

# Inner Speech, Dialogue Text and Collaborative Learning in Virtual Learning Communities

Stefanos Nikiforos      Katia Lida Kermanidis

Department of Informatics, Ionian University,

7, Tsirigoti Sq., 49100, Corfu, Greece

{c13niki;kerman}@ionio.gr

## Abstract

**English.** Virtual Learning Communities offer new opportunities in education and set new challenges in Computer Supported Collaborative Learning. In this study, a detailed linguistic analysis in the discourse among the class members is proposed in five distinct test case scenarios, in order to detect whether a Virtual Class is a community or not. Communities are of particular importance as they provide benefits to students and effectively improve knowledge perception. This analysis is focused on two axes: inner speech and collaborative learning as they both are basic features of a community.

**Italiano.** *Le comunità di apprendimento virtuale offrono nuove opportunità nel campo dell'istruzione e propongono nuove sfide nella Supported Collaborative Learning. In questo lavoro viene proposta, in cinque scenari distinti di prova, un'analisi linguistica dettagliata del discorso instaurato tra i membri di una classe. L'analisi è volta a rilevare se una classe virtuale sia o no una comunità. Le comunità sono di particolare importanza in quanto forniscono benefici per gli studenti e sono un modo efficace di migliorare la percezione della conoscenza. Questa analisi è focalizzata su due assi: il discorso interiore e l'apprendimento collaborativo in quanto entrambi sono caratteristiche fondamentali di una comunità.*

## 1 Introduction

Virtual Learning Communities (VLCs) constitute an aspect of particular importance for Computer Supported Collaborative Learning (CSCL). The stronger the sense of community is, the more effectively is learning perceived, resulting in less isolation and greater satisfaction (Rovai, 2002; Daniel et al, 2003; Innes, 2007). Strong feelings of community provide benefits to students by increasing 1) the commitment to group goals, 2) collaboration among them and 3) motivation to learn (Rovai, 2002). Virtual Classes (VCs) are frequently created and embodied in the learning

procedure (Dillenbourg and Fischer, 2007). Nevertheless there are questions arising: *Is every VC always a community as well? How can we detect the existence of a community? What are its idiosyncratic properties?* Sharing of knowledge within a community is achieved through shared codes and language (Daniel et al, 2003; Stahl, 2000; Innes, 2007). Language is not only a communication tool; it also serves knowledge and information exchange (Dillenbourg and Fischer, 2007; Knipfer et al, 2009; Daniel et al, 2003; Bielaczyc and Collins, 1999). Communication and dialogue are in a privileged position in the learning process due to the assumption that knowledge is socially constructed (Innes, 2007).

*Collaborative learning (CL)* is strongly associated with *communities* as it occurs when individuals are *actively* engaged in a *community* in which learning takes place through collaborative efforts (Stahl et al, 2006). This active engagement is achieved through public discussion, which is a central way for a community to expand its knowledge (Bielaczyc and Collins, 1999). Developing an understanding of how meaning is collaboratively constructed, preserved, and re-learned through the media of *language* in group interaction, is a challenge for CL theory (Daniel et al, 2003; Wells, 2002; Warschauer, 1997; Koschmann, 1999). *Inner speech (IS)* is an esoteric mental language, usually not outwardly expressed, having an idiosyncratic syntax. When outwardly expressed, its structure consists of apparent lack of cohesion, extensive fragmentation and abbreviation compared to the outer (formal) language used in most everyday interactions. Clauses keep only the predicate and its accompanying words, while the subject and its dependents are omitted. This does not lead to misunderstandings if the thoughts of the individuals are in accordance (they form a community). The more identical the thoughts of the individuals are, the less linguistic cues are used (Vygotsky, 2008; Socolov, 1972).

Various works using discourse analysis have been presented in the CSCL field: some of them focus on the role of dialogue (Wells, 2002), oth-

ers examine the relationship between teachers and students (Blau et al., 1998; Veermans and Cesareni, 2005), while others focus on the type of the language used (Maness, 2008; Innes, 2007), on knowledge building (Zhang et al., 2007), or on the scripts addressed (Kollar et al., 2005). Spanger et al. (2009) analyzed a corpus of referring expressions targeting to develop algorithms for generating expressions in a situated collaboration. Other studies use machine learning techniques in order to build automated classifiers of affect in chat logs (Brooks, 2013). Rovai (2002), examined the relationship between the sense of community and cognitive learning in an online educational environment. Daniel et al. (2003) explored how the notions of social capital and trust can be extended in virtual communities.

Unlike these studies, the proposed approach, for the first time to the authors' knowledge, takes into account the correlation between community properties and both inner speech and collaborative learning features (Bielaczyc and Collins, 1999) by applying linguistic analysis to the discourse among class members as a means for community detection. To this end, the discourse of four different types of VCs is analyzed and compared against non-conversational language use.

## 2 Inner speech linguistic analysis model

In a community, under certain conditions, the specific features of inner speech appear in outer (surface) speech (Socolov, 1972). The stronger the presence of inner speech, the more confident we are of the existence of a community. The stronger the specific mental action of inner speech is, the clearer the peculiarities of its syntax structure appear (Vygotsky, 2008; Wiley, 2006). A linguistic analysis based on the following features is therefore proposed (Appendix A).

In inner speech there is a common code for communication among the communicating parties (Emerson, 1983) transforming the language genre and style, and making it more specific (*IS1, IS2, IS3*) (Vygotsky, 2008; Wiley, 2006). The main feature of inner speech is ellipticity (Vygotsky, 2008). The *informal clauses* (Maness, 2008; Pérez-Sabater, 2012), the clauses having *no verb*, the semantically abbreviated clauses being *elliptical* in meaning, the reduced use of *subordination*<sup>1</sup> and of *prepositional*

*phrases* and the average number of words in the clauses (Wiley, 2006) are features of ellipticity in the language. *Punctuation* is likely to be sparse as well (Brooks et al., 2013; Pérez-Sabater, 2012; Mannes, 2008). The *word types* used, are another indicator of inner speech. In inner speech, use of *adverbs* is not so essential, due to the common/mutual understanding (Emerson, 1983). Absence of *adjectives* makes the language elliptical, ambiguous and general. In inner speech "adjectives and other modifiers can usually be dispensed with" (Wiley, 2006). Use of *Greeklish* (informal written language, typing Greek words with Latin letters), *informal words* (shortened and simplified word forms, idioms, diminutives) and *emoticons* indicate informal communication, a basic feature of inner speech, (Brooks et al., 2013; Pérez-Sabater, 2012; Mannes, 2008).

In inner speech, where common/mutual understanding exists, the message is definite and clear to the receiver (Emerson, 1983; Mairesse et al, 2007). Therefore the use of indefinite articles will be limited, while definite articles are likely to constitute the majority. Using additional terms (*IS13, 14, 15, 16*), is essential for achieving formal communication, but not necessary for inner speech. *Abbreviation* is a core feature of inner speech (Vygotsky, 2008; Socolov, 1972; Wiley, 2006). *Metaphors* are powerful for creating and exchanging rich sets of meaning (Daniel et al, 2003). Use of abbreviation and metaphors require a prior common understanding between the sender and the receiver, indicating inner speech. In contrast, use of *similes* indicates a necessity for additional information. So, their *absence* is an indicator for inner speech. *IS-20*: The percentage of distinct words in the discourse within a community is usually restricted (Vygotsky, 2008). Therefore, the *vocabulary richness* is poor (Wiley, 2006; Mairesse et al, 2007).

## 3 Collaborative learning linguistic analysis model

Collaboration is considered to be the most important shared characteristic in VLCs (Daniel et al, 2003). Analysis of the discourse, among the members of a class, focused on specific characteristics (Appendix B), can provide us with index marks of collaborative learning (CL).

Use of *verbs in the 1st person plural form* constitutes an indicator of team action or knowledge that has been produced collaboratively (Mc Millan and Chavis, 1986). Emotion is an elementary characteristic of the discourse within

<sup>1</sup> In case subordinate clauses are used as an object, they are not to be taken into account, because they are essential for the meaning of the sentence.

a community (Mc Millan and Chavis, 1986; Brooks et al., 2013) and is directly related to inner speech as well (Wiley, 2006). Emotion is distinguished between *positive* and *negative*. In the case of CL, the majority of the emotional words will express positive emotion, as there is strong correlation between the members' positive experience and the community bond (Mc Millan and Chavis, 1986; Mairesse et al, 2007). Community members feel the need to reward their partners for their effort (Bielaczyc and Collins, 1999; Mc Millan and Chavis, 1986; Mairesse et al, 2007). *Clauses of negation* (containing negative words: *no, not, don't*) are likely to be *less* frequent as collaboration *increases* (Mairesse et al, 2007). *Clauses of reason*: their use shows that a member of a team respects his team (he is proposing something, without giving orders). Use of *familiarity words* indicates the intimacy among the members of a team which has been transformed into a community (Mairesse et al, 2007). In a VC where the students do not know each other before the creation of the class, this metric is a strong indication of the existence of a community. Use of *inclusive words* (like *together, team, company, community*) and *social words* (like *friend, colleague, mate*) offer an index of a feeling of membership (Mairesse et al, 2007) and provide an index mark for the existence of a community (Mairesse et al, 2007). Using *pronouns in the 1st person plural form* indicates the sense of belonging to a team, the co-construction of knowledge and the feeling of sharing with others (Mc Millan and Chavis, 1986). The average number of 1st person pronouns to the total number of pronouns (*CA12*) and to the total number of personal and possessive pronouns (*CA13*) is therefore counted.

#### 4 Case studies and Results

The five different learning communities used as case studies in this work are described in this section. *Virtual class 1 (VC1)* was created between an elementary school (ES:20 students, ages 11-12) and a high school (HS:20 students, ages 12-13) located in two different towns in Greece. The target of that project was the collaboration between the two classes in order to create a wiki about the location they live in. Students were divided into working groups of two or three. The teachers had a supporting and inspirational role and tried to minimize their involvement. Wikispaces was the collaborative platform used. During the project students were exchange-

ing communication messages via a special web page. Discourse in VC1 is divided in two sub-groups (*VC1.1, VC1.2*) for the needs of the analysis. *VC1.1* contains the discourse among the team members after having completed their task. Students expressed their impressions and feelings for the already completed project. In this case, there was *no problem* to be solved and the students chatted in a more free frame. *VC1.2* pertains to the discourse among the team members during the project. *Virtual Class 2 (VC2)* was created between two elementary schools (ES1 and ES2: 20 students each, ages 11-12) located in different towns in Greece. ES1 students were the same ones described in VC1. Designing of this project was the same as in VC1. The two main differences that have to be mentioned were: i) the difference between the educative level of the students in VC1 which does not exist in this VC, and ii) the previous experience for the ES1 students gained through their participation in VC1. *Virtual class 3 (VC3)*: A real class was transformed into a virtual one through running a project using online collaborative tools. The target of the project was the creation of presentations for a national holiday. The students were the same of ES1 that joined in the two aforementioned VCs. Students were divided in groups of two or three. *Teachers had an active instructive role*. The selected environment was Google Drive. Two files were created in order to create a collaborative platform: one presentation file and one document file for the necessities of the communication among the group members. *Student's essay texts (ST)*: The results of the conversational analysis (usually informal-Brooks, 2013; Bielaczyc and Collins, 1999) in the aforementioned VCs are compared against non-conversational language use, in order to detect differences. For this reason, students' essay texts (ST) were used in the analysis. These texts are narrative and they were written by the students of ES1 that took part in the VCs. They were written within the linguistics course in their school throughout the same school year when the case studies took place, by 7 different students (4 boys and 3 girls) out of a total of 20 in the class. They contain 3.577 words and 666 clauses, while VC1.1 had 210 and 52, VC1.2 had 453 and 106, VC2 had 471 and 102 and VC3 had 704 and 147 respectively. In the analysis these essay texts were treated as a single corpus.

Appendices C and D show the results for the two linguistic analysis models (percentage values for all aforementioned features). Statistical sig-

nificance testing (two tailed independent t-test - Roussos and Tsaousis, 2006) was applied to detect differences between every VC and the ST. Bold indicates significance at  $p < .05$  level, italics at  $p < .02$  level and asterisks at  $p < .01$  level.

## 5 Discussion

VCS examined in this study were transformed into communities, providing students with the benefits of the community membership. In VC3 which was a priori a community as the students had already been working as a team for seven years (from kindergarten till the 6th grade), the community existence was confirmed. Comparison between the VCs and the ST reveals that there are statistically significant differences in the language used. In VCs the language was mainly informal, elliptical in meaning and abbreviated (the basic features of inner speech). The students of these VCs collaborated enough and had the membership feeling. The active in-

structive role of the teachers affects the language and makes it more formal. There are differences in the language use between problem-based and non-problem based projects. The existence of a common code and the mutual understanding in communities was confirmed. Existence of emotion among community members and their positive attitude was confirmed as well.

## 6 Conclusion

Applying linguistic analysis to the discourse among the members of a VC can provide us with useful results. Combining the result of the two categories (inner speech and collaboration) we can get strong indications of community existence. Furthermore, results of the analysis can help us improve the design of the VCs. However there is room for future research, e.g. applying this model and evaluating it on a larger corpus and different case studies.

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## Appendices

IS1	Omission of Subjects	IS2	Omission of Conjunction
IS3	Informal clauses	IS4	Omission of verbs
IS5	Elliptical clauses	IS6	Words per clause
IS7	Words per period	IS8a	Parenthesis
IS8b	Commas	IS8c	Question marks
IS8d	Dots	IS8e	Exclamation Marks
IS8f	Full stops	IS8g	Punctuation (total)
IS9a	Adverbs	IS9b	Adjectives
IS9c	Greeklsh	IS9d	Informal words
IS9e	Emoticons	IS10a	Advs of place
IS10b	Advs of time	IS10c	Advs of manner
IS10d	Advs of certainty	IS10e	Quantitative advs
IS10f	Interrogative advs	IS10g	Relative advs
IS10h	Viewpoint & commenting advs	IS11a	Subordinate clauses
IS11b	Prepositional phrases	IS12a	Definite articles/total
IS12b	indefin articles/total	IS12c	Articles/total words
IS12d	Articles/periods	IS13	Apposition
IS14	Epexegeis	IS15	Additional terms in genitive case
IS16	Additional terms in accusative case	IS17	Abbreviations
IS18	Metaphors	IS19	Similes
IS20	Word variety		

Appendix A. Inner Speech Analysis summary

CA1	Verbs in 1st plural person	CA2	Emotional clauses
CA3	Rewarding clauses	CA4	Clauses of negation
CA5	Clauses of reason	CA6	Familiarity words
CA7	Inclusive words	CA8	Social words
CA9	Emotional words	CA10	Positive emotion
CA11	Negative emotion	CA12	Use of 1st person plural pronouns
CA13	Use of 1st person plural pronouns		

Appendix B. Collaboration Analysis summary

<i>Feature id</i>	<i>VC 1.1</i>	<i>VC 1.2</i>	<i>VC 2</i>	<i>VC 3</i>	<i>ST</i>
CA-1	<b>0,76*</b>	<b>0,43*</b>	<b>0,31*</b>	<b>0,03</b>	0,16
CA-2	<b>0,33*</b>	<b>0,21</b>	<b>0,22</b>	0,10	0,05
CA-3	0,02	<b>0,16*</b>	<b>0,16</b>	0,06	0
CA-4	<b>0*</b>	0,03	0,07	0,06	0,05
CA-5	<b>0,29*</b>	0,02	0,01	0,01	0,02
CA-6	<b>0,33*</b>	<b>0,05*</b>	<b>0,02</b>	<b>0,04</b>	0
CA-7	0,01	0	0	0	0
CA-8	<b>0,06</b>	0	0,01	0,02	0
CA-9	<b>0,18*</b>	<b>0,10*</b>	<b>0,07</b>	0,04	0,02
CA-10	<b>1,00*</b>	0,55	<b>0,94</b>	0,68	0,65
CA-11	<b>0*</b>	0,45	<b>0,06</b>	0,32	0,35
CA-12	<b>0,33</b>	0,44	<b>0,68*</b>	0	0,08
CA-13	0,34	<b>0,47</b>	<b>0,70*</b>	0	0,10

Appendix C. Results for collaborative linguistic analysis model

(Bold indicates significance at p<,05 level, italics at p<,02 level and asterisks at p<,01 level)

<i>Feature id</i>	<i>VC 1.1</i>	<i>VC 1.2</i>	<i>VC 2</i>	<i>VC 3</i>	<i>ST</i>
IS-1	<b>0,88</b>	<b>0,92*</b>	<b>0,85</b>	0,51	0,67
IS-2	<b>0</b>	0,02	0,12	0,14	0,03
IS-3	<b>0,23</b>	<b>0,75*</b>	<b>0,58*</b>	<b>0,69*</b>	0
IS-4	0,04	<b>0,21*</b>	<b>0,25*</b>	<b>0,14</b>	0,01
IS-5	0,12	<b>0,57*</b>	<b>0,34*</b>	<b>0,61*</b>	0,04
IS-6	<b>4,04*</b>	<b>4,27*</b>	<b>4,62*</b>	4,79	5,37
IS-7	12,35	<b>7,08*</b>	<b>7,03*</b>	<b>8,09*</b>	12,82
IS-8.a	0	0	0,03	0,01	0
IS-8.b	<b>0,02*</b>	<b>0,08*</b>	<b>0,02*</b>	<b>0,14</b>	0,18
IS-8.c	0,02	0,03	0,20	<b>0,07</b>	0
IS-8.d	0,02	0,03	0,02	0,02	0
IS-8.e	0,52	<b>0,28*</b>	0,15	0,06	0,02
IS-8.f	<b>0,13*</b>	<b>0,26*</b>	<b>0,24*</b>	0,25	0,40
IS-8.g	0,71	0,68	0,65	0,54	0,61
IS-9.a	0,12	0,07	0,06	0,06	0,06
IS-9.b	<b>0,01*</b>	0,07	<b>0,04</b>	0,08	0,09
IS-9.c	0	0	0,13	0,01	0
IS-9.d	0,02	<b>0,06*</b>	<b>0,07*</b>	<b>0,08</b>	0
IS-9.e	0	0	0	0	0
IS-10.a	0,16	0,18	0,33	0,26	0,16
IS-10.b	<b>0*</b>	0,12	<b>0*</b>	<b>0,09</b>	0,34
IS-10.c	0,28	0,24	<b>0,07*</b>	0,26	0,23
IS-10.d	0	0	0	0	0
IS-10.e	<b>0,56</b>	0,39	0,30	0,33	0,27
IS-10.f	0	0	0	0	0
IS-10.g	0	0,03	0	0	0,01
IS-10.h	0	0,03	<b>0,30</b>	0,05	0
IS-11.a	0,29	<b>0,12</b>	0,14	<b>0,07*</b>	0,23
IS-11.b	0,25	<b>0,21</b>	0,25	0,29	0,36
IS-12.a	<b>1,00*</b>	<b>0,98</b>	<b>0,97*</b>	0,94	0,88
IS-12.b	<b>0*</b>	<b>0,02</b>	<b>0,03*</b>	0,06	0,12
IS-12.c	<b>0,09</b>	0,12	<b>0,12*</b>	0,16	0,15
IS-12.d	<b>1,12</b>	<b>0,84*</b>	<b>0,87*</b>	<b>1,26*</b>	1,90
IS-13	0	0	0	0	0
IS-14	0,02	0	0,01	0,01	0,01
IS-15	<b>0*</b>	<b>0,01*</b>	<b>0*</b>	0,02	0,03
IS-16	<b>0*</b>	<b>0*</b>	<b>0*</b>	<b>0*</b>	0,01
IS-17	0	0	0,02	0,04	0
IS-18	<b>0*</b>	<b>0*</b>	0,04	0,12	0,04
IS-19	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	0,02
IS-20	0,34	0,39	0,36	0,38	0,50
IS-20	Average of VCs: <b>0,37*</b>				0,50

Appendix D. Results for IS linguistic analysis model

(Bold indicates significance at p<,05 level, italics at p<,02 level and asterisks at p<,01 level)