Materiality of Online Students' Peer-Review Activities in Higher Education

Teresa Cerratto-Pargman, Stockholm University, tessy@dsv.su.se
Ola Knutsson, Stockholm University, knutsson@dsv.su.se
Petter Karlström, Stockholm University, petter@dsv.su.se

Abstract: In spite of the widespread use of technology in higher education, discourses on learning technologies commonly account for their features as disembodied from their use. There have so far been few theoretical approaches that have delved into "the technology question" in CSCL. We present an empirical study that investigates how students' peer-review activities are entangled with sociomaterial aspects of mediated collaborative learning. The students' peer-review activities were analyzed according to *the Collective Instrument-mediated Activity Situation* (CIAS) model, and findings show that the materiality of two different tools had considerable influence on how students engaged with the texts and how they interacted with each other.

Keywords: peer-review practices, web-based commenting tools, technology, higher education, learning, design, socio-materiality.

Introduction: The technology question in CSCL

Technologies matter. They are not neutral (Haas, 1996; Säljö, 2010; Rabardel, 1995), but "imbued with history and values" (Haas,1999:209). Yet, in the field of technology in education, most research refers to technology either as a "glass box", transparent to the user and not altering learning or our understandings of our learning practices in any significant way or as a "black box", all-powerful, self-determining and having "one-way" effects (Haas, 1996). As a consequence of such view on technology, little attention has indeed been paid to its material properties (i.e. "the arrangement of an artifact's physical and/or digital materials into particular forms that endure across differences in place and time and are important to users" Leonardi, 2012:161). The sociomaterial nature of technology and its concomitant role in enacting change in our learning practices has so far been overlooked (Johri, 2011; Sörensen, 2009). Drawing on recent conceptualizations of "CSCL artifacts" (Stahl et al. 2014; Overdijk et al. 2012) and the instrumental perspective on CSCL systems (Rabardel and Bourmaud 2003; Lonchamp, 2012), this paper addresses the question of technology while taking heed of its materiality, in this case embedded in higher education institutions. We argue thus for an approach able to describe how students' peer-review is bound to the material characteristics (affordances) of the artifacts in use and intertwined with peer-review practices accepted and legitimated at their educational institution. The aim is to address the constitutive entanglement of material and social aspects of CSCL artifacts in collaborative learning and in particular students' peer-review practices. Within CSCL, the interest for the imbrication between material and social aspects of human activities is not really new; questions pertaining to the material aspects of human activities have been the object of attention within, for instance, the cultural historical approach (Vygotsky, 1934/1997); Scribner and Cole, 1981; Engeström,1897; Rabardel,1995; Nardi and Kaptelinin, 2006; Säljö and Wyndhamn, 1993). These concerns and questions about the role played by technology in education have recently been renewed and conceptualized by Johri (2011); Sörensen (2009) and Fenwick et al. (2011). Sörensen in particular has pointed at "a blindness toward the question of how educational practice is affected by materials" and how these materials are much more than mere artifacts to advance educational performance (Sörensen, 2009:2). Such understandings of sociomaterial aspects embedded in CSCL practices seem to resonate with Pierre Rabardel's (1995) instrumental genesis approach as introduced into the CSCL community by Lonchamp (2012).

In this paper, we will first introduce the contribution of the sociomateriality perspective to the understanding of contemporary forms of collaborative learning as introduced by Johri (2011), Sörensen (2008) and Fenwick et al. (2011). Second, we present the *Collective Instrument-mediated Activity Situation* (CIAS) model (Rabardel, 1995) for the analysis of sociomateriality in CSCL practices. Third, we describe the empirical study investigating how does the design of online commenting functions of social tools (i.e. Google doc and WordPress) come to embody university students' online peer-review practices? To this end, we focus on students' electronic comments and their reflections post-experience. Third, we report our findings particularly looking at how emergent multiple instrumental mediations, established during peer-review, are on the one hand, bound to the materiality embedded in the design of the tools' features and on the other hand, present

implications for the inner organization of students' peer-review activity. We conclude with a brief discussion on the role that a sociomateriality approach can play in the field of CSCL.

Sociomateriality and CSCL practices

The technology question introduced by Haas (1996) in the field of literacy, refers to the relationship between technology and materiality that we consider be at the center of our CSCL practices. In our view, learning becomes material through the use of technologies and this materiality has implications for the development of "human culture and the shape of human consciousness" (Haas,1996:4). In the field of CSCL, Haas's technology question brings us to study the sociomaterial perspective on learning (Johri, 2011; Sörensen, 2008; Fenwick et al. 2011). This perspective has mainly drawn from research on science studies conducted by scholars such as Latour (2005), Barad (2003), Knorr Cetina (2001), and in the field of education by Engeström (1987, 2001) and Miettinen et al. (1999). Its main tenet is that learning, which is situated in the material world (i.e. classrooms, worksites, virtual spaces, community projects, social movements, and so forth), is sociomaterial as its "energies, processes, motives and outcomes are fully entangled with material practice, knowledge representations (e.g. text, pedagogy, curriculum content) nature, time, space, technologies and objects of all kinds" (Fenwick et al. 2011:vii). Such a conception of sociomateriality conveys an understanding of learning that is situated and embedded within an activity, context and culture (Lave, 1988) and bounded to the artifacts making such activity possible (Vygotsky, 1997; Rabardel, 1995; Nardi and Kaptelinin, 2006). It refers to learning as everyday practice where technologies are at a central position between the individual learner or teacher and the cultural practice within which learners and teachers as individuals operate (Lave, 1988; Wenger 1998; Stahl and Hesse, 2009; O'Malley et al. 2009). Moreover, a perspective on sociomateriality questions the idea of treating CSCL technology as a given and disembodied from aspects pertaining to learning practices that technologies embody in its design and are enacted when they are used. A focus on the sociomaterial invites us to dig into the heterogeneous and multiple relationships that assemble and configure contemporary CSCL practices.

Analytical framework

One of the analytical models within the sociocultural tradition that seizes the technology question in CSCL is the one proposed by Pierre Rabardel in his conceptualization of the instrumental genesis approach (Rabardel, 1995). This approach is built around the concepts of *instrument* (a mixed entity constituted by the constraints and potentialities of the artifact and the subject with her knowledge and former habits), instrumental genesis, and artifact's instrumental field (Lonchamp, 2012; Ritella and Hakkarainen, 2012). Central to this conceptualization of instrument is the notion of *utilization scheme* designating a cognitive structure that describes an invariant organization of behavior for a given class of situations including both technical and conceptual aspects (Lonchamp, 2012). Such structure underlies the inner organization of mediated human activities and constitute the social, behavior part of the instrument whilst the artifact, the technical or material part. Rabardel distinguishes two sub-process in the development of the instruments: the *instrumentalization* process that is *artifact-oriented* and concerns the evolution of the artifact, material side of the instrument and the *instrumentation* process, *subject-oriented* and relative to the emergence and evolution of the utilization schemes.

Two analytical models are proposed by the instrumental genesis approach, of which the Collective Instrument-mediated Activity Situation (CIAS) model is of particular concern here. The CIAS model consists of four poles: the subject, the other subject(s), the tool and the object of the activity and distinguishes between two kinds of subject–object mediations: i-the *epistemic mediation* oriented toward comprehending the object, its properties and evolution, and ii-the *pragmatic mediation* oriented toward the transformation of the object and the achievements of the results. Building on the work of Cerratto Pargman (2003) and Folcher (2003), Rabardel and Bourmaud (2003), distinguish the *interpersonal mediation* between subjects that may also be epistemic or pragmatic in nature depending on whether it is a question of knowing the object or transforming it. Finally a fourth mediation is introduced as the subject also relates to herself (Rabardel and Samurcay, 2001). This latter is called *reflexive or heuristic mediation* and aims to explain how the subject manages her activity in relation to her goals, means, resources etc.

These four instrumental mediations may or may not be established during CSCL activities. Their establishment and development will depend on how the user deals with and adapts to changes introduced by the tool, and how well the user succeeds in transforming and approaching the artifact. The strength of the model is the identification of emergent mediations that constitute themselves from the imbrication of the materiality of the artifacts in use (its design rationale) and the sociocultural organization of human activities (subject's representations and utilization schemes).

Methods

Context and participants of the study

A qualitative study comprising 12 recruited bachelor students (10 males and 2 females) using online web-based commenting tools was set up in May 2012 at a department of Informatics at a Swedish university. The purpose of the study was to understand how undergraduate students appropriate online web-commenting tools in their peer-review tasks. Students were divided into 2 groups of 6 participants each who in pairs discussed 6 texts, consisting of students' own early drafts of bachelor theses (e.g. 4-9 pages). Each text had two authors (as it is accepted at the institution studied), and two reviewers made comments. For commenting, half of the groups used Google docs (GD), and the other half used Wordpress (WP). The crucial difference between the two systems is that the commenting function in GD allows the reviewer to directly anchor the comment in the text while the one provided by WP offers instead a common writing field at the end of the document. These tools were selected because of the learning promises associated to online collaborative annotations tools in higher education (Su et al. 2010; Glover et al. 2007).

The respondents were enrolled in a mandatory course aimed at scaffolding students in their academic writing. Central to the course is the review of others' bachelor drafts. Most students perform their reviews using the university's in-house developed Learning Managing System (LMS). Using the LMS entails students i-respond to a list of pre-formulated questions that embody peer-review criteria accepted at the chosen institution and ii- grade different key sections of the text reviewed. As such students' peer review (before introducing GD and WP) presents a summative character, is private between the reviewer-author, and is organized around providing feedback and/or answering questions (Aghaee and Hansson, 2013).

Participants' peer-review tasks

Three texts from three groups were posted on three different blogs in WP, and three groups uploaded their texts to GD. Two reviewers critiqued each text and the pair of authors of each draft could reply to the critique for the duration of the review phase (72 hours). The reviewer pairs were not the same as the author pairs. Each participant had two assignments: i) giving critique and ii) discussing the critique given.

Data collection techniques

We collected both interaction and reflective data. Interaction data consisted of participants' written comments (153 comments). Reflective data consisted of focus group discussions (80 min with 10 participants) and questionnaires (11 out 12). The interaction data was analyzed according to principles for the analysis of verbal interactions (Cerratto-Pargman, 2003). Responses to the questionnaires and transcriptions of the focus group were analyzed using Graneheim and Lundman's (2004) method of qualitative content analysis.

Coding schemes for data analysis

The data collected was analyzed with the CIAS model. The unit of analysis chosen was students' comments and students' self-reflections on their use of online web-based commenting tools in peer-review. The instantiation of the instrumental mediations emerging from the data was conducted in the following manner:

- *Epistemic mediations* were understood as those relationships oriented toward the comprehension of the content of the text to be reviewed. More precisely, epistemic mediations were identified from the analysis of the *function* of critique given (see table 1).

- *Pragmatic mediations* were understood as those relationships oriented toward the transformation of reading the text into the writing of the critique. More precisely, these mediations were identified from the analysis of the *forms* of the comments (e.g. anchor, compound, detached).

- *Interpersonal mediations* were understood as those relationships oriented toward the interaction with the other. These mediations are identified from the *amount*, *length* of the comment as well as *type* of exchanges generated (e.g. minimal, complete).

- *Reflexive mediations* were understood as relationships oriented toward one-self, intending to manage the own individual activity within a collaborative effort. These mediations were identified from the semantic analysis of the transcriptions generated from the discussion during the focus group and the answers to the questionnaire post-study.

The electronic comments generated by both commenting tools were coded in terms of initiative-only comment and exchanges. Exchanges were further coded based on 1-*type*, 2-*form* and 3-*function*. 1-*Type* was distinguished between minimal (e.g. initiative-reactive) and complete (initiative-reactive-evaluative); *2-Form* was distinguished among anchored (inserted in the text), compound (inserted and highlighted in the text) and, detached (disassociated from the word, sentence or paragraph being commented). 3-*Function* consisted of the following categories (see table 1). These categories were identified according to the ultimate purpose of the peer-review critique given. They were identified from the iterative analysis performed on participants' comments and exchanges (not established a-priori).

Table 1: Categories for the analysis of the critique conveyed in the comments

Conceptual critique (CC)	addresses the quality of the thinking underlying the text and the construction of the arguments written.
Form and structure (FS)	addresses how the text is put together, the order of the sections, subsections and overall structure of the text.
Cohesion and coherence (COCO)	addresses how the different parts of the text are linked together and how they make sense.
Textual errors (TE)	points out at minor elements as specific faults in the text, like spelling errors or omitted words.
Overall critique (OC)	focuses on providing an overview of the text and may contain elements of all other categories in one comment. It is often presented as a short report.
Non-critique (NC) entails any	comment, which discusses topics outside of the text itself. It may be comments regarding the critique process or social comments of various kinds.

Findings

From the different types of relationships that were instrumented with both commenting tools GD and WP in the students' peer-review, we observed the emergence of interpersonal, epistemic, pragmatic and reflexive mediations. These instrumental mediations accounted for both, *material* characteristics (affordances) of the different commenting functions (that were reflected in the amount, type, form and function of the students' comments) and students' *utilization schemes* underlying the organization of their peer-review practice. More specifically, we observed that the materiality of the tools had implications on the *function* (purpose) of the critique as it differed according to the online tool used. With GD, students focused more on "form and structure" and "textual errors" whilst with WP they focused more on "cohesion and coherence" and "overall critique".

Moreover, interacting with both tools reflected the presence of a specific peer-review organization students enacted in their activities. We refer in particular to students' peer-interaction that was organized in initiate-only comment and/or minimal exchange indicating the presence of utilization schemes bound in part to i-characteristics of the commenting tools constituting GD and WP but also to other features previously and commonly used (i.e. university's LMS, MS word, e-mail) and, to ii-students' particular understandings of what performing an academic peer-review entails at their educational institution (i.e. tacit knowledge conveyed through instructions, assessment criteria, discussions at research seminars, feedback from supervisors, thesis defense). Students' peer-review critique also reflected a colloquial, informal character that deviated from the formal tone that is often chosen in the students' peer-reviews performed in the university's LMS (Aghaee and Hansson, 2013). Such a deviation introduced confusion in some occasions. We elaborate on these findings from the four instrumental mediations instantiated from the analysis of the data.

Interpersonal instrumental mediation

A macroscopic view of this mediation shows that the amount of comments (interpreted here as an indicator of interactivity between authors and reviewers) with GD was of 97 with a median length of 16 words. 56 comments were made in WP, with a median length of 40 words. Taking into account that the 12 respondents were involved during 72 hours, the degree of interaction between respondents seems low independently of the tool used. Firstly, this might be due to the synchronicity afforded by the tools that was deviated and thus instrumentalized in an asynchronous mode of interaction by students' peer-interaction. In this sense, the students in their activity attributed a different function to the interactivity mode afforded by the tools. Secondly, such an instrumentalization was certainly due to students' previous experiences of interacting asynchronously with peers

in their academic peer-reviews. The asynchronous property attributed to the online tools might be due to students' needs to organize their peer-review according to pre-existing social, behavioral invariants underlying the organization of the interactions between the students vis-à-vis the text and, vis-à-vis the reviewing task to be accomplished.

Furthermore, the use of GD encouraged more exchanges than WP but shorter in length; whilst WP promoted less exchanges but longer in length. Reviews conducted with GD presented a higher number of *minimal* exchanges whilst WP presented a slightly higher number of *complete* exchanges. These differences can be explained in relation to the quotations (copying) of paragraphs under discussion that students were re-writing in the blogs (WP). The length of the exchanges in WP can be related to reviewers' necessity to recreate authors' sentences (and thus to write more) in order to make sure the semantic context of the detached comments in the blog was available to the authors. The design of WP disregards in fact the location of the comments in relation to the text (i.e. section, paragraph, sentence, word) being commented. As such the reviewers contributed with their comments to connect detached (critique) note with text being critiqued.

These results can be seen in relation to students' previous and established practices of peer-review associated to specific asynchronous tools such as the university's LMS, E-mail and MS Word and students' mode of interaction most often organized around question-answer. As such, this observation accounts for students' needs to change the instrument (instrumentalization) and their utilization schemes (instrumentation) as they attempt to organize their interaction on a question-answer basis rather than on a argumentative discussion.
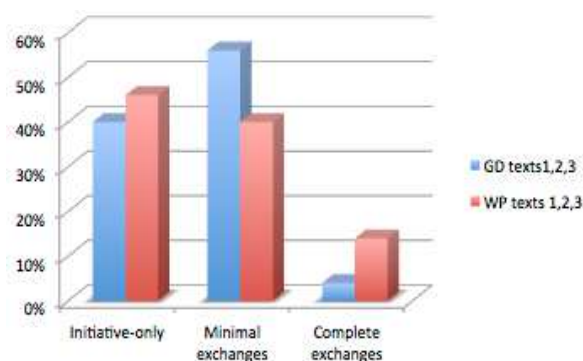

Figure 1. Type of exchanges

Epistemic instrumental mediations

The materiality of the commenting tools mattered. For instance, the amount of comments on "*conceptual critique*", were higher in WP than in GD. Functions such as "*form and structure*" and "*textual errors*" were prevalent on GD whilst "*overall critique*" dominated in WP. The category "*cohesion and coherence*" was predominant with more comments on both tools. It was also the category that contained the most minimal exchanges in GD, and the most complete exchanges in WP. This difference probably stems from having different thresholds of effort facilitated by each of the tools used. GD makes it easier for an author to respond while commenting, as the dialogue is embedded in the text being commented. In WP, responding to comments is more cumbersome as the dialogue is detached from the text.

These results reflect differences in the students' ways to engage with the texts that had implications on how they understood the peer-review activity from their interaction with the online commenting tools.
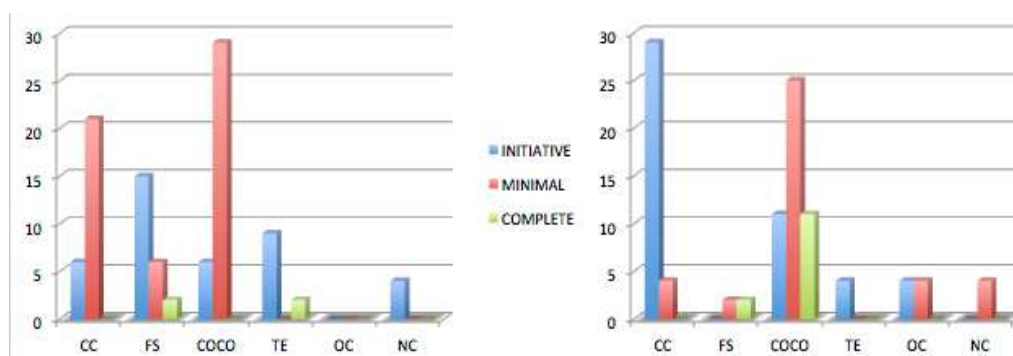

Figure 2. Function of critique with GD and function of critique with WP

Pragmatic instrumental mediations

Transforming the object of the peer-review activity (i.e. composing comments in order to improve the quality of the other's text), pointed to differences between how the comments were composed on both tools. Comments composed in GD were *anchored comments* – directly inserted in the paragraph or word being discussed-. As such, their topology made it easier to understand what the critique was pointing out. Comments in WP were *detached notes* that topologically speaking were not connected with a particular paragraph or word but with a more general understanding of conveyed ideas. In addition, *c*omments composed in GD were in the form of *compound annotations*, consisting of both an anchor (highlighted text) and textual content (the comment) – or a reply to another of comment. GD also allows participants to only highlight text, or to make a comment without a highlight, but commenting without highlighting did not happen during the study.

During the focus group, students explained it was central for them to communicate their critique as clear as possible in order to facilitate author's comprehension of what the critique was specifically pointing out. The material characteristics of the commenting features in GD appeared to encourage short, concise comments on specific, local parts of the text. Since the comments are placed right beside the text, the tool let reviewers begin adding their comments immediately during their very first read-through. WP's commenting function is instead placed at the bottom of the text. This compels the reader to read through the complete text before leaving the first comment. This was one of the major issues the students brought up during the focus group discussion, stating that it felt silly commenting on minor details when the comments were topologically speaking completely disconnected from the text.

The materiality of the commenting tools encouraged participants to engage differently with the texts under review and then to critique them dissimilarly. Students using *compound comments* commented on more sections of the texts but their comments were succinct and local in relation to students' *detached notes* who commented on fewer sections of the texts, but with a larger number of words and with a more global or holistic approach. Comments with GD were embedded in the text promoting a narrow context for the critique (i.e. the context was the word, the sentence, or a paragraph). In comparison, comments with WP presented a broader context (i.e. the whole text or sections of the text) encouraging students to recreate the relation between comments and focus of the critique provided.

Reflexive instrumental mediations

During the focus group, the students explained that most of them often print the texts to be reviewed so they can work off-line, highlighting, making annotations on paper and then reviewing their comments, structuring, organizing them and rewriting those they will send to the authors via the university's LMS platform. In this sense, students mentioned that great part of the review is done first privately, off-line and then it is communicated to the author. With the use of GD's and WP's commenting functions the private, off-line phase of the peer-review was apparently absent.

Moreover, students mentioned that they were unsure and some confused about the new possibilities the commenting tools were bringing to their peer-review process. Some questioned the idea of discussing academic critique: "*Does one discuss critique in a an academic peer-review process*?"; "*We have learned that one should only accept feedback and do not discuss it*". They perceived that commenting tools were shaping the peer-review with a dialogic format some of them were skeptic to adopt as they mentioned they usually do not discuss or socialize around critique that is given. The use of emoticons in the comments was also source of discussion among the participants as some argued that such an element might sometimes influence the direction of the ongoing discussion.

Furthermore, 5 out 10 students commented on the distraction that reading others' critique can introduce in their own reading and understanding of what they consider important to comment on. Three students expressed concerns about "becoming influenced by others' voices on the text under review"; Student A mentioned: *"one changes the level* (of the comment) *because of group pressure"*. Student B*" you are inhibited by seeing others' comments. You only see what is already commented on and may struggle to find your own things"*. These concerns may be seen as conflicts students experienced in their interaction with online commenting tools that came to challenge established reviewers' utilizations schemes bound to tools lacking a social and synchronous dimension. Engaging with an open peer-review opened thus questions pertaining to social and public aspects of critiquing texts in relation to students' own understanding of what academic critique entails at their educational institution.

Implications

Beyond commonalities and differences observed at the level of the comments produced with the different online commenting tools investigated, this study sheds light on the type of relationships CSCL artifacts mediate. More importantly, the study shows how instrumental mediations emerge from the imbrication of sociomaterialities of collaborative learning practices such as peer-review.

In particular, materiality of the commenting tools in use or previously used had implications on i- how students engaged in with the text and transformed it as well as on ii-how their interaction with the other(s) and with oneself was organized. More precisely, the peer-interaction observed, was mainly based on initiative-only comments and minimal exchanges. This specific organization in the students' interaction reflected the presence of a utilization scheme underlying the activity of peer-review that does not disappear with the advent of new tools. At the opposite, students' utilization schemes associated to peer-review were challenged but not completely destabilized. Students' schemes of utilization were challenged by the synchronous, open and public character of the tools studied but not completely destabilized as the underlying organization of their peer-review practices (e.g. question-answer interaction) was maintained. Students' utilization schemes accommodated to the new conditions opened by the online commenting tools that led the development of instrumentalization processes (Rabardel, 1996). For instance, the synchronous mode of interaction was diverted into asynchronous interaction and the lack of a feature establishing the connection between critique and component of the text critiqued in WP, conducted reviewers to created it through establishing a semantic connection between comment and text being commented (i.e. students make use of quoting- rewriting- that in turn contributed to longer comments structured in some occasions, in complete exchanges). Such changes in the artifact, material-side (instrumentalization) and the subject, social-side (instrumentation) become observable as they were i-enacted in reviewers' behavior (type of peer-interaction) and ii-bound to the affordances and constraints of the tools in use (i.e. anchored, compound and detached comments).

Finally, the study contributes to show that sociomaterial aspects of CSCL practices are necessary to embrace in order to gain a deeper understanding of the relational, dynamic and complex ties between learning and technology (Chaiklin and Lave, 1996). Such an understanding will be beneficial for better seizing the changes that learners and teachers interacting with contemporary technologies enact in their daily learning experiences (Dewey,1938/1998) and practices (Lave, 1988; Wenger, 1998).

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