. This implies that the analysis is still largely explorative and unsystematic.

The dimensions that we outline in this paper are a first step toward a clearer definition of a chronotopic methodology. We derived the dimensions by examining how our own and others' investigations have been able to make visible educationally relevant phenomena related to space-time. We briefly discussed how each dimension is grounded in the dialogical tradition of theorizing and offer them as reflective tools that researchers might consider when selecting and conceptualizing units of analysis framed by the notion of chronotope. The chronotopic studies typically foreground one or two of these dimensions in an implicit way. Making the dimensions (and how they are addressed in the existing research) explicit, allowed us to advance understanding of what kind of educationally relevant phenomena chronotopic research is making "visible", and how the selection and conceptualization of units of analysis is contributing to this end. Each dimension, we argue, is well grounded in the dialogical theory of chronotope initiated by Bakhtin and allows generating further insights on the role that space-time relations play in learning and in educational processes and contexts.

The first and second dimensions, in different ways, emphasize that chronotopic research attempts at a dynamic understanding of space-time, as social constructions that are continuously negotiated and enacted by people. The analysis seeks to account for the dialectical and dialogical relations between the material world and the various discourses through which places become "lived entities" (van Eijck & Roth, 2010). This dialogical stance includes both a dynamic understanding of learning processes (dimension 1) and a focus on tensions, conflicts, disagreements, and discrepancies between perspectives, evaluations and accounts (dimension 2). Building on these two dimensions, we suggest an alternative wording might be used to foreground chronotope as processual and dialogic. Indeed, chronotope as a countable noun implies a reified understanding of space-time relations. Perhaps, phrases like chronotopic relations, or chronotopic dynamics or chronotopic development would contribute to a more appropriate framing of chronotopic research.

The discussion of the third dimension emphasizes specifically the interdependency between material and discursive processes. Given such ground, many scholars have used chronotope to investigate space-time at the boundary between material and discursive processes (e.g. Brown & Renshaw, 2006; Hirst & Vadeboncoeur, 2006; Ritella & Ligorio, 2016; van Eijck & Roth, 2010). in the studies mentioned above, the use of chronotope revealed the interconnectedness between material, social and semiotic aspects of space-time. However, it is possible to find studies using chronotope that prioritize the analysis of semiotic/social aspects of space-time relations and pay less attention to materiality (e.g., Ritella et al., 2017). Such studies are valuable, but our discussion of this dimension showed that further insights might arise when there is a holistic framing of research which integrates material, social and discursive aspects.

The discussion of the fourth dimension shows that we can gain further insights into educational practices if we conceptualize units

of analysis that permit the examination of space and time in their interdependent unity. Such unity of space and time is particularly relevant for contemporary learning, where the usually clear-cut spatial and temporal boundaries are often blurred, and persons can be present in multiple - virtual and physical - places at the same time, or they can engage in asynchronous communication, interacting with others located both in different places and in different times (Erstad, 2014; Leander et al., 2010).

We consider our effort as a starting point for discussion within the scientific community, rather than as the final word. Possibly further dimensions will emerge or these ones might be reframed and revised to advance our capacity to shed new light on space-time frames and their implications for learning and education.

Acknowledgments

The authors are grateful to the editors Crina Damşa and Alfredo Jornet Gil, the anonymous reviewers, as well as to Alessio Surian, for their valuable comments on previous versions of this article. Rajala wishes to thank the Academy of Finland project no. 299191 for the financial support for preparing this article.

References

Bakhtin, M. M. (1981). *The dialogic imagination. Four essays by M. M. Bakhtin*. Austin, TX: University of Texas Press.
Bakhtin, M. M. (1984). In C. Emerson (Ed.), *Problems of Dostoevsky's poetics*. Minneapolis, MA: University of Minnesota Press. Edited and translated by.
Bakhtin, M. M. (1986). In C. Emerson, & M. Holquist (Eds.), *Speech genres and other late essays*. Austin, TX: University of Texas Press.
Bloome, D., Beierle, M., Grigorenko, M., & Goldman, S. (2009). Learning over time: Uses of intercontextuality, collective memories, and classroom chronotopes in the construction of learning opportunities in a ninth-grade language arts classroom. *Language and Education, 23*(4), 313–334.
Brown, R., & Renshaw, P. (2006). Positioning students as actors and authors: A chronotopic analysis of collaborative learning activities. *Mind, Culture, and Activity, 13*, 247–259.
Daniels, H. (2001). *Vygotsky and pedagogy*. London: Routledge.
Davies, K. (2015). *The life and times of "Asperger"s syndrome': A Bakhtinian analysis of discourses and identities in sociocultural context*. Doctoral dissertation. University of Queensland.
Erstad, O. (2014). The expanded classroom–spatial relations in classroom practices using ICT. *Nordic Journal of Digital Literacy, 1*(1), 8–22.
Hirst, E., & Vadeboncoeur, J. A. (2006). Patrolling the borders of otherness: Dis/placed identity positions for teachers and students in schooled spaces. *Mind, Culture, and Activity, 13*(3), 205–227.
Holquist, M. (1982). Bakhtin and Rabelais: Theory as praxis. *Boundary, 2*, 5–19.
Hutchins, E. (2010). Cognitive ecology. *Topics in Cognitive Science, 2*(4), 705–715.
Kumpulainen, K., Mikkola, A., & Jaatinen, A. M. (2014). The chronotopes of technology-mediated creative learning practices in an elementary school community. *Learning, Media and Technology, 39*(1), 53–74.
Kumpulainen, K., & Rajala, A. (2017). Negotiating time-space contexts in students' technology-mediated interaction during a collaborative learning activity. *International Journal of Educational Research, 84*, 90–99.
Leander, K. M. (2001). "This is our freedom bus going home right now": Producing and hybridizing space-time contexts in pedagogical discourse. *Journal of Literacy Research, 33*(4), 637–679.
Leander, K. M., Phillips, N. C., & Taylor, K. H. (2010). The changing social spaces of learning: Mapping new mobilities. *Review of Research in Education, 34*(1), 329–394.
Lemke, J. L. (2000). Across the scales of time: Artifacts, activities, and meanings in ecosocial systems. *Mind, Culture, and Activity, 7*(4), 273–290.
Ligorio, M. B., Loperfido, F. F., & Sansone, N. (2013). Dialogical positions as a method of understanding identity trajectories in a collaborative blended university course. *International Journal of Computer-Supported Collaborative Learning, 8*(3), 351–367.
Ligorio, M. B., & Ritella, G. (2010). The collaborative construction of chronotopes during computer-supported collaborative professional tasks. *International Journal of Computer-Supported Collaborative Learning, 5*(4), 433–452.
Linell, P. (2009). *Rethinking language, mind, and world dialogically: Interactional and contextual theories of human sense-making*. Charlotte, NC: Information Age Publishing.
Matusov, E. (2007). In search of the appropriate unit of analysis for sociocultural research. *Culture & Psychology, 13*(3), 307–333.
Mercer, N., & Wegerif, R. (1999). Is 'exploratory talk' productive talk. In *Learning with computers: Analyzing productive interaction* (pp. 79–101).
Morson, G. S., & Emerson, C. (1990). *Mikhail Bakhtin: Creation of a prosaics*. Stanford, CA: Stanford University Press.
Rajala, A., Hilppö, J., Lipponen, L., & Kumpulainen, K. (2013). Expanding the chronotopes of schooling for the promotion of students' agency. In O. Erstad, & J. Sefton-Green (Eds.), *Identity, community, and learning lives in the digital age* (pp. 107–125). Cambridge, MA: Cambridge University Press.
Renshaw, P. D. (2014). Classroom chronotopes privileged by contemporary educational policy: Teaching and learning in testing times. In S. Phillipson, Y. Kelly, L. Ku, & S. N. Phillipson (Eds.), *Constructing educational achievement: A sociocultural perspective* (pp. 57–69). Oxon, UK: Routledge.
Ritella, G. (2018). *Chronotope: An investigation of the spatial and temporal organization in technology-mediated collaborative learning*. Doctoral dissertation. University of Helsinki.
Ritella, G., & Ligorio, M. B. (2016). Investigating chronotopes to advance a dialogical theory of collaborative sensemaking. *Culture & Psychology, 22*(2), 216–231.
Ritella, G., Ligorio, M. B., & Hakkarainen, K. (2016). The role of context in a collaborative problem-solving task during professional development. *Technology, Pedagogy and Education, 25*(3), 395–412.
Ritella, G., Ligorio, M. B., & Hakkarainen, K. (2017). Interconnections between the discursive framing of space-time and the interpretation of a collaborative task. *Learning, Culture and Social Interaction, 20*, 45–57.
Salgado, J., & Clegg, J. W. (2011). Dialogism and the psyche: Bakhtin and contemporary psychology. *Culture & Psychology, 17*(4), 421–440.
Säljö, R. (2009). Learning, theories of learning, and units of analysis in research. *Educational Psychologist, 44*(3), 202–208.
Toiviainen, H. (2003). *Learning across levels. Challenges of collaboration in a small-firm network* (Doctoral dissertation). Helsinki: University of Helsinki, Department of Education.
Vadeboncoeur, J. A. (2005). The difference that time and space make: An analysis of institutional and narrative landscapes. In J. A. Vadeboncoeur, & L. Patel Stevens (Eds.), *Re/constructing "the adolescent": Sign, symbol, and body* (pp. 123–152). New York: Peter Lang.
van Eijck, M., & Roth, W. M. (2010). Towards a chronotopic theory of "place" in place-based education. *Cultural Studies of Science Education, 5*(4), 869–898.
Wegerif, R. (1996). Using computers to help coach exploratory talk across the curriculum. *Computers & Education, 26*(1–3), 51–60.
Wertsch, J. V. (1995). The need for action in sociocultural research. In J. V. Wertsch, P. Del Rio, & A. Alvarez (Eds.), *Sociocultural studies of mind* (pp. 56–74). Cambridge, UK: Cambridge University Press.
White, E. J. (2014). A dialogic space in early childhood education: Chronotopic encounters with people, places and things. In L. Harrison, & J. Sumsion (Eds.), *Lived spaces of infant-toddler education and care* (pp. 211–223). Dordrecht, The Netherlands: Springer.