Annals of the Academy of Romanian Scientists
Series on Science and Technology of Information
ISSN 2066-8562 Volume **8**, Number **2**/**2015**

ANALYSIS OF THE TYPES OF PAUSES IN CSCL CHAT CONVERSATIONS

Sibel DENISLEAM (MOLOMER)[1], Stefan TRAUSAN-MATU[2]

Abstract. *The paper presents a research that is focused on considering the role of pauses in Computer-Supported Collaborative Learning chats. Several goals are pursuit, in the direction of analyzing cognitive and social aspects related to pauses in chats, and to identify criteria based on them for grading students. A classification of pauses in chats is introduced starting from their duration and adjacency pairs. Three chats were manually annotated and statistics were computed. Grading rules for students are proposed based on the types of pauses.*

Keywords: Chat, Dialogue analysis, Natural Language Processing, Pause, Computer-Supported Collaborative Learning

1. Introduction

Exchanging information through dialogue is done at an ever accelerated pace in the daily life of this new century. Moreover, the road from simple to complex conversations has been opened in recent years due to the affordance of debates in the Web2.0 (Social Web) collaborative environments such as instant messenger (chat).

Some main factors, which give contour to the exchange of information within the chat collaborative communication are the real time in which the conversation of the participants takes place, the rhythm and pauses in the flow of discussion.

The main element of communication that underlies the chat type technology within the collaborative environment is to ensure the exchange of information between participants, based on the sequence of the utterances that in turn build the communication act [1]. Starting from the general advantages of chat conversations in the direction of encouraging collaboration we can emphasize the advantage of using chat in the educational area, giving to both students and teachers the possibility of a much faster learning and assessment.

Chat conversations are a major ingredient of Computer Supported Collaborative Learning (CSCL). Several systems have been developed for providing analyses of interactions between participants, for example: Polyphony [2], PolyCAFe [3],

[1]PhD student, Department of Computer Science, University ”Politehnica” of Bucharest, Romania, (d_sybelle@yahoo.com).
[2]Prof., PhD, Faculty of Automatic Control and Computers, University Politehnica of Bucharest, Senior Researcher, Research Institute for Artificial Intelligence of the Romanian Academy, full member of the Academy of Romanian Scientists (stefan.trausan@cs.pub.ro).

based on Latent Semantic Analysis (LSA), Natural Language Processing (NLP) [4, 5, 6] and Social Network Analysis (SNA) [6, 7]. However, as we know, the role of pauses in conversation has not been considered in previous approaches in CSCL. This paper tries to make some steps in the direction of filling this gap.

The paper presents a research directed towards analysing the types of pauses in chat conversations, with the purpose of providing patterns for developing NLP tools for classifying pauses depending on the participant's utterances and adjacency pairs in the conversation.

The starting point in the analysis is based on identifying the participants in a conversation, their utterances and the interval of time between the participants' utterances. From the participant's perspective, the analysis and classification of the pause patterns involve considering certain cognitive processes, an implication that can be seen quantitatively, qualitatively as well as socially. The participants provide various answers depending on the questions, can offer solutions, and all these aspects are fundamentally important in the construction and identification process of pauses.

In our analysis we used conversations from Computer-Supported Collaborative Learning sessions in which students had the task of discussing about collaborative technologies ("chat", "wiki" , "blog", "forum") where each participant is intended to support his/her idea on this technology. In light of these conversations, the utterances and their utterances are the key points and with their help we will identify the types of pauses in chat conversations. The utterance is the first step in detecting pauses and for this we defined a coding (markup) of utterances on which we build the specific markup of pauses in chat conversations. The analysis of patterns of pause types for their identification is done on an XML coding of the chat logs, highlighting the types depending on the utterance type, the duration between utterances as well as the number of utterances.

The paper continues with presenting Bakhtin's concept of dialogism, followed by a section which contains an analysis and classification of types of pauses. The experiment is presented in the fourth section and in the following section is discussed how the results may be used for grading students.

2. Concepts of dialogue in chat conversations

Discourse analysis in our approach is based on Bakhtin's dialogical theory [8, 9, 20]. He considered that dialogical relations are "a much broader phenomenon than more rejoinders in a dialogue, laid out compositionally in the text; they are an almost universal phenomenon, permeating all human speech and all relationships and manifestations of human life—in general, everything that has meaning and significance." [20, 25].

Dialogue is based on words, which are the essential element of both an online conversation and a face-to-face conversation. The exchange of words in conversations is constituted through utterances [9] and represents a bridge between the participants' contributions. Utterances can be seen as linguistic actions whereby the key element is the word. Theories approaching these linguistic actions were described by both Mikhail Bakhtin and Ferdinand de Saussure. The difference between these theories is that Bakhtin considers words also as a kind of utterance, being filled with echoes of other utterances, while de Saussure considered words as arbitrary signs.

Dialogue can be regarded as an exchange of utterances between several participants, each of such utterances being associated with one or more speech acts. Austin introduced the theory of speech acts that includes constative acts and performative acts, a development of this theory being done by Searle [16, 17]. Speech acts were associated with two classes of functions that represent the basics of DAMSL architecture (Dialog Act Markup in Several Layers) [21, 22], called anticipatory functions ("forward looking function") and regressive adaptation functions ("backward looking function"). The exchange of utterances associated with speech acts and the exchange of words associated with utterances form the central point of departure in analysing chat conversations.

3. Description of the concept of pause. Types of pauses

Silence can be a resource to communicate some elements of a problem which are not written easily. It can appear as: gaps/lacunae, interruptions (lapses) or pauses [14]. We will consider in this paper the concept of pause symbolized by the silence between the participants' utterances in the conversation that, depending on the number of participants, may take different aspects. Important factors in describing the concept of pause are the number of participants, the time, the written text, and the type of speech act. The term "pause" started its influence as early as 1959 in the Anglo-Saxon literature when Maclay H and C.E.Osgood [13] describe it as the "hesitation phenomena". We meet again this hesitation phenomenon ("*Phenomene d'hesitation*") in the works of Maria Cândea [18] described by the following terms: filled pauses ("*pauses remplies*"), elongated syllables *("syllabes allonges"),* repetitions *("repetition"* [19]) and false starts *("faux departs"* [19]).

Before discussing literature about pauses, we should mention that pauses are considered by researchers in different contexts: reading text, monologues, and conversations. Regarding the latter case, only face-to-face or phone conversations involving only two participants are usually taken into account. In recent years, due to its explosive usage, instant messenger ("chat") should also be considered and important differences between these two types of conversations are present. This paper analyzes this second case.

We can highlight a first classification of pauses by recalling Linde's description that supports the idea that there are the following types of pauses: "extended pauses between 3-16 seconds, long pauses between 1-1.9 seconds, and short pauses between 0.1-0.6 seconds" [10]. Also, in a work of Kristine Fors [11] we find the idea that short pauses are greater in number. Starting from this classification, long pauses may be indicators of thinking and having as result the providing of better answers, reflected in the number of words explaining the ideas of a sentence.

Short pauses are many times associated to the usage of short utterances. They have the role to allow sharing the sentence idea and underline a better control on the interaction between participants.

In terms of utterances, we can say that the pauses between exchanges of utterances are the most frequent, followed by pauses with selection, that means one participant is explicitly selected to answer by an other, and then by pauses before the response given by the participant [12].

If we analyze a chat conversation, we can see the problems faced by the participants and we can enumerate some of the complex tasks they may face, such as: determining the intervention time, determining whether the speaker intends to continue the conversation, preparation of what themselves might say. From here we emphasize the idea that both chat and face-to-face conversations are characterized by pauses in which the main role is given to the length during pauses. However, in the instant messenger (chat) case, as compared to the face-to-face one, to the duration of pause we should add the duration of typing the text.

Conversations logs help us define another category of pauses, with the participant in the lead role. The participant may be called to take over the conversation, to end a conversation or to intervene in a conversation. According to these moments of conversation, we may say that there are the following categories of pauses identified by Kristina Lundholm, and Jessica Villing [11]:

a) ”pause internal within”
b) ”pause internal between”
c) ”pause initial”

We conclude the classification of the types of pauses referring again to the concept of silence and define a "*pause silencieuse*" as any pause which includes: a) non-structuring pauses b) structuring pauses [18]. The difference between the two types of pauses lies in that the structuring pause is between two sound sequences emitted by the same person and preceded by a sound sequence like interjections, for example *um*, or the repetition of certain words, while a non-structuring pause is preceded by words repetitions, monosyllabic repetitions, and false starts [18].

All these classifications of the types and features of pauses will be used in analysing conversations in collaborative environments also referring to the types of pauses associated to the code of utterances which will be described in the next section. A table of codes for each type of pause based on which the analysis of chat files will be done, will also be presented in the next section (Table 3).

4. Experiment

During chat conversations, a major factor is represented by the explicit references [27] and the identification of implicit references, which will help us analyse the evolution of the participants in the conversation, identify the types of pauses in the conversation, and analyse the participation degree of a student depending on the utterances used. This article aims to identify utterance-reply pairs (through explicit references) used by the participants, and based on them, to determine the types of utterances and the types of pauses depending on the utterance emitted by the participant.

The experiment consisted in analysing the logs of three conversations of some computer science students debating, in an assignment at the Human-Computer Interaction course, about collaborative technologies (chat, forum, blog, wiki). Chat conversations are represented in XML files [2, 3, 7, 25]. The utterances that we will analyse are represented as:

```
<Turn nickname="participant1">
   <Utterance genid="11"
      time="03.23.34"
      ref="0">
      well we are all here..can we start?
   </Utterance>
</Turn>
```

where:

nickname is participant's name;
genid represents the unique id associated to the utterance;
ref represents the reference to which the utterance explicitly refers to using the chat tool facilities [27]; in case its value is 0, it means that it did not refer to any utterance;
time shows us the moment in which the utterance was written;
the text that appears between the **'Utterance'** tags represents of the utterance itself.

A manual annotation of the chat log files has been done. Each chat had 4-5 participants and an average of 100-450 utterances.

Question type utterances and answer type utterances were identified, each being classified according to how one participant asked or a answered question.

Starting from a classification of the types of utterances presented in a previous section, we have identified three types of pauses specific to the utterances-replies pairs used: short, medium, and long. We have classified the three types of pauses through a manual analysis of the three files based on the number of utterances, the average time between consecutive utterances and the utterances used by a single participant.

We present below ways of grading and evaluating the participant in a conversation carried in a collaborative environment (chat).

5. Evaluating and grading the participants in a chat conversation

We can look to words, groups of words, phrases, interjections, and symbols rendered by a question or an answer in the form of utterances that determine intent, mental state or other feelings of the one in conversation.

The utterances generated during conversations may refer implicitly or explicitly to previous ones, distinguished through co-references, repetitions, lexical chains, [14] inter-animation [15] in the case of implicit references and the possibility of referral in the case of explicit ones (through the facilities of some chat environments, such as ConcertChat [27]).

A factor determining student's contribution in the chat conversation can be the types of her utterances, which can have a positive or a negative aspect, and which reflect student's contributions. Therefore, the participants' assessment method is carried out by means of the set of utterances used. The student can answer to a participant, ask a question or continue an idea, all of which being important in building the utterance set. We can achieve another criterion for determining the level of a participant grading starting from how students support their ideas on the technology chosen.

The utterances that have an explicit reference to a previous utterance indicate that the participant uses that reference to support or criticise that idea, that it is a continuation of an idea, showing that there is strong communication between participants and also a very good criterion for student's assessment. We can also consider the utterance that is referenced by several utterances as a significant utterance.

Besides the communication between participants, there are other factors involved in students' assessment, evidenced by the number of utterances exchanged, the type of utterances used, the total number of pauses, pause type, as well as by the utterance structure made of the number of utterances. The factors described represent the starting point in the analysis of participants, and the participants' final grade is deduced from the factors stated.

In the assessment process we can take into account four important factors in the manual analysis of chat conversation (see Table 1).

Table 1

Factor	***Factor description***
Type of utterance	Question, answer
Structure of utterances	Number of interchanged utterances
Pause	Time between utterances
Structure of pauses	Number of pauses, type of pauses

The manual analysis is focused on two directions: on the one hand, on highlighting types of utterances and the other hand, on highlighting pauses. From the perspective of a quantitative analysis, it can easily be noticed the types of utterance used by the participant, which may lead to a description of how to grade the participant. Another important aspect is the quantitative analysis of the number of pauses that also contribute to assess the student's participation degree.

In the assessment process of a student, the utterances that are explicitly referenced by the current utterance of the conversation and the utterance type were considered. The type of utterance and the type of pause are based on codes (mark-ups) of utterances and codes of the types of pauses. Each chat log file was analysed in terms of number and duration of pauses, yielding an average of the three files of *50.56* s, *66* s, and *64.39* s.

Based on these values, we defined three categories of pauses:

a) short pauses in the interval *1* s - *49* s*;*

b) medium pauses in the interval *50 s - 66 s;*

c) long pauses for values greater than *67 s.*

The results are influenced by the nature of manual annotation process and factors involved:

- Number of long pauses: 122, number of short pauses: 235, number of medium pauses: 61
- Number of utterances, between 203-397
- Participant's scoring (number of utterances/participant's utterance) between 2.57 and 7.52

We continue the description of our analysis with the description of the code set for tagging the utterances (inspired from previous sets of codes [23, 24]) in Table 2.

Table 2

Code	***Meaning***
	General
S	Statement – affirmation
RS	Regulate – to introduce a rule
	Questions
QY	Yes-no question
QW	Wh-question - Question with an answer other than yes/no (when, who, where, etc.)
QR	Or/or-clause question (question ”... or ... or ...”)
QH	Rhetorical question
QO	Open ended question
R	Request
O	Offer (for example, a solution, an idea)
	Answers
YN	Short Y/N answer: yes, yep, no, ok, k etc.
A	Agree- Acceptance, confirmation with a longer answer than Y/N
D	Disagree - Non-acceptance, negation with a longer answer than Y/N
C	Critique
E	Explanation
RE	Repair, correction
RS	Respond, more general than the codes below that are tied to problem solving
F	Continuation, follow
EL	Elaboration, development
EX	Extension (for example, of a question)
U	Uncertain response

Starting from this code set, pause coding is derived. The type of pause (short, medium, and long) is indicated as a prefix to the actual code. For example, **PS-YN** means a short pause for an Y/N answer (yes, yep, no, ok, k, etc.), **PM-YN** a medium pause, and **PL-YN** a long pause for the same type of answer.

In Table 3 is presented a fragment of one of the log files containing the name of the utterer, the text of the utterance, its number, the referred utterance, its time stamp, the duration between consecutive utterances, and the pause between an utterance and the referenced utterance (if it exist an explicit reference).

After the manual analysis considering the codes described above, the utterance "and so, it can be confusing" has associated the code **C (critique)**, the duration between utterances is 11 *s,* which leads us to considering it as a short critique pause.

The utterance "in blogging however, only allowed users can post, and that makes it more accurate" is a utterance with code **E (explain)**, the duration between utterances is 36 *s* and we have a short explain pause.

Table 3

Name of Participant	*Utterance*	*Utt. no.*	*No. of referred utt.*	*Time stamp*	*Inter-utterance duration*	*Pause*
Liviu	yes, but wiki has a major problem	40	36	03.28 .21	15	
Liviu	the major problem of wiki is that too many people can change the content	41		03.28 .49	28	
Liviu	and so, it can be confusing	42	41	03.29 .00	11	11
...	...	...	...	...	...	...
Liviu	yes, but not "everybody" is smart or capable of editing or adding valuable content	79	76	03.35 .47	31	
Andreea	*dragos, if i write something, somebody can come and edit what i wrote, true?*	80		03.35 .51	4	
dragos	well yes....	81		03.36 .06	15	
Andreea	well that's bad	82		03.36 .14	8	
dragos	not really	83		03.36 .20	6	
Liviu	in blogging however, only allowed users can post, and that makes it more accurate	84	79	03.36 .23	3	36

The diagram in Figure 1 shows the participants in the conversation, the number of utterances and the number of pauses.

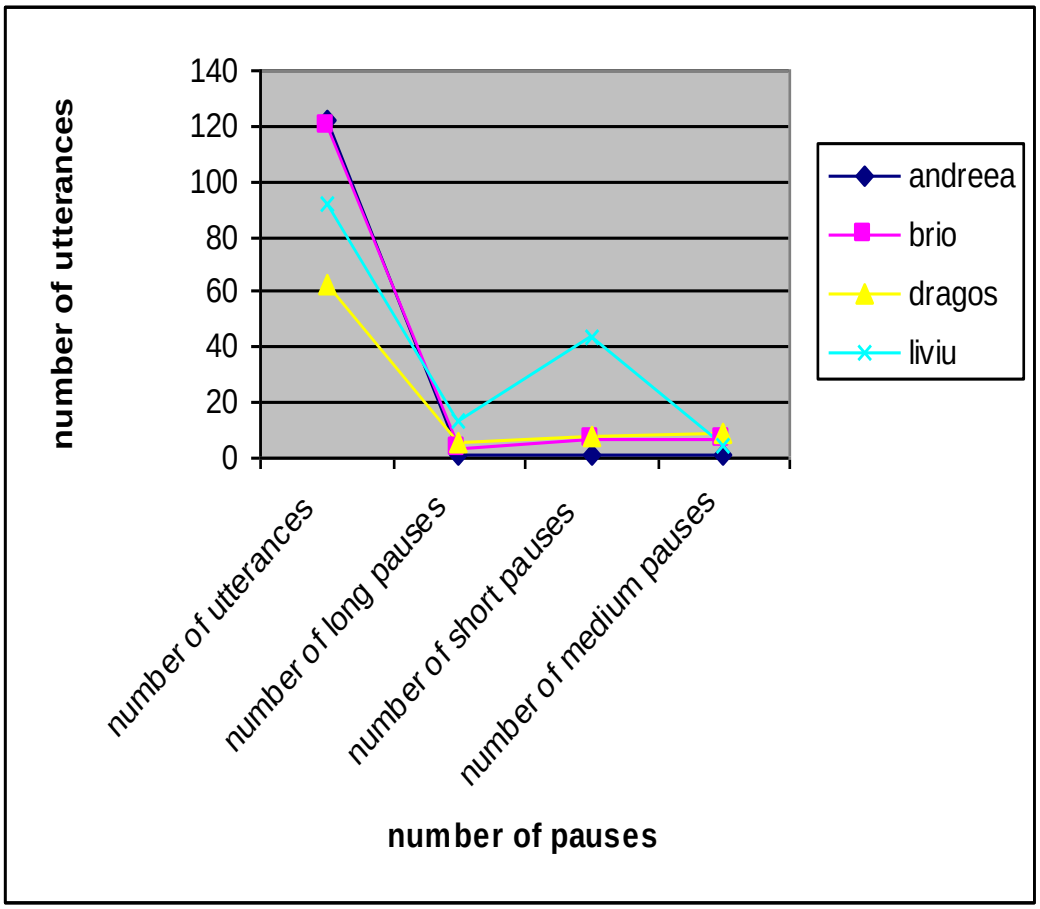

Fig. 1. Representation pattern of the number of utterances and pauses / participant

Based on the obtained results, the analysis of all files with chat logs was done, obtaining an assessment and grading of participants.

On a scale from 1 to 5 we have considered the following grading categories:

1 – INSUFFICIENT,
2- SUFFICIENT,
3 - MEDIUM,
4 - GOOD,
5 – VERY GOOD.

In this classification, the types of utterances and pauses were taken into account.

A tentative grading scheme that we propose is to assign a **VERY GOOD** scoring to a participant if a great number of short pauses combined with agreement / affirmation utterances appear in the conversation. **GOOD** is given for short pauses and Y/N utterances, explanation and continuation, **MEDIUM** for medium pauses and utterances of agreement and explanation, **SUFFICIENT** for long pauses and utterances of explanation and agreement, and **INSUFFICIENT** for long pauses and utterances of continuation and non-agreement (see Table 4).

Table 4

Grading type of participant	*Grading characteristics*
1/INSUFICIENT	Long pauses – continuation – non-agreement utterances
2/SUFICIENT	Long pauses – explanation – agreement utterances
3/MEDIUM	Medium pauses – agreement– explanation utterances
4/GOOD	Short pauses – agreement – explanation utterance
5/VERY GOOD	Short pauses – agreement – affirmation utterance

Another aspect that we have taken into account in the manner of grading classification was the coverage percentage of these pause types specific to utterances.

For example, a percentage with the highest value is found in the short affirmation pauses 80%, followed by the medium agreement pauses 45%, long agreement pauses 38%, short agreement pauses 31%.

The lowest values are found in the case of medium continuation pauses 9%, medium explanatory pauses 11%, uncertain short pauses 11%, short explanatory pauses 13%.

6. Conclusions

This paper aims to assess the participants' contribution in a collaborative environment by creating a manual method, which can be automated, which considers the numbers and types of utterances and pauses. From the dialogism perspective, we analysed the texts of the conversations and outlined the commitment levels of each participant in the conversation, participant's assessment and grading in collaborative terms.

Computer-Supported Collaborative Learning [26] offers, besides the possibility of effective communication between students, the possibility of assessment and grading of the participant in conversation.

In this paper we have taken into account utterances that have explicit references and, based on adjacency pairs of such utterances, we have experimented how, using a manual annotation, an analysis of the types of pauses can be performed. We have also established a grading level of participants in the conversation starting from utterance numbers and types of pauses.

In the future, we will bring contributions by improving the possibility to analyze the entire corpus of chat we have developed in recent years, to identify all types of pauses and all utterances for the entire corpus, and to develop and asses the grading criteria based on pauses.

Acknowledgements

The work has been funded by the Sectoral Operational Program Human Resources Development 2007-2013 of the Ministry of European Funds through the Financial Agreement POSDRU/159/1.5/S/132397.

REFERENCES

[1] Linell, P. (**2009**), *Rethinking language, mind, and world dialogically: Interactional and contextual theories of human sense-making*, Information Age Publishing: Charlotte, NC., Greenwich.

[2] Trausan-Matu, S., Rebedea, T., Dragan, A., & Alexandru, C. (**2007**), *Visualisation of Learners' Contributions in Chat Conversations*, In: J. Fong & F.L. Wang (Eds.): Blended Learning: Addison-Wesley.

[3] Trausan-Matu, S., & Rebedea, T. (**2010**), *A Polyphonic Model and System for Inter-animation Analysis in Chat Conversations with Multiple Participants*, In: A. Gelbukh (Eds.): Cicling 2010, Springer Berlin / Heidelberg, LNCS. 6008, pp. 354- 363.

[4] Rose, C. P., Wang, Y.C., Cui, Y., Arguello, J., Stegmann, K., Weinberger, A., Fischer, F. (**2007**), *Analyzing Collaborative Learning Processes Automatically:Exploiting the Advances of Computational Linguistics in Computer-Supported Collaborative Learning*, International Journal of Computer-Supported Collaborative Learning, 3, Springer, pp. 237-271 .

[5] Dong, A. (**2006**), *Concept formation as knowledge accumulation: A computational linguistics study*, Artif. Intell. Eng. Des. Anal. Manuf. 20, 1, 35-53.

[6] Dascalu, M., Chioasca, E.V., Trausan-Matu S. (**2008**). ASAP - D. Dochev, M. Pistore, and P. Traverso (Eds.): *AIMSA 2008*, LNAI 5253, Springer, pp. 58–68.

[7] Trausan-Matu, S., Rebedea, T. (**2009**), *Polyphonic Inter- Animation of Voices in VMT*, In: Stahl, G. (Eds): Studying Virtual Math Teams, Boston, MA, Springer US, pp. 451-473.

[8] Bakhtin, M.M. (**1981**), *The dialogic Imagination; Four Essays*. University of Texas Press.

[9] Bakhtin, M.M. (**1986**), *Speech Genres and other Late Essays*, University of Texas Press.

[10] Brown, G., Yule, G. (**1983**). *Discourse Analysis*, Cambridge University Press.

[11] Lundholm Fors, K., Villing, J., (**2011**) *Reducing cognitive load in in-vehicle dialogue system interaction.* SemDial: Proceedings of the 15th Workshop on the Semantics and Pragmatics of Dialogue, Los Angeles, California, 2011, pp. 55–62.

[12] Goldman-Eisler. F. (**1972**), *Pauses, clauses, sentences*, Language and Speech 15. pp. 103-113.

[13] Maclay, H., & Osgoog, C.E. (**1959**), *Hesitation phenomena in spontaneous English speech*, Word, 15, pp. 19-44.

[14] Sacks, H., Schegloff, E. A., Jefferson, G.A. (**1974**), *A simplest systematics for the organization of turn-taking in conversation*, Language, 50. pp. 696-735.

[15] Wegerif, R. (**2005**) *A dialogical understanding of the relationship between CSCL and teaching thinking skills*, in Koschman,T., Suthers, D. & Chan, T.W (Eds.): Computer Supported Collaborative Learning: The Next 10 Years! Mahwah, NJ.pp.707-716.

[16] Austin, J.L.(**2003**). *Cum să faci lucruri cu vorbe*. Editura Parelela 45.

[17] Boboc A.I, (**1997**). *Limbaj și ontologie*. Editura Didactică și Pedagogică.

[18] Candea, M. (**2000**), *Contribution à l'étude des pauses silencieuses et des phénomènes dits "d'hésitation" en français oral spontané*. Université Paris III-Sorbonne. U.F.R. de Littérature et linguistique françaises et latines.

[19] Fox Tree, J. E. (**2002**). *Interpreting pauses and ums at turn exchanges*, Discourse Processes, 34(1), pp. 37-55.

[20] Bakhtin, M.M. (**1984**). *Problems of Dostoevsky's poetics* (Emerson, C., Trans. C. Emerson (Eds.): Minneapolis: University of Minnesota Press.

[21] Allen, J., Core, M. Draft of DAMSL: *Dialog Act markup in Several Layers,* ftp://ftp.cs.rochester.edu/pub/packages/dialog-annotation/manual.ps.gz.

[22] Juravsky, D., Martin, J. (**2000**) *Speech and Language Processing. An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition,* Prentice Hall: San Francisco.

[23] Shafiq Joty & Giuseppe Carenini, Chin-Yew Lin. *Unsupervised Modeling of Dialog Acts in Asynchronous Conversations*, Proceedings of IJCAI 2011, last accessed at 18 August **2015** http://www.cs.ubc.ca/~carenini/PAPERS/ijcai11CR-Joty.pdf.

[24] Tavafi, M., Mehdad, Y., Joty, S., Carenini, G.,Raymond Ng. (**2013**). *Dialogue Act Recognition in Synchronous and Asynchronous Conversations*, Proceedings of the SIGDIAL 2013 Conference, pp. 117–121.

[25] Trausan-Matu, S., Dascalu, M.,&Rebedea, T. (**2014**). *PolyCAFe—automatic support for the polyphonic analysis of CSCL chats*, International Journal of Computer-Supported Collaborative Learning, pp. 7-8.

[26] Stahl, G. (**2006**). *Group Cognition. Computer Support for Building Collaborative Knowledge*, MIT Press.

[27] Holmer, T., Kienle, A., Wessner, M. (**2006**) *Explicit Referencing in Learning Chats: Needs and Acceptance*, in Nejdl, W., Tochtermann, K. (Eds.): Innovative Approaches for Learning and Knowledge Sharing, First European Conference on Technology Enhanced Learning, Lecture Notes in Computer Science, 4227, Springer, pp. 170-184.