The development of second language critical thinking in a virtual language learning environment: A process-oriented mixed-method study

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Abstract

This article presents a process-oriented mixed-method study, focusing on the emergence of second language (L2) critical thinking (CT) skills in the collaborative discourse produced by a focal group of five college-level students of French working in a virtual language learning environment (the VLLE Cinet Second Life). Levels of CT ability were elicited through episodes of L2 negotiation and co-construction of meaning. The study also examines the perception by students of the impact of the VLLE on the emergence of their L2 CT skills.

Motivated by the need advocated in recent CALL research for a shift in paradigm and in method to alleviate the limitations inherent to quantitative studies, the study was situated at the juncture of sociocultural theory and ecological perspective, and this article focuses on the theoretical rationale behind the selection of a mixed-method methodology.

KEYWORDS: ECOLOGICAL PERSPECTIVE; L2 CRITICAL THINKING; L2 NEGOTIATION OF MEANING; MIXED METHODS RESEARCH; SOCIOCULTURAL THEORY; VIRTUAL LEARNING ENVIRONMENTS

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Introduction

In their meta-analyses on research in Computer Assisted Language Learning (CALL), Felix (2005a; 2005b; 2008) and Zhao (2005) noted an excess in quantitative studies, pervasively focusing on learning *outcomes* and with somewhat equivocal conclusions. In their study of Virtual Language Learning Environments (VLLEs), Feldon and Kafai (2008) cautioned that 'without qualitative inquiry to provide context for server-generated statistics, key aspects of the interactions are lost and attempts to make claims about patterns of interaction would lead to invalid conclusions' (p. 577). Increasingly aware of the limitations of quantitative approaches to CALL, researchers have called for a 'shift in paradigm as well as in method' (Chapelle, 2005, pp. 56–57), accounting for the holistic and messy *process* of second language (L2) learning in the specific complexity of innovative computer-mediated *contexts* (Blake, 2008; Meskill, 2005; Saarenkunnas, Kuure, & Taalas, 2003; Schulze, 2001).

This article will present an exploratory, process-oriented, mixed-method study situated at the juncture of sociocultural theory (SCT) and ecological perspective. It will examine the emergence of L2 critical thinking (CT) skills in the discourse produced by a group of five college-level students of French working collaboratively in a VLLE. We will contend that L2 CT can be traced by examining instances of L2 negotiation and co-construction of meaning, as a reliable object of study providing 'a bird's eye view of student interactions and critical thinking processes' (Jeong, 2003: 28). Redefined as a result of the shift in paradigm reflected in this study, L2 negotiation and co-construction of meaning were hypothesized as being:

> The subjective and alternatively collective and individual process by which learners produce and exchange discourse and meaning in an L2 that is affected, negotiated, arbitrated, and reconstructed as a result of opportunistic dissonances in social interactions, in individual perceptions, and in the surrounding environment. (adapted from Jeong, 2003: 28)

This article will focus on the rationale behind the selection of a mixed-method research methodology, while addressing two research questions:

- (RQ1) What does the nature of the discursive patterns produced by the students in the focal group indicate about their L2 CT process?
- (RQ2) How do the students perceive the impact of the VLLE on their experience of the L2 CT process?

We will present an embedded mixed methods design (Creswell & Plano Clark, 2007) and discuss the results to these two research questions, as well as how the study relies on a shift in paradigm and in research method.

Theoretical framework

CALL research in the twenty-first century has been increasingly concerned with determining criteria leading to more research effectiveness (Blake, 2008; Chapelle, 2005; Felix, 2005a; 2005b; 2008). Researchers have highlighted several weaknesses affecting research outcomes, notably: (a) the lack of theoretical framing in many CALL studies; (b) the predominance of technocentric assumptions; and (c) the lack of well-suited research designs (Huh & Hu, 2005: 18). This study has been informed by the need to compensate for these perceived weaknesses.

Overview of theories

Our study was mainly framed by sociocultural theory (SCT). SCT has been primarily based on the work of Vygotsky for L1 acquisition and Lantolf for L2 acquisition. According to SCT, human mental development is a social process, fundamentally mediated through activities and by cultural artifacts such as language (Lantolf & Thorne, 2007). In the twenty-first century, another prominent artifact is arguably technology. SCT contends that: (a) language, cognition, and culture are acquired through social interactions and engagement in meaning-making activities; and (b) that they cannot be separated from the context in which they occur (Ohta, 1995: 93–94).

The SCT frame of this study was combined with an ecological perspective in order 'to add significant direction and theoretical cohesion to SCT work' (van Lier, 2004: 21). Rooted in SCT, the ecological perspective in SLA is illustrated in the work of Kramsch and van Lier. The ecological perspective conceives L2 acquisition as a relational process (van Lier, 2000) and assumes the existence of an inherent interconnected, interdependent, and interactional relationship between the learners, the language, the tools, and the environment (Kramsch & Steffensen, 2008). It thus contends that language cannot be studied as an isolated object but that research should account for: (a) the social relationship among learners engaging in meaning-making activities: (b) the impact of the tools and the environment on their L2 acquisition process; and (c) their perception of (a) and (b) (Kuriscak & Luke, 2009).

Social interactions in meaning-making activities

Sociocultural and ecological approaches suggest new ways of researching interactions, different from what is generally found in more conventional SLA and CALL studies. Rather, they imply focusing 'on social actors as they are acting, not linguistic detail alone' (Saarenkunnas *et al.*, 2003: 206), and moving

beyond properties of individual learner language to examination of the creation of context, construction of task, coordination of goals, affective variables, learner cognition, and learner collaboration in order to better understand how learners socially construct the shared understandings through which language is acquired. (Ohta, 1995: 96)

Of particular interest for research in SLA is the determination of whether learners can use their L2 beyond social interactional needs to mediate their psychological activity for higher mental processes (Lantolf, 2006: 90), such as CT. *Emergence* refers to the transformation process by which the 'relatively simple elements [of these social interactions] combine to form a higher-order system' (van Lier, 2004: 5). *Internalization* is the process by which symbolic artifacts like language are appropriated through social interactions and converted into psychological artifacts that mediate mental functioning. Lantolf (2006) also argues that these processes can be more readily observed by exposing learners to complex tasks, triggering the need for them to externalize their thought through talk (p. 71). One way to approach the exploration of emergent L2 learners' CT abilities is to focus on episodes of L2 negotiation and co-construction of meaning as a variable that readily elicits higher mental functioning in the learners' collective discourse (Campbell *et al.*, 2001; Hull & Saxon, 2009; Jeong, 2003; Lipman, 1988).

Research on L2 negotiation of meaning has traditionally followed Long's (1983; 1996) Interaction Hypothesis and Varonis and Gass's (1985) TIRR model (Trigger, Indicator, Response, Reaction). In this perspective learning outcomes are achieved in a linear sequence following a discourse interrupted by episodes of negotiation of meaning. The episodes are triggered by the production of an incorrect L2 form, the learner then notices the gap in accuracy, adapts her interlanguage ruling system, corrects her output, and retains this modified output for intake of the target-like form to happen. Most studies following this view have adopted a quantitative approach to research which – as several researchers pointed out – led to inconclusive or contradictory findings. Jauregi (1997) notably highlighted that calculating the frequency of indicators or the amount of retention of discrete items while disregarding the rest of the overall discursive context was inherently invalid. More recently, Beißwenger (2008) pointed out that the quantitative study of L2 negotiation of meaning in CALL has typically relied on the exclusive use of computer-generated scripted logs, falsely assuming that computer-based communication is linear and one-dimensional, and unduly imposing a fallacious turn-taking paradigm in research on CALL. Researchers have thus increasingly supported the need to conduct in-depth qualitative analyses of the overall discursive process surrounding episodes of L2 negotiation of meaning (Brooks & Donato, 1994; Foster & Ohta, 2005; Swain & Lapkin, 1998) to 'investigate learner language

for evidence of how L2 development proceeds through and is constituted by meaning-making' (Ohta, 1995: 95).

Our dual theoretical approach allowed 'question[ing] some basic assumptions that lie behind most of the rationalist and empiricist theories and practices that dominate in our field, and offers fresh ways of looking at same old questions' (van Lier, 2000: 245). By aligning with SCT and the ecological perspective, we hypothesized that L2 negotiation and co-construction of meaning was rather an example of a learning *process*. We argue that it can be viewed as discourse *per se*, rather than an interruption of discourse, relying on the collaborative construction rather than the simple correction of the L2 (Jauregi, 1997), and focusing on its meaning-making function rather than simply its form (Brooks & Donato, 1994; Foster & Ohta, 2005). We also considered gaps in understanding among interlocutors as opportunistic dissonances rather than marks of their dysfunctionality in the language (Jauregi, 1997; Vandergriff, 2006).

Context, tools, and environment

The importance and impact of context in the L2 acquisition process is central to SCT and the ecological perspective. The concept of *affordance* is essential to this (Gibson, 1979): it refers to the *potential* a particular property of the environment has to contribute to actions carried out by a learner immersed in the environment, but this property does not in and of itself cause or trigger action unless it is actually perceived as relevant and activated by this learner (van Lier, 2000). This concept allows redefining the theoretical impact of the environment in the learning process from *providing input* to *affording opportunities for meaning-making*. With Kramsch and Steffensen (2008) we thus contend that language cannot be studied as an isolated system but that it derives part of its 'semiotic budget' (van Lier, 2000: 252) from the tools with which and the environment within which the active learners engage together in meaning-making activities.

A growing number of CALL studies have been focusing on the study of VLLEs 'as [rich semiotic] site[s] for learning and socialization' (Kramsch & Steffensen, 2008: 24). However, some researchers have warned about the excessively technocentric view that has pervasively dominated research in this domain, notably 'falling into the traps of media-comparison [studies]' (Huh & Hu, 2005: 15; Salomon, 2000). Limitations in CALL research on VLLEs can be generally attributed to a skewed understanding of *affordances*, conceived as properties of the environment or the tool per se, rather than a latent relationship between the learners, the environment, and the tools. This skewed understanding has 'provoked an overemphasis on what particular technologies prompt us to do' (Savin-Baden, 2008: 152). Thus, several

researchers (Blake, 2008; Felix, 2005a; 2008; Saarenkunnas *et al.*, 2003) have called for a need to re-orient our attention 'to the complex nature of humans as sociocultural actors, and technological settings as artifacts and as mediators, rather than determiners, of action and interaction' (O'Rourke, 2005: 435).

Rationale for a mixed methods approach

The selection of the most appropriate research method for this study was driven by the holistic approach that an ecological perspective supports. It answers the need 'to investigate the contextual properties' of the discourse produced collectively by a group of L2 learners, to 'abandon any attempts to reduce [the complexity and messiness of the] phenomena' emerging, and to highlight 'the particular and the specific over the general and universal' (Kramsch & Steffensen, 2008: 18). A pragmatic take on research methodology was thus adopted to tailor the methodological design and procedures to the two research questions that guided the study (Rocco *et al.*, 2003).

Informed by CALL researchers' call for 'a combination of various data collection methods within one single study [to] help in strengthening confidence levels about results' (Chi, 1997: 273), the decisions was taken to adopt a '[research] method that can integrate both [quantitative and qualitative] methods to answer complex questions such as learning in context' (Chi, 1997: 273). A mixed methods approach was adopted, aligning with a dialectical philosophy, i.e., with an intention to 'consciously go back and forth between qualitative interpretation and quantitative analysis (…) to better reflect the social realities [at work]' (Rocco *et al.*, 2003: 596–597), and with an initiation purpose, i.e., with an intention to allow for the discovery of contradiction between the qualitative and the quantitative results, to better inform the interpretation of findings (Green, Caracelli, & Graham, 1989: 259).

Methods

Design

Creswell & Plano Clark's (2007) *embedded* design was selected from their mixed methods research models and modified with a *data transformation* procedure to fit our research needs. Our methodological design consists of embedding a small quantitative strand to support and enhance the otherwise predominantly qualitative study (Creswell & Plano Clark, 2007: 67–71). It comprises three phases: Phase 1 was intended to narrow the scope of the study by selecting participants to form a focal group; Phase 2 relied on a curricular intervention forming the center of this study; and Phase 3 consisted of collecting post-intervention data.

Data collection

Participants were five undergraduate L2 French learners from an American university, selected to form a focal group among a pool of 27 students belonging to two Intermediate French II classes (fourth-semester French), and exhibiting an Intermediate-Mid level of reading and writing proficiency (ACTFL 1999; 2001).

Phase 1 of this study consisted of bi-weekly observations of the two classes, under unmodified curricular conditions, over a seven-week period of time. The field-notes gathered allowed:

(a) establishing an ethnographic-like portrait of these students in their traditional learning environment as a social organism;

(b) forming the collaborative groups structuring the upcoming curricular intervention based on a representativeness criterion (Teddlie & Yu, 2007) in an attempt to represent the social and educational heterogeneity found at (a); and

(c) selecting a focal group of volunteers from one of these groups.

The resulting focal group comprised five students: Charlotte, Jacqueline, Bernard, Daniel, and Florence. A first round of individual semi-structured interviews was conducted with the focal group to gain a sense of their L2 academic and informal learning background, as well as their background, attitude, and habits toward the use of technology for L2 learning purposes, notably to gauge their pre-conceived apprehensions or expectations regarding the technological aspect of the curricular intervention.

Phase 2 relied on a curricular intervention replacing the traditional curriculum for ten days. Daily 50-minute sessions around an online problem-based activity, inspired by Oliver and Nelson's (1997) murder mystery *Un Meurtre à Cinet*, were organized in a computer lab for both classes. All elements of this intervention (the activity, the VLLE, the learning tools) were designed in accordance with SCT and EP principles: learner-centeredness, authenticity, contextualization, complexity, collaboration, multiplicity of perspectives, and support for internalization. Students were informed of the learning objectives at the beginning of the intervention, to: (a) work and strategize as a team in French (without knowing the real identity of their partners); (b) find, read, and understand the information hidden in a large collection of multimodal French texts; (c) communicate, discuss, and connect this information; in order to (d) discriminate relevant from irrelevant information; and (e) build a detailed, collective, viable, and supported case. Participants used the VLLE *Cinet Second Life* where they were each represented by an avatar, corresponding to a fictional character (see Figure 1).

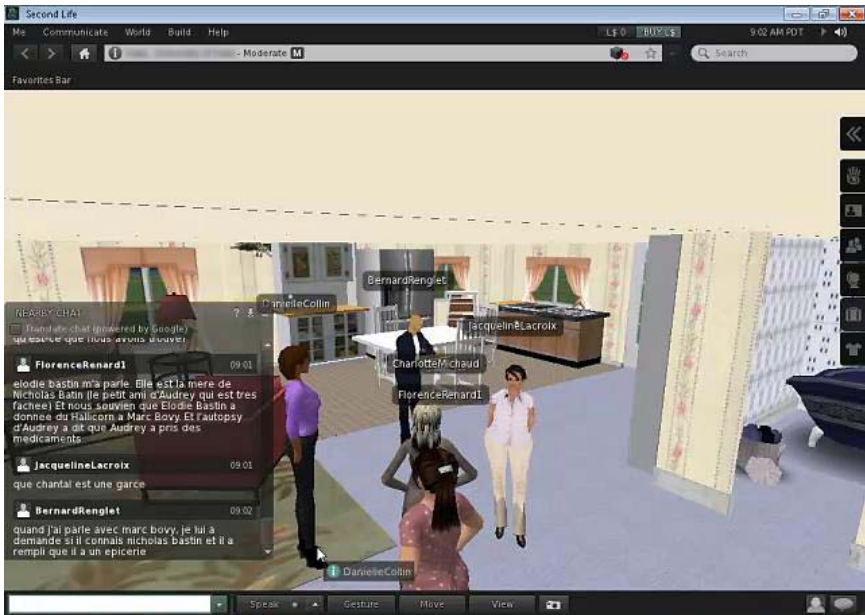They could gather information by communicating through chat and instant messages, and by retrieving clues.

Figure 1: VLLE Cinet Second Life

Each student was equipped with a multimedia *Detective Notebook*, intended to promote internalization (Lantolf, 2006) in the management of their individual dissonances (see Figure 2). The activity was structured around five rounds of incremental difficulty, culminating in the final defense of their case to the class. In Phase 2, a second semi-structured interview was conducted to elicit students' *in medias res* perception of the impact of the activity and the learning environment on their learning and CT.

Phase 3 was intended to elicit students' *retrospective* perception of the impact of the activity and the learning environment on their learning and CT after the curricular intervention, (the third semi-structured interview).

The study of research question 1 (RQ1: What does the nature of the discursive patterns produced by the students in the focal group indicate about their L2 CT process?) relied on the triangulation of:

- a primary dataset composed of the computer-generated logs of students' collective chat produced in Phase 2 in the VLLE *Cinet Second Life*; and
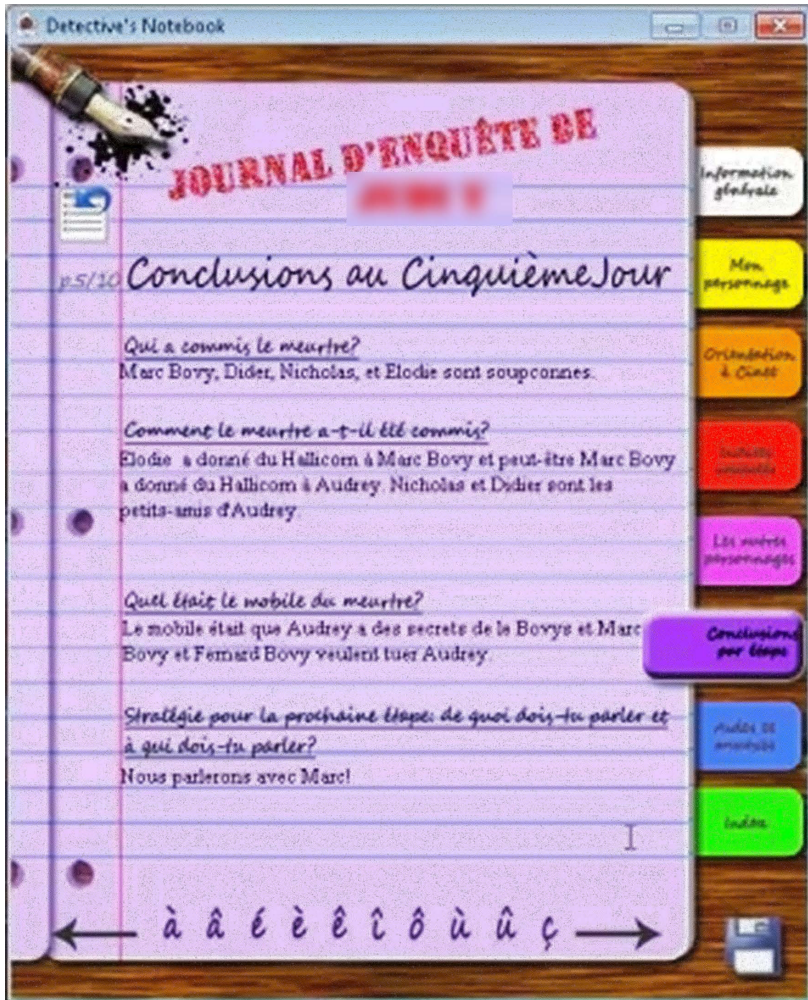- secondary datasets comprising computer-generated logs of students'

Figure 2: Detective Notebook

individual notes produced in Phase 2 in their *Detective Notebook*, as well as on-screen video recordings of their interactions made with *Camtasia*.

This design allowed us to create the quantitative dataset needed to answer RQ1 by embedding a data transformation procedure at the analysis phase, whereby the students' collective discourse obtained in the computer-generated logs of their chat was quantified with the help of the secondary datasets.

The study of research question 2 (RQ2: How do the students perceive the impact of the VLLE on their experience of the L2 CT process?) relied on the triangulation of:

- a primary dataset composed of the three rounds of interviews conducted in English during all three phases of the study; and
- secondary datasets comprising the observational fields notes taken in Phase 1, the computer-generated logs of students' individual notes from their *Detective Notebook* produced in Phase 2, as well as the on-screen video recordings of their interactions.

Data analysis

RQ1 was addressed via quantified conversation analysis intended to account for the different functions, as well as the sequential structure, of the group's collective discourse (Markee, 2000; Schegloff, 1993; Wooffitt, 2005). The collective discourse produced by students in *Cinet Second Life* chat thus underwent a data transformation procedure. It was first segmented by *units of meaning*, following Strijbos, Martens, Prins, and Jochems's (2006) segmentation procedure, independent from the subsequent coding procedure. Reliability of the latter was a primary concern, as Kramsch and Steffensen's (2008) warned that 'an ecological research approach offers more internal validity but less reliability and inordinately less generalizability' (p. 25). Reliability thus depended on: (a) *source triangulation* (the synergistic merging of a variety of data sources); and (b) *investigator triangulation* (the dialogical nature of the relationship between coders) (Janesick, 1994; Kramsch & Steffensen, 2008; Lincoln & Guba, 1985).

Source triangulation involved the merging of the secondary datasets (the individual notes from the Detective Notebook and the on-screen recordings) with the primary dataset of students' collective discourse (now segmented). The objective was to obtain a rich recontextualization of the way the discourse under study was unfolding, in order to account for each student's intentions and to code each unit of meaning according to its function. On-screen recordings were particularly instrumental in 'teas[ing] out the often tangled turn sequences that are a by-product of the chat interface'" (Smith & Gorsuch, 2004: 559) to 'counter-act the misleading linearity and one-dimensional nature of scripted logs' that has unduly influenced the fallacious turn-taking paradigm in research on CALL (Beißwenger, 2008: 1).

Investigator triangulation involved a dialogical process between two coders. The different units of meaning were first coded independently, with the help of the merged datasets. Results were then compared and all non-congruent units

of meaning were discussed until reaching agreement (Krippendorff, 2004). Each decision was thoroughly documented to build a trail serving as a reference for further coding, in order to guarantee the consistency and trustworthiness of the procedure.

Using both types of triangulation, each unit of meaning was thus attributed a number ranging from 1 to 7, corresponding to the incremental levels of CT abilities elicited in Hull and Saxon's (2009) Interaction Analysis model, to conduct statistical analyses to examine the nature of the discursive patterns. The definition and indicators for each level in the Interaction Analysis model (Hull & Saxon, 2009) are presented in Figure 3. Table 1 shows examples of coding at Level 5, in an exchange displaying all the indicators of negotiation and co-construction through semiotic mediation. The English translation is intended to approximate students' imperfections in the original text written in French.

Once students' chat logs had been transformed into quantitative data, two statistical analyses were conducted: (1) a Friedman's test (non-parametric) to determine the different levels of L2 CT abilities at which the discourse was impacted by the different tasks in the activity; and (2) a sequential analysis to determine if patterns of L2 CT abilities existed (Jeong, 2003).

The treatment of RQ2 for the examination of the students' experiences and perceptions of the impact of the problem-based activity and the VLLE on their L2 CT process relied on an interpretative phenomenological analysis (Pietkiewicz & Smith, 2014). As shown in Figure 4, emerging themes from the interviews were cross-referenced with a list of pre-established properties of VLLEs (as found in the literature), the list of pedagogical principles that guided the design of the task, and the different stages we hypothesized were involved in the meaning-making process. To deepen their interpretation, these results were then compared and contrasted with the information contained in the secondary datasets, as well as results from RQ1.

Results for RQ1

RQ1 aimed at determining what the nature of the discursive patterns produced by the students in the focal group indicated about their L2 CT process. The evaluation of the students' discourse was found to be significantly impacted by the activity at four out of the seven levels of CT abilities (see Appendix): two lower levels (Level 1: instruction to the group; Level 2: sharing new information) and two higher levels (Level 5: negotiation and co-construction; Level 6: testing tentative constructions).

Code	Definitions	Indicators
1 Direct instruction(s) to the group	Initiating new activity for the group	1a. statements that cause the group to undertake a discussion of on a totally new subject
		1b. statements that provide clarity to a previous instruction
2 Sharing new information	Information is provided that has not been previously discussed	2a. a statement of observation or opinion
		2b. a simple response to a question or instruction
		2c. definition, description, or identification of a problem
3 Situated definition	Information is validated through a socially-shared, distributed consciousness	3a. statements of agreement
		3b. realization of agreement
		3c. providing corroborating example(s)
		3d. providing encourage for a previously expressed idea
		3e. basic questions of clarification
4 Intersubjective/dissonance	Inconsistency is discovered between a new observation and the learner's existing framework of knowledge	4a. identifying or stating areas of disagreement
		4b. asking and answering questions
		4c. restating some else's position
		4d. clarifying one's own position (without substantial changes to that position)
5 Negotiation/co-construction (semiotic mediation)	Higher mental functioning that attempts to bridge differences in situated definitions	5a. clarifying someone else's position
		5b. re-proposing an idea previously provided to the group
		5c. statement that appears new but that may contain elements from others
6 Testing tentative constructions	Testing new ideas developed through the group	6a. "what if" questions/statement
		6b. proposed behaviors that incorporate newly constructed ideas
7 Reporting application of newly constructed knowledge	Behavior is provoked by discussions resulting in reports about activities in which a participant engaged	7a. statements indicating that new ideas are being tried
		7b. reports of attempts (successful or unsuccessful) to implement a new concept or idea

Figure 3: Interaction Analysis model (adapted from Hull & Saxon, 2009)

Although it is beyond the scope of this article to give a detailed account of these statistical results (see Mroz, 2012 for more details), it is worth noting that descriptive statistics indicate a significant decrease in instances of lower levels of CT abilities as the activity progressed, and, conversely, a significant increase in instances of higher levels. Results also indicate that the consensus-building task led to a peak in higher level of CT abilities as well as in variability among students, particularly at Level 5 (negotiation and co-construction). Results thus show a significant although increasingly asymmetrical progression of the

Table 1. Coding at Level 5

Indicators	Participants	Units of meaning	Translation
	Benard:	Je juste trouve le journal de Lea Carron	I just find Lea Carron's diary
		Elle etait faire chanter les personnes	She was blackmail people
	Jacqueline:	Florence, tu fais chanter mon mari ?	Florence, do you blackmail my husband?
	Florence :	Non,	No,
(5a)		Lea fait chanter Bernard et moi	Lea blackmails Bernard and me
	Jacqueline:	J'ai trouve un lettre pour 500 euros aussi a Jean-Pierre et Chantal	I found a letter for 500 euros too to Jean-Pierre and Chantal
(5c)		Donc Lea fais chanter Florence et Bernard et Jean-Pierre et Chantal	So Lea blackmail Florence and Bernard and Jean-Pierre and Chantal
		Donc, quoi est-ce que la tue?	So, what to kill her?
		Qu'est-ce que de Audrey ?	What of Audrey?
(5b)	Florence:	Elle était enceinte*	She was pregnant*

Note. * idea presented by Jacqueline as new information earlier that day.

learners' L2 CT abilities, particularly due to the consensus-building task and particularly impacting the process of L2 negotiation and co-construction of meaning. The sequential analysis showed two types of significant patterns: (1) discursive plateaus (trends of consecutive units of meaning at the same level), sustained the longest at Level 5, and direct discursive transfers (progression from one level of CT abilities to the next level up). Results thus show that the activity led collectively to the linear progression of learners' discursive markers of L2 CT abilities.

Findings for RQ2

Many themes emerging from the interviews cross-referenced with several of our pre-established list of affordances of the VLLE and of the different stages we hypothesized were involved in the meaning-making process (Figure 4).

We will primarily focus on the themes that best inform the impact of the VLLE on negotiation and co-construction of meaning, namely: (a) the diverse social aspects of collaborative learning in the VLLE and the activity; and (b) students' epistemological stands on the use of technology for L2 learning.

| | Stages of the L2 negotiation and co-construction of meaning process | | | | | | | | |
| Emerging themes in the focal group students' interviews / Aspects of the problem-based *VLLE* perceived to have an impact on L2 negotiation and co-construction of meaning | Social interactions and participation with others | | | Dissonances | | Arbitration and critical convergence | | | Internalization in French (inner voice) |
	Anticipation of collaborative small groups	Assimilation of avatar identity	Anonymity induced by avatar	Malleability under pressure of dissonance	3D representation of space	Impact of information capital acquired in VLE on social dynamic	Arbitration as interconnection of information	Critical convergence and power relationships in the VLE	Internalization in French (inner voice)
Properties of the VLLE									
• Immersive		X			X				X
• Multimodal				X		X			
• Social	X	X	X			X	X	X	X
• 3D representation of space					X				
• 3D persona representing learners (avatar)		X	X						
• Synchronous interactions				X				X	X
• Transfer of knowledge									
• Acting on the environment					X				
• Underlying pedagogical principles → *Characteristics of the problem-based activity*									
- Learner-centeredness									X
- Authenticity		X	X		X				
- Contextualization				X	X	X			
- Complexity				X		X	X	X	
- Multiple perspectives					X		X	X	
- Collaborative learning	X		X				X	X	
- Tools supporting internalization	X	X			X		X		

Figure 4: Cross-referencing of the themes emerging from the interviews

Social aspects of collaborative learning

The collaborative nature of the activity was not equally welcomed by all students in the group. Initially, Jacqueline and Daniel were enthusiastic, while Charlotte and Florence admitted being more comfortable in a teacher-fronted environment because of their shyness or lack of self-confidence. Bernard was resistant to collaborative work, which he described as a 'confusing social space

where nothing tangible [could] get accomplished', considering that learning French in isolation from others was more efficient.

Students' perceptions evolved as the activity progressed. Prompted to determine if the avatar-mediated nature of their interactions had an impact on their collaborative work, they unanimously admitted equating their fictional character and its online representation with themselves. Jacqueline felt that it decreased the anxiety she felt in face-to-face settings. Daniel also commented:

> Working through an avatar was really cool because you don't know who you're working with, so you can't really judge that person. You work with people, without really having any previous opinions about them and you just have to trust them. (interview, 16 May 2011)

The anonymity afforded by the avatar was thus perceived as beneficial for collaborative learning, decreasing the inherent anxiety and self-awareness felt when exposing their imperfect command of the L2, and increasing their engagement in the task and eagerness to take risks. Some also considered that it led to prejudice-free and trust-based relationships, which enhanced the quality and density of their social interactions.

To assess the impact of dissonances promoted by the puzzle-like structure of the activity on their collaborative learning, students were prompted to determine and comment on whether the group mainly agreed or disagreed with each other. They unanimously answered the latter and commented positively on it, as demonstrated by Florence:

> My group members, they're good about not always saying 'yeah! We agree!'. They're good about being like 'No, this is what I think', which is helpful because you need people to be like 'No! this is why it's different, because I have this fact and this fact'. Because we only have fragmented clues, so you need each other to put the clues together, and if everybody's agreeing with you all the time, then you're just going to go way off into a different direction and you're going to come to the wrong conclusion. (interview, 8 May 2011)

Students were also asked to reflect on the social dynamic of their group in view of the case they were building. They all considered that their respective role in the group was determined by the capital of information they had each harvested in the VLLE (the number of clues and testimonies collected). All five students agreed that Jacqueline had earned the role of leader as she had collected the most information (confirmed in the logs from students' *Detective Notebooks*). Charlotte and Bernard considered themselves as 'followers', and Florence and Daniel as 'active helpers'. However, no student commented on the quality of the information actually contained in the clues. Relevance of the type of information shared with the group was thus not considered a

criterion in determining their social role, which demonstrates certain limitations in their emerging CT abilities.

During the exit interview, students were asked how they felt about the case the group had defended and if they had been heard in the building of this case. They unanimously answered that, although it had turned out to be wrong, their case was plausible and supported by meaningful evidence, and all agreed that their individual contributions had been fully taken into consideration. However, when later prompted to reflect on their personal dissonances, all but Jacqueline confessed that they had a different idea than the one presented by the group. This was confirmed in on-screen recordings and notes from the *Detective Notebooks*: as the group appointed Jacqueline leader, her voice became predominant and led to several instances of self-censuring from other students (e.g., Daniel typing meaningful contributions in the chat but erasing them or never sending them; Florence generating hypotheses in her private notes but never testing them with the group).

The students thus seemed to be aware of the fact that their individual contributions could only be taken into consideration in the building of the case to the extent that they had actually shared their individual dissonances with the group, but did not seem to connect the subsequent instances of self-censuring to the social dynamic they had forged in their group, let alone to the roots of this social dynamic, namely, the capital rather than the relevance of information retrieved from the semiotic budget of the VLLE (van Lier, 2000: 252).

Epistemological views on technology for L2 learning

Before the intervention, students were asked to describe their typical use of technology to learn French. Jacqueline's answer is a fair representation of the group's responses:

> I use technology for French for a lot of verbs, that aren't in the book and that I can't find in the dictionary. I use *conjugation.com*. It's really helpful and it's fast. Sometimes, I use *Google Translate* if I don't want to spend 45 minutes trying to solve a paragraph. I'll type it in and then it'll say what it means, that way I can finish my homework. (interview, 2 May 2011)

This was congruent with a recurrent observation made during Phase 1: Jacqueline and Bernard making extensive use of their dictionary during class. Students were also asked about their expectations regarding the VLLE for training purposes prior to the intervention. Charlotte's response captures the essence of the group's expectations:

> If we do exercises on the computer, and you type your answer and it responds back 'this is wrong' or 'this is right', I think it'll help putting words together. (interview, 3 May 2011).

During interview #2, students were asked to describe how they felt the VLLE was impacting their understanding and interactions. Charlotte and Florence mentioned having some initial difficulties navigating the 3-D space and making sense of the buildings' locations. Jacqueline and Bernard commented on the lack of access to an online dictionary, despite access to a 200-word glossary. They initially showed acute signs of resistance to the dissonances arising in the group's discourse: on-screen recordings for the first three days showed very frequent interruptions of their reading or writing process through an abundance of switching back and forth between windows to access the glossary and verify the translation of several words. Bernard explained he was very concerned with form and accuracy, and Jacqueline commented she was afraid she would miss something in the story and in the chat. Both showed intense signs of frustration. Prompted to expand, Jacqueline characterized her experience as follows:

> It just feels that you're literally thrown into this entire world, with only a couple of key words that you really, really know, and the rest, you just have to – or iffy about – and people are – you're trying to solve this problem and people are saying things to you and you are not sure what they mean and it's – it's frustrating. It's a culture shock, I think. (interview, 7 May 2011)

Later asked how she remedied this issue, she explained she decided to let go of trying to understand every single word and to rather use the broader context offered by the VLLE and the multimodal texts to make informed guesses on meaning. Charlotte, Daniel, and Bernard also highlighted the importance of the VLLE 3-D representation of space which, once they were used to navigating through it, provided landmarks on which to anchor their experiential understanding of the story. Bernard also explained that working around his negative reaction unexpectedly turned into a positive experience:

> I'm always that guy who, if I don't know a word, I'm just looking it up in the dictionary. What [the problem-based VLLE] does is that it makes you have to think for yourself rather than, in a school setting, you have your book, your notes, and things to look back at. It's making me have to actually think about what I'm going to say. I have to simplify, I have to find the best alternative to what I was going to say that was super drawn out in English. The other day, I didn't know what 'an affair' was in French, so I just put that they were making love in French. That way, to me, it makes sense. I don't know if it's correct, but it makes sense to me. (interview, 15 May 2011)

To assess the potential emergence of *internalization*, as the process at stake in converting language into psychological artifacts that mediate mental functioning (Lantolf, 2006), notably CT, students were prompted to explain and describe whether they were able to think in French and how their inner voice worked during French tasks. During interview #1, Daniel and Florence

explained that they were not able to. Charlotte, Jacqueline, and Bernard felt they could think in French from time to time, describing it as a process of spontaneous translation from English to French.

During interview #3, Charlotte and Jacqueline kept characterizing it as a process of spontaneous translation, yet the frequency and speed of which they felt had increased during the activity. Bernard, Florence, and Daniel mentioned more radical changes, related to 'not having to think'. Daniel described it as follows:

> There was a moment when I was interrogating one of the people, for some reason, I was thinking in French, I'm not sure why. But it was cool because I didn't really have to go from English to French. I was just able to just ask her straight on, without really having to think much. (interview, 16 May 2011)

Florence also explained that the sustainability of her French inner voice would stop as soon as she reverted to focusing on form. Bernard expressed a similar idea and reflected on the way he now approached thinking in French:

> You've memorized your whole language in English, so you should just be able to memorize another language later, right?. But I've gotten out in the mindset of 'oh! *Je* is *I*', and '*moi* is *me*'. I've been trying to relate 'no! *je* is *je*', even if it means '*I*'. Does it make sense? I'm trying not to think 'oh! How do I say "I'm going to the store", like "je … going … aller"'. I'm trying to just equate that '*je*' is '*je*' and why it's '*je*', rather than having that underlying translation there. I'm just trying to look at '*je*' and know that it means '*I*' without actually thinking '*I*' but thinking '*je*'. Does that make sense? (interview, 15 May 2011)

Discussion

Dialectical purpose

The exploration of the focal group's collective discourse (RQ1) served as a first step toward the shift in paradigm and method prompted by CALL researchers (Chapelle, 2005) to alleviate some of the limitations found in quantitative studies. The use of on-screen videos was particularly instrumental in confirming Rourke and Anderson's (2004) warning that automatic scripted chat logs alone were insufficient, in the messy co-construction of a collaborative discourse, to 'investigate learner language for evidence of how L2 development proceeds through and is constituted by meaning-making' (Ohta, 1995: 95) in order to access and account for the cognitive processes at play in L2 CT. Through the association of scripted logs and screen captures, it was possible to reconstruct the overall discursive context (Brooks & Donato, 1994) needed to more reliably quantify verbal data in order to track the process of emergence of L2 CT skills by assessing the function of each unit of meaning in this collective discourse.

Our shift in paradigm and method also permitted to adopt a fresh way of looking at the old question of L2 negotiation of meaning in CALL (van Lier, 2000), which was found to be the most prominent, steadiest, and most sustainable aspect encountered in 'how [these] learners socially construct[ed] the shared understanding through which language is acquired' (Ohta, 1995: 96). By accounting for social interactions among learners in meaning-making activities (Kuriscak & Luke, 2009), it was shown that learners in the group unanimously found merit in having to fill in the gaps in understanding that arose in their disagreements. The integration of findings promoted by our mixed methods design confirmed that these gaps in understanding, from which episodes of L2 negotiation of meaning originated, acted and were perceived as opportunistic and beneficial dissonances (Jauregi, 1997; Vandergriff, 2006), from which discourse at higher levels of CT emerged, rather than as interrupters of this discourse or markers of dysfunctionality (Varonis & Gass, 1985).

More specifically, exposing learners to a consensus-building task confirmed Lantolf's (2006) theory on the role of complex tasks to promote the use of L2 to mediate psychological activity for higher mental processes. Consensus-building revealed to be the task that more readily prompted the emergence of higher levels of L2 CT and can be argued to have contributed the most to the onset of an internalization process (as reported in the evolution of students' inner voice in French), i.e., the appropriation and conversion of a social use of the L2 to a psychological use of the L2 aimed at regulating higher-order cognitive activities such as critical thinking (Lantolf, 2006).

However, the nature of the task alone cannot explain the general pattern of progression toward higher levels of CT. Rather, as posited by Kramsch and Steffensen (2008), the students' meaning-making process extended beyond their discourse, as they negotiated and arbitrated the very meaning of learning and approached it in the interrelation sustained between themselves, their environment, and the tools at their disposal: students felt that the quality and density of their social interactions had been enhanced by the decreased anxiety and self-awareness that the anonymity of their avatar afforded them; Bernard moved away from translating and experienced a profound epistemological shift, where thinking in the L2 served as the starting point to the original creation of discourse and meaning; Jacqueline used the cues provided by the surrounding multimodal context and 'derive[d] part of its semiotic budget (…) [to] engage [actively] in meaning-making' (van Lier, 2000: 252) to overcome the dissonances she experienced; Charlotte and Daniel embraced the experiential understanding of space that the VLLE afforded them, which, together with their avatar, led to a beneficial form of suspension of disbelief. As these aspects of the negotiation of meaning process could not be *directly* accounted

for by Hull and Saxon's (2009) Interaction Analysis model, future research on CT will need to augment its list of indicators to fully account for social, contextual, and environmental factors.

Initiation purpose

The initiation purpose that guided the design of this study allowed for the discovery of contradiction and confirmed the need to account for the holistic and messy process of L2 learning in context in CALL (Blake, 2008; Meskill, 2005; Saarenkunnas, Kuure, & Taalas, 2003; Schulze, 2001). Indeed, two elements were found to interfere with or contradict the general pattern of progression toward higher levels of CT: the technocentric approach initially adopted in the meaning-making process, and the power relationships at play in the group.

Students' initial use of technology for L2 learning showed that they approached it as a provider of ready-made answers, an unchallenged prescriber of meaning, and an automatized assessor and corrector of the accuracy of the sort of closed-item grammatical output they were used to producing. This initial assumption regarding the role of technology for L2 learning can be attributed to the technocentric view that not only continues to dominate research in CALL (Huh & Hu, 2005), but also endures in the classroom and, as we saw, unduly influences L2 learning too. More specifically, the initial resistance and frustration displayed by Bernard and Jacqueline perfectly illustrated the skewed understanding of the affordances of the VLLE. Technological properties can only enhance learning if they are perceived as relevant and activated by learners (van Lier, 2000). This supports O'Rourke's (2005) and others' call to reorient research on CALL to better consider where the source of interaction is located, and furthers this call by arguing that both practitioners and researchers alike should, in fact, be more resolutely aware of the impact of these erroneous assumptions on L2 learning in CALL.

Moreover, an important discrepancy was discovered between the impact of power relationships in the group (mirroring the asymmetrical relationship found in our statistical analysis), and the lack of perception of this impact. The integration of findings that our mixed methods design permitted allowed to confirm Flower's (1994) and Jauregi's (1997) conclusions on the need to account for the impact of power relationships on the quality and function of the discourse produced by a group in episodes of L2 negotiation of meaning. This study confirmed that the mutuality inherent in L2 negotiation of meaning (i.e., the capacity for each interlocutor to affect others and be affected by them to some extent) does not imply equality or prevent the formation of power relationships (i.e., the fact that authority is given to some voices at the expense of others in the process) that can impede the reciprocity and collaboration in the co-construction of discourse and the development of CT skills. It was further

shown that the emergence of these power relationships could be in part related to the impact of the learning environment, insomuch as students considered that the *quantity* of its semiotic budget, rather than its *quality*, was the primary determiner of their social function in the group. Future research is needed that further investigates the impact of VLLEs on the social aspects of collaborative learning; and to examine the nature and role of the parts of discourse in collaborative learning that are directly impacted by power relationships, notably instances of deleting and/or self-censuring, i.e., of text being produced but never sent and thus never integrated into the collective discourse.

Conclusion

By following the shift in both paradigm and method that CALL researchers have been advocating in view of the limitations of quantitative approaches to research, this study contributed to a new trend of research, able to revisit 'old questions' like L2 negotiation of meaning, while also pursuing new research questions, like the impact of VLLEs in the emergence of higher-order thinking skills such as L2 CT. By adopting a dual sociocultural and ecological framework, this study gained in legitimacy to understand 'the [complex] way language learning technologies and virtual environments mediate learners' acquisition of a second language' (Kramsch & Steffensen, 2008: 24). It also contributed to show how validity and reliability can be enhanced through the adoption of a pragmatic approach to research methodology and the selection of a mixed methods design, allowing highlighting of the contextual and social realities at work in CALL interactions, as well as the discovery of contradictions to account for the holistic and messy process of L2 learning in CALL. Although inherently limited in its capacity to make generalizable claims by its scope and its number of participants, this article nevertheless provides an example of the type of rich contextualized and process-oriented studies that research in CALL could benefit from. We will finally argue that, to carry the field of CALL and SLA forward, more research efforts are needed that deviate from the trend of empirical, quantitative-based, and technocentric approaches that has unduly dominated the field and its publications, in order to contribute to a more balanced research landscape in CALL.

About the author

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References

ACTFL. (1999, 2001). *ACTFL Proficiency Guidelines.* Retrieved from http://www.actfl.org/i4a/pages/index.cfm?pageid=4236

Beißwenger, M. (2008). Situated chat analysis as a window to the user's perspective: Aspects of temporal and sequential organization. *Language@Internet,* 5 (6), 1–19. Retrieved from http://www.languageatinternet.de/articles/2008/1532

Blake, R. (2008). *Brave New Digital Classroom: Technology and Foreign Language Learning.* Washington DC: Georgetown University Press.

Brooks, F. B., & Donato, R. (1994). Vygotskyan approaches to understanding foreign language learner discourse during communicative tasks. *Hispania,* 77 (2), 262–274. http://dx.doi.org/10.2307/344508

Campbell, J., Smith, D., Boulton-Lewis, G., Brownlee, J., Burnett, P. C., Carrington, S., & Purdie, N. (2001). Students' perceptions of teaching and learning: The influence of students' approaches to learning and teachers approaches to teaching. *Teachers & Teaching,* 7 (2), 173–187. http://dx.doi.org/10.1080/13540600120054964

Chapelle, C. (2005). CALL in the year 2000. Still in search of research paradigms? In Y. Zhao (Ed.), *Research in technology and second language learning. Developments and directions,* 39–60. Greenwich, CN: Information Age Publishing.

Chi, M. (1997). Quantifying qualitative analyses of verbal data: a practical guide. *Journal of the Learning Sciences,* 6 (3), 271–315. http://dx.doi.org/10.1207/s15327809jls0603_1

Creswell, J. W., & Plano Clark, V. L. (2007). *Designing and Conducting Mixed Methods research.* Thousand Oaks, CA: SAGE Publications.

Feldon, D. F., & Kafai, Y. B. (2008). Mixed methods for mixed reality: Understanding users' avatar activities in virtual worlds. *Educational Technology Research & Development,* 56 (5), 575–593. http://dx.doi.org/10.1007/s11423-007-9081-2

Felix, U. (2005a). What do meta-analyses tell us about CALL effectiveness? *ReCALL,* 17 (2), 269–288. http://dx.doi.org/10.1017/S0958344005000923

Felix, U. (2005b). Analyzing recent CALL effectiveness research: Towards a common agenda. *Computer Assisted Language Learning,* 18 (1 & 2), 1–32. http://dx.doi.org/10.1080/09588220500132274

Felix, U. (2008). The unreasonable effectiveness of CALL: What have we learned in two decades of research?. *ReCALL,* 20 (2), 141–161. http://dx.doi.org/10.1017/S0958344008000323

Flower, L. (1994). *The Construction of Negotiated Meaning: A Social Cognitive Theory of Writing.* Carbondale, IL: Southern Illinois University Press.

Foster, P., & Ohta, A. S. (2005). Negotiation for meaning and peer assistance in second language classrooms. *Applied Linguistics,* 26 (3), 402–430. http://dx.doi.org/10.1093/applin/ami014

Gibson, J. J. (1979). *The Ecological Approach to Visual Perception.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis,* 11 (3), 255–274. http://dx.doi.org/10.3102/01623737011003255

Huh, K., & Hu, W. (2005). Criteria for effective CALL research. In J. L. Egbert, & G. M. Petrie (Eds), *CALL Research Perspectives,* 9–21). Mahwah, NJ: Erlbaum.

Hull, D. M., & Saxon, T. F. (2009). Negotiation of meaning and co-construction of knowledge: An experimental analysis of asynchronous online instruction. *Computers and Education, 52*(3), 624-639. http://dx.doi.org/10.1016/j.compedu.2008.11.005

Janesick, V. J. (1994). The dance of qualitative research design: Metaphor, methodolatry and meaning. In N. K. Denzin, & Y. S. Lincoln (Eds), *Handbook of Qualitative Research*, 209-219. Thousand Oaks, CA: SAGE Publications.

Jauregi, K. (1997). *Collaborative Negotiation of Meaning: A Longitudinal Approach.* Amsterdam: Rodopi.

Jeong, A. C. (2003). The sequential analysis of group interaction and critical thinking in online threaded discussions. *The American Journal of Distance Education,* 17 (1), 25–43. http://dx.doi.org/10.1207/S15389286AJDE1701_3

Kramsch, C., & Steffensen, S. (2008). Ecological perspectives on second language acquisition and socialization. In P. A. Duff, & N. H. Hornberger (Eds), *Encyclopedia of Language and Education* (2nd edn), 17–28. New York: Springer. http://dx.doi.org/10.1007/978-0-387-30424-3_194

Krippendorff, K. (2004). *Content Analysis. An Introduction to its Methodology* (2nd edn). Thousand Oaks, CA: SAGE Publications.

Kuriscak, L. M., & Luke, C. L. (2009). Language learner attitudes toward virtual worlds: An investigation of Second Life. In L. Lomicka, & G. Lord (Eds), *The Next Generation: Social Networking and Online Collaboration in Foreign Language Learning,* 173–198. San Marcos, TX: CALICO.

Lantolf, J. P. (2006). Sociocultural theory and L2. State of the art. *Studies in Second Language Acquisition,* 28 (1), 67–109. http://dx.doi.org/10.1017/S0272263106060037

Lantolf, J. P., & Thorne, S. L. (2007). Sociocultural theory and second language learning. In B. VanPatten, & J. Williams (Eds), *Theories in Second Language Acquisition,* 201–224. Mahwah, NJ: Erlbaum.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic Enquiry.* Beverly Hills, CA: SAGE Publications.

Lipman, M. (1988). Critical thinking – What can it be? *Educational Leadership,* 46 (1), 38–43. Retrieved from http://www.ascd.org/ASCD/pdf/journals/ed_lead/el_198809_lipman.pdf

Long, M. (1983). Native speaker / nonnative speaker conversation and the negotiation of comprehensible input. *Applied Linguistics,* 4 (2), 126–141. http://dx.doi.org/10.1093/applin/4.2.126

Long, M. (1996). The role of the linguistic environment in second language acquisition.

In W. C. Ritchie, & T. K. Bhatia (Eds), *Handbook of Research on Language Acquisition: Second Language Acquisition* (Vol. 2), 413-468. New York, NY: Acadmic Press. http://dx.doi.org/10.1016/b978-012589042-7/50015-3

Markee, N. (2000). *Conversation Analysis.* Mahwah, NJ: Erlbaum.

Meskill, C. (2005). Metaphors that shape and guide CALL research. In J. L. Egbert, & G. M. Petrie (Eds), *CALL Research Perspectives,* 25–40. Mahwah, NJ: Erlbaum.

Mroz, A.P. (2012). *Nature of L2 negotiation and co-construction of meaning in a problem-based virtual learning environment: a mixed methods study*. (Unpublished doctoral dissertation). The University of Iowa, Iowa City, IA.

Pietkiewicz, I., & Smith, J. A. (2014). A practical guide to using Interpretative Phenomenological Analysis in qualitative research psychology. *Psychological Journal,* 20 (1), 7–14. http://dx.doi.org/10.14691/CPPJ.20.1.7

Ohta, A. M. (1995). Applying sociocultural theory to an analysis of learner discourse: Learner-learner collaborative interaction in the zone of proximal development. *Issues in Applied Linguistics,* 6 (2), 93–121. Retrieved from http://escholarship.org/uc/item/0zs5j7ps

Oliver, W. C., & Nelson, T. (1997). Un Meurtre à Cinet (Un homicidio en Toluca): A web and email whodunit to develop writing competence in Intermediate-level language classes. *International Journal of Educational Telecommunications,* 3 (2), 205–217. Retrieved from http://www.editlib.org/p/15140

O'Rourke, B. (2005). Form-focused interaction in online tandem learning. *CALICO Journal, 22* (3), 433–466. Retrieved from https://www.calico.org/memberBrowse.php?action=article&id=144

Rocco, T. S., Bliss, L. A., Gallagher, S., Perez-Prado, A., Alacaci, C., Dwyer, E. S., *et al.* (2003). The pragmatic and dialectical lenses: Two views of mixed methods use in education. In A. Tashakkori, & C. Teddlie (Eds), *Handbook of Mixed Methods in Social and Behavioral Research,* 595–615. Thousand Oaks, CA: SAGE Publications.

Rourke, L., & Anderson, T. (2004). Validity in Quantitative Content Analysis. *Educational Technology Research and Development,* 52 (1), 5–18. Retrieved from http://scholar.google.com/citations?view_op=view_citation&hl=en&user=19zDF-8AAAAJ&citation_for_view=19zDF-8AAAAJ:roLk4NBRz8UC http://dx.doi.org/10.1007/BF02504769

Saarenkunnas, M., Kuure, L., & Taalas, P. (2003). The polycontextual nature of computer-supported learning. Theoretical and methodological perspectives. *ReCALL,* 15 (2), 202–216. http://dx.doi.org/10.1017/S0958344003000624

Salomon, G. (2000, June). It is not just the tool, but the educational rationale that counts. Montreal, Canada. Retrieved from Keynote address at the 2000 Ed-Media Meeting: Retrieved from http://www.aace.org/conf/edmedia/00/salomonkeynote.htm

Savin-Baden, M. (2008). From cognitive capability to social performance? Shifting perceptions of learning in immersive virtual worlds. *ALT-J Research in Learning Technology,* 16 (3), 151–161. http://dx.doi.org/10.1080/09687760802526731

Schegloff, E. A. (1993). Reflections on quantification in the study of conversation. *Re-*

search on Language and Social Interaction, 26 (1), 99–128. http://dx.doi.org/10.1207/s15 327973rlsi2601_5

Schulze, M. (2001). Human language technologies in computer-assisted language learning. In A. Chambers, & G. Davies (Eds), *ICT and Language Learning: A European Perspective,* 111–132. Lisse: Sets and Zeitlinger.

Smith, B., & Gorsuch, G. J. (2004). Synchronous computer mediated communication captured by usability lab technologies: New interpretations. *System,* 32 (4), 553–575. http://dx.doi.org/10.1016/j.system.2004.09.012

Strijbos, J. W., Martens, R. L., Prins, F. J., & Jochems, W. M. (2006). Content analysis: What are they talking about? *Computers & Education,* 46 (1), 29–48. http://dx.doi.org/10.10 16/j.compedu.2005.04.002

Swain, M., & Lapkin, S. (1998). Interaction and second language learning: Two adolescent French immersion students working together. *The Modern Language Journal,* 82 (3), 320–337. http://dx.doi.org/10.1111/j.1540-4781.1998.tb01209.x

Teddlie, C., & Yu, F. (2007). Mixed methods sampling. A typology with examples. *Journal of Mixed Methods Research,* 1 (1), 77–100. http://dx.doi.org/10.1177/2345678906292430

van Lier, L. (2000). From input to affordance: Social-interactive learning from an ecological perspective. In J. P. Lantolf (Ed.), *Sociocultural Theory and Second Language Learning,* 245–259. Oxford: Oxford University Press.

van Lier, L. (2004). *The Ecology and Semiotics of Language Learning. A Sociocultural Perspective.* Norwell, MA: Kluwer Academic Publishers. http://dx.doi.org/10.1007/1-4020-7912-5

Vandergriff, I. (2006). Negotiating common ground in computer-mediated versus face-to-face discussions. *Language Learning & Technology,* 10 (1), 110–138. Retrieved from http://llt.msu.edu/vol10num1/pdf/vandergriff.pdf

Varonis, E., & Gass, S. (1985). Nonnative / nonnative conversations: A model for negotiation of meaning. *Applied Linguistics,* 6 (1), 71–79. http://dx.doi.org/10.1093/applin/6.1.71

Wooffitt, R. (2005). *Conversation Analysis and Discourse Analysis. A Comparative and Critical Introduction.* London: SAGE Publications.

Zhao, Y. (2005). Recent developments in technology and language learning. In Y. Zhao (Ed.), *Research in Technology and Second Language Learning. Developments and Directions,* 17–37. Greenwich, CN: Information Age Publishing.

Appendix

Levels of critical thinking in students' discourse (Friedman's test)

	Levels of critical thinking abilities (from Hull & Saxon's (2009) IA model)						
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
N	5	5	5	5	5	5	5
c^2	15.59	18.80	6.55	12.16	26.28	26.87	8.00
Df	7	7	7	7	7	7	7
Asymp. Sig.	0.029*	0.009**	0.477	0.096	0.000**	0.000**	0.333

Note. $* < 0.05$. $** < 0.01$