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THE MESSAGE CONTENT CATEGORY AS ANALYSIS UNIT FOR DISCUSSIONS STUDY IN ASYNCHRONOUS DISTANCE EDUCATION FORA

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Abstract

This paper focuses on the content analysis, a technique frequently used for the approach of issues concerning asynchronous computer mediated discussion groups in distance education. Despite the fact that this research technique is frequently used, there are still no standards established. There is a variety of approaches, varying both at detail's level and at the type of categories of analysis they use. In this paper the content category as a unit of analysis for the explanation of messages at the asynchronous distance education fora is presented, which is incorporated in the modelling in a formal language and the development of a respective system done by Hellenic Open University for this purpose.

Keywords: *E-Learning, Asynchronous Distance Education Fora, Content analysis, Formal language, Modelling.*

1 INTRODUCTION

During the last years, a big number of educational institutions, as well as companies, applies asynchronous educational services through internet. One of the means used by distance education during the last decade is the electronic fora (fora hereinafter). Research efforts on fora of distance education, at an international level, begun during the '90s. Otherwise, this is a dynamically formed field, requiring constant updating and redefinition. Given, also, the fact that the practice of distant education during the last years has acquired new features, both in its methodology and in the tools which are used, the further exploration of this field becomes necessary. A big part of the researches presented in the international literature concerning distant education's fora, refer to the content analysis. The goal of content analysis is to reveal information which is invisible at first sight. The technique of content analysis may be defined as "a research methodology that builds on procedures to make valid inferences from text" (Anderson et al, 2001). Despite the fact that this research technique is frequently used, though there are still no standards established. There is a variety of approaches, varying both at detail's level and at the type of categories of analysis they use.

The structure of this article is the following: section 2, where there is a short description of the respective assignment on the content analysis technique of asynchronous discussions at distance education fora, section 3 where the role of the fora of Hellenic Open University (HOU) for the educational procedure is described, section 4, where the unit of analysis which was used is described, section 5 where the integration of the message's content category as a unit of analysis in formal language is described, section 6 where the system of automatic text classification and the time's association with the message's content category is presented, section 7 where there takes place a respective discussion on the necessity of this system and section 8 which contains the conclusions of this article.

2 THEORETICAL FRAMEWORK

Although the researchers seem to agree that the collaboration may encourage the learning procedure (Lazonder et al, to 2003), there is no clear theory available to guide research on computer mediated

interaction (Stahl, 2003), empirical markers which shall be the base of a codification tool as a standard against which to evaluate whether or not effective learning is occurring in the online discussions (Gunawardena et al, 2001). During the last years, numerous efforts of approaching this issue were made, beginning from different theoretical backgrounds. Indicatively, Henri (1992) uses the point of Cognitive and metacognitive knowledge, while others (Newman et al, 1995; Bullen, 1997) the point of Critical thinking.

Many, though, start from social constructivism using different variations. Indicatively, some (Gunawardena et al,1997; Diermanse, 2001; Veerman and Veldhuis-Diermanse, 2001; Pena-Shaff and Nicholls, 2004; Weinberger and Fischer, 2006) use the approach of social constructivism in combination with knowledge construction; others (Jarvela and Hakkinen, 2002) in combination with perspective taking, while others (Lockhorst et al, 2003) in combination with learning strategies. Moreover, there are cases, such as Zhu (1996) who uses theories of cognitive and constructive learning in combination with knowledge construction. Many are those who use the approach of Community of inquiry in different variations. Others (Rourke et al, 1999) use the approach of Community of inquiry from the point of social presence, while others (Garrison et al, 2001) from the point of cognitive presence or (Anderson et al, 2001) the teaching presence. There are those (Fahy et Al, 2001) who use the social network theory as theoretical background from the point of interactional exchange patterns.

As is shown from all the above, an important arising issue is the unit of analysis which shall be used for the content analysis. Some researchers consider each single sentence as one unit of analysis (Fahy et Al, 2001), and others use the sentence as unit of analysis, trying to approach it at a paragraph level (Pena-Shaff and Nicholls, 2004). Others choose the definition thematic unit (or otherwise of a “theme” or an “idea”) to be their unit of analysis. (Henri, 1992; Newman et al, 1995; Rourke et al, 1999; Lockhorst et al, 2003). Another approach (Zhu 1996; Bullen, 1997; Gunawardena et al, 1997; Veerman and Veldhuis-Diermanse, 2001; Garrison et al, 2001; Anderson et al, 2001; Rourke et al, 2001) is to consider the whole message that a student enters at a specific moment in the conversation as the unit of analysis. Jarvela and Hakkinen (2002) choose a Complete discussion, while during the last years there has been an approach of multiple point both at a micro and at a macro level (Weinberger and Fischer, 2006). Further down, a comprehensive review is presented in a table form, referring to the unit of analysis used by this field’s researchers.

Instrument	Theoretical background	Unit of analysis
Henri (1992)	Cognitive and metacognitive knowledge	Thematic unit
Newman et al (1995)	Critical thinking	Thematic unit
Zhu (1996)	Theories of cognitive and constructive learning – knowledge construction	Message
Gunawardena et al (1997)	Social constructivism – knowledge construction	Message
Bullen (1997)	Critical thinking	Message
Rourke et al (1999)	Community of inquiry – social presence	Thematic unit
Fahy et al (2000)	Social network theory – Interactional exchange patterns	Sentence
Veerman and Veldhuis-Diermanse (2001)	Social constructivism – knowledge construction	Message
Garrison et al (2001)	Community of inquiry – cognitive presence	Message
Anderson et al (2001)	Community of inquiry – teaching presence	Message
Jarvela and Hakkinen (2002)	Social constructivism – perspective taking	Complete discussion
Veldhuis-Diermanse (2002)	Social constructivism – knowledge construction	Thematic unit
Lockhorst et al (2003)	Social constructivism – learning strategies	Thematic unit
Pena-Shaff and Nicholls (2004)	Social constructivism – knowledge construction	Paragraph
Weinberger and Fischer (2006)	Social constructivism –knowledge construction	Micro and macro-level

Table 1. *Overview of the content analysis schemes.*

Hereinafter the HOU's fora environment is briefly presented in sections 3 and 4.

3 THE HOU CASE

HOU is the eminent educational institution offering distant education in Greece. Nowadays, HOU has 28.121 students (16.763 undergraduate, 11.305 postgraduate and 53 PhD candidates); and also 1348 professors (only 27 of which are permanent and the rest are associate professors-counsellors).

The HOU's structural educational unit is the course module; nowadays 184 course modules are offered by HOU. An important supportive mean of the educational procedure is the fora of HOU, which contribute both to the studies' organization during the course module but also to the elaboration and development of what the student have already studied.

The HOU's fora offer an important help during the educational procedure. They may also contribute to the following:

a) as for the studies' organization during the course module:

- to the communication between the teacher and the students (regularity of contacts, subject, resolution of "technical" problems etc.).
- to the organization of homework (method of use of the teaching material and the preparation of the activities, exploitation of the literature and the other sources, timetables, encountering problems related to it et. al.)
- to the supply of information about the advisory meetings (their number, their duration, the timetables, the goals, their content and methodology applied, problems' encountering as for the ability to attend them et. al.).
- to supply clarifications about the procedure of preparation and evaluation of the written assignments (form, method of preparation, evaluation criteria, ways to be supported by the teacher et. al.).
- to inform about the procedure of final exams (students' preparation, support by the teacher, marking criteria, way and time of examination et. al.).

b) as for the elaboration and development of what the students have already studied, the HOU's fora may be exploited for:

- the presentation of consolidation exercises, short suggestions, presentation of examples, methodologies, literature et. al.,
- the questions' resolution and the supply of clarifications about the teaching material.
- the interconnection between what is already studied and the next chapters and the following written assignment.

At the discussion threads of each course module the teacher and all the students of the course module have the chance to participate. As for the students of informatics, for the 16 course modules of informatics (for undergraduate level) offered by HOU, by the time this research was conducted, there were 6.067 discussion threads created with 26.246 messages. About the evolution of the HOU forum's use, indicatively, at the course module "Introduction to Informatics" (INF10), during the last three academic years there is a big increase in the number of messages: 982 (2005-6), 1205 (2006-7) noted and 1942 (2007-8).

Given the big flow of information transferred through fora of HOU, as well as previous works that explored the behaviour of students of the HOU (Xenos, 2004; Xenos, Pierrakeas & Pintelas, 2002), simulated the development of a formal language to interpret messages in the fora of HOU (Patriarcheas & Xenos, 2009), a system based on modelling with the use of a formal language was created, entering threads from discussion fora and exporting the respective strings in an automatic way.

4 THE UNIT OF ANALYSIS WHICH WAS USED

Given that the choice of a unit of analysis is dependent on the context and should be well-considered, because changes to the size of this unit will affect coding decisions and comparability of outcome between different models (Cook & Ralston, 2003), as well as given the fact that Schrire (2006) refers to a dynamic approach in which data is coded more than once and the grain size of the unit of analysis is set, depending on the purpose and the research question, it was decided not to take into consideration the discussion thread, not even the message as unit of analysis, nor the paragraph or the single sentence.

It was decided to use as unit of analysis, the category of the message's content, as for the observation of the discussion threads, it was noticed that there are cases of messages which may comprise two (or/and more) content categories, e.g. a question about the next advisory meeting and a reply to a question concerning the study of the educational material.

Thus, in that case, the analysis at a message's level used by some researchers (Zhu 1996; Bullen, 1997; Gunawardena et al, 1997; Veerman and Veldhuis-Diermanse, 2001; Garrison et al, 2001; Anderson et al, 2001; Rourke et al, 2001) is not enough for the exploitation of information that shall arise aiming to reach educational conclusions, as it is obvious that in a message more content categories may coexist.

Furthermore, the analysis at a level of a single sentence used by some researchers (Fahy et Al, 2001) could not be taken as a single unit of analysis since a content category may extent to two or/ and more sentences. For the same reason the unit of analysis at a paragraph level, used by Pena-Shaff and Nicholls (2004), was not chosen. In addition, in our case, not even the Complete discussion used by Jarvela and Hakkinen (2002) as unit of analysis cannot be exploited, since it is noted that in a discussion thread there may exist many more than one content categories. Otherwise, the title of a discussion thread may not be representative of this and the discussion may extent to more than one subjects.

Consequently, the content category chosen seems closer to the point of course module used by numerous researchers (Henri, 1992; Newman et al, 1995; Rourke et al, 1999; Lockhorst et al, 2003). Another approach (Zhu 1996; Bullen, 1997; Gunawardena et al, 1997; Veerman and Veldhuis-Diermanse, 2001; Garrison et al, 2001; Anderson et al, 2001; Rourke et al, 2001).

According to the study of the messages of INF10 for academic years 2005-2008) the messages as for their content may concern (in brackets you see the respective symbols used in formal Language):

- a) study of educational material (*M*),
- b) questions/answers for exercises – assignments (*X*),
- c) presentation of sample assignments by tutors (*P*),
- d) instructions (*I*),
- e) assignment comments, corrections (*C*),
- f) student comments on assignments (*D*),
- g) sending – receiving assignments (*J*),
- h) sending - receiving grade marks (*G*),
- i) notification of advisory meeting (*V*)
- j) pointless message (*L*).

Ε.Α.Π.
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Επισκόπηση προηγούμενης θ.Ενότητας :: Επισκόπηση επόμενης θ.Ενότητας	
Συγγραφέας	Μήνυμα
teodkats Forum User Εγγραφή: 22 Οκτ 2007 Δημοσιεύσεις: 6 Τόπος: ΛΑΡΙΣΑ	<div style="border: 2px solid red; padding: 5px;"> Δεν το είχα δει, σε ευχαριστώ Δημήτρη. Συνάντηση 23/03/2008 Κυριακή 13:30-17:00 Αφου το πρότεινες πρώτος πρέπει και να το <<σχεδιάσεις>>.. πχ. ΥΠΟΕΡΓΑΣΙΑ 2 { 1. Φτιάξε μια διαδικασία που να... 2. Φτιάξε μια διαδικασία εισόδου.. 3. Μια διαδικασία που θα ενημερώνει.. 4. Μια συνάρτηση που θα ελέγχει.. 5. Μια διαδικασία που θα υλοποιεί την συνάντηση. } 😊 😊 Μην με παρεξηγήσεις είναι από την πολύ C. Δεν έχω κάνει τη 2η υποέργασια, απορίες;; </div>

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Figure 2. The HOU's forum. In the same message there are two content categories V and X.

5 INTEGRATION OF THE CATEGORY OF THE MESSAGE CONTEXT AS A UNIT OF ANALYSIS IN FORMAL LANGUAGE

According to the study of the messages on HOU's fora during the academic years, a Language was developed, which is defined by mathematic terms and represents the messages using as unit of analysis the category of the message content. More specifically:

- There are two categories of communication's carriers: a) Teachers, b) Students
- For brevity reasons, teachers shall be symbolized with T and students with E
- As for the type of message, they are discerned to questions and replies. Having the symbol q and a respectively.
- As for their content category, we have the symbols aforementioned in the previous section: $M, X, P, I, F, D, J, G, V$.
- Finally, the order in which the above symbols appear is: a) the message carrier, b) the type of message and c) the content category to which the message belongs.

Thus, the Language contains:

a) Terminal symbols alphabet V_T , where $V_T = \{T, E, q, a, n, M, X, P, I, F, D, J, G, V, L\}$

b) Non terminals alphabet V_N , where $V_N = \{u, r, y, c\}$, more specifically :

r : represents the message carrier (where T for tutors and E for students)

u : represents a pair yc i.e. a message type y (whether it is a question q or an answer a) followed by its content category.

c) The grammar P

A set of rules of the form $\alpha \rightarrow \beta$, where α and β sequences containing terminal and non-terminal symbols and α is not an empty sequence, as follows:

- | | | | |
|---------------------------------|----------------------------------|------------------------|----------------------------------|
| (1) $S \rightarrow ruS$ | (7) $r \rightarrow \varepsilon$ | (13) $c \rightarrow P$ | (19) $c \rightarrow V$ |
| (2) $S \rightarrow \varepsilon$ | (8) $y \rightarrow q$ | (14) $c \rightarrow I$ | (20) $c \rightarrow L$ |
| (3) $u \rightarrow uyc$ | (9) $y \rightarrow a$ | (15) $c \rightarrow F$ | (21) $c \rightarrow \varepsilon$ |
| (4) $u \rightarrow \varepsilon$ | (10) $y \rightarrow \varepsilon$ | (16) $c \rightarrow D$ | |
| (5) $r \rightarrow T$ | (11) $c \rightarrow M$ | (17) $c \rightarrow J$ | |
| (6) $r \rightarrow E$ | (12) $c \rightarrow X$ | (18) $c \rightarrow G$ | |

Where ε stands for an empty symbol

d) Symbol S

Every sentence generated starts with this symbol.

According to the above, when a message should be represented concerning a student's message, addressing a question about the study of the educational material, followed by another student's question about the following assignment and at the end of the thread there is the reply of the teacher both for the study of the material and for the following assignment, it shall be represented as follows: *EqMEqXTaMX* (*E* for the student's capacity, *q* for the question, *M* as it concerns the study of the educational material, *X* for the fact that the next message concerned an assignment, *T* for the teacher's capacity, *a* for the fact that it is an answer, *M* for the fact that this reply concerns the study of educational material and *X* for the fact that the second part of the message concerns an assignment.). According to the above, the sequence *EqMEqXTaMX* constitutes a sentence of the *Language* because:

Rule: (1) (1) (1) (3) (4)(6)(8)(11)
 $S \rightarrow ruS \rightarrow ruruS \rightarrow rururuS \rightarrow ruycrucrucycS \rightarrow \dots \rightarrow EqMrucrucycS$

Rule: (4)(6)(8)(11) (3) (2)(4)(5)(9)(10)(12)
 $\dots \rightarrow EqMEqXrucycS \rightarrow EqMEqXrucycS \rightarrow \dots \rightarrow EqMEqXTaMX$

As it is obvious from the example, while to the first two messages corresponds one content category *M* and *X* respectively, at the 3rd message there are two content categories *MX*.

6 THE SYSTEM - ASSOCIATION OF THE TIME WITH THE CONTENT CATEGORY OF THE MESSAGE

According to this approach, a system of automatic classification was developed, which comprised the following: a) Data filtering: where there are considered as input some web pages accommodating the discussion threads of a distance education forum of HOU (which include much data having no essential information concerning the educational procedure e.g. titles, images etc.) and creates a temporary file with the "useful" part (User name, date, message's content) which may become a source of information for educational conclusions.

b) Storage of roots files: which is a dynamic way according to which word or phrases or symbols roots are stored, as well as the respective terminal symbols *q* if it is a question or *a* if it is an answer. The same thing was also done for the storage of information necessary for the determination of content category of a message, i.e. if it is about study, assignment, comment etc. or combination of them (e.g. a message concerning both the study and an assignment). To wit, it takes as input couples of information of the type root of a word or phrase and terminal symbol of the content category (*M, X, P, I, F, D, J, G, V, L*). As it is obvious, the system provides the ability to add further content categories if necessary.

c) strings' production: receiving as input the temporary file with the "useful" information (User name, date, message's content) and the files with the couples of roots words/ phrases/ symbols and terminal symbols and presents (and stores) the respective strings with the relative extensible file, so as the results to be kept for further exploitation.

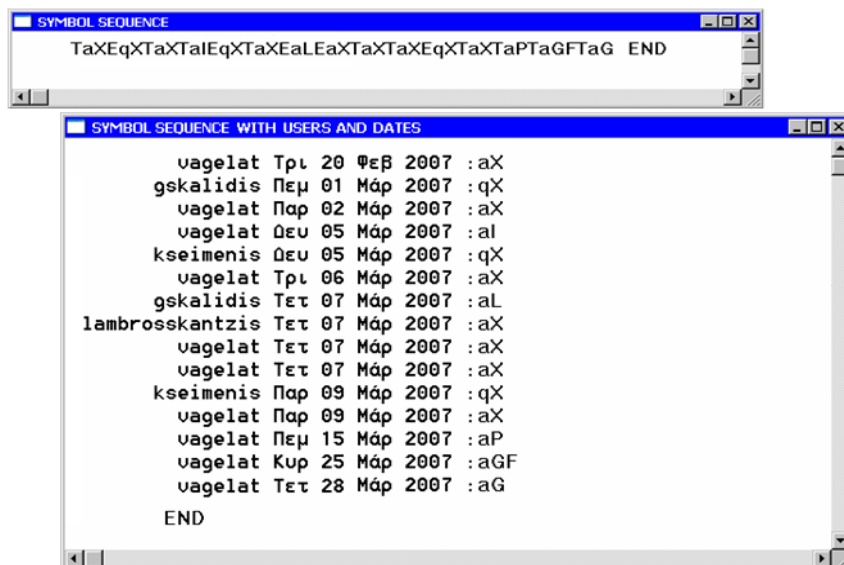


Figure 2. Representation of a discussion thread both in simple string and also after the addition of User names and dates.

It is worthy to note here that this specific system incorporates the sense of time along with its association with each of the nine (9) categories of message content chosen as unit of analysis. More specifically and given that within a message (as it is deduced both from literary review and from the observation of the fora of HOU) more than one contents may exist, the dates are recorded for each such case and not simply in each message.

In fact after each couple *yc* there is a date's record. Certainly, so as to effectuate the above procedure nine (9) piles were used – as many at the message's content categories, each one having as many figures as the number of appearance of terminal symbols (*M, X, P, I, F, D, J, G, V, L*) resulting from the non terminal symbol *c*. Consequently, time differences may automatically exist (in days, if from each current date, by content category, it is deduced the previous one) and thus there may arise another nine (9) respective piles with the above date references. Of course, the length of these Piles is equal to the length of dates minus one (-1), i.e. apart from the initial message, which is considered to be the point zero (0), where the numbering of the time differences shall begin. The contents of the piles of time differences may constitute an important criterion, which may participate as such (in combination with other criteria) in case of evaluation of a forum's consequences to the educational process.

Finally, it should be noted that an experimental operation of the system for the course module INF10 of HOU was effectuated and as for the correct messages' interpretation, there was a successful recognition of the categories of content message by 92.36% for the academic year 2005-6, 95.19% for 2006-7 and 97.89% for 2007-8. This paper will not go into further details on this particular experiment, since it has been presented in paper with title "Automated interpretation of discussion threads' messages in asynchronous distance education fora" (submitted at "Journal of Educational Technology & Society", Jan. 2009).

7 DISCUSSION

At this point, it is important to initially discuss the need for such a system using the content category as analysis unit. As it is noted through the literature review, there is a gap at this specific field and

consequently, there is a need to create a tool to interpret in a structured way the discussion of a forum about distant education, through the approach presented above and at the same time taking into consideration the concept of time and producing respective results, so as to help the participating students to improve their educational practices.

In fact, this system – which is under development – defines a “code” clarifying some issues which determine both the quality of the communication relations and the educational principles of teaching/ learning procedure. In other words, this specific tool aims to encourage towards the direction of the use of “good” or “desirable” educational techniques, adding up to the distant education. At this point it should be clarified that the development of this system does not intend to disorientate from the basic principles of distant education, but aims to contribute to its further development and upgrading and to act auxiliary and not in excess.

As it is noted, this system is under development. The results of its use shall constitute data for the creation of a database aiming to investigate the effects of fora in educational procedure from the point of causal interpretation point of view. Given that the HOU is not a conventional university (with the features of a homogenous student community) but it addresses to adults with special educational needs and incongruity (both as far as their age, their professional and family obligations are concerned), the future research access to such issues becomes particularly important.

More specifically, the system in the future shall collect the students’ particulars (e.g. marital status, age, sex, profession etc.), their performance at course modules of HOU (final mark, assignments’ marks, effort of success of the course module) and the strings produces by the system so as to interpret the messages of HOU’s fora, in order to reach educational conclusions in combination with the use of the a tool, weka type. In fact, this application refers to a wider field of interdisciplinary encounter, by the merge of cognitive theories and artificial intelligence.

8 CONCLUSIONS

The practice of distant education during the last years has acquired new features, both in relation to methodology and in the tools it uses. It is also a fact that the subject of electronic fora in distant education is a dynamically formed field requiring constant updating and redefinition. A big part of the researches presented in the international literature concerning distant education's fora, refer to the content analysis, which principally aims despite the fact that this research technique is frequently used, though there are still no standards established. There is a variety of approaches, varying both at detail’s level and at the type of categories of analysis they use. As it was deduced from the above presentation and study of the discussion threads of HOU, it was noticed that there are cases of messages which may comprise two (or/and more) content categories, e.g. a question about the next advisory meeting and a reply to a question concerning the study of the educational material. For this reason, this paper uses the content category as unit of analysis for the messages’ interpretation in Asynchronous distance education fora and for this purpose incorporates it in a modeling in a formal language. Furthermore, time indexes of participation were integrated in combination with the content categories of the message, in order to define the way these elements could improve the capacity of the teacher to evaluate the progress of a discussion thread in a forum of distant education.

Among others, as future researchers are predicted to be long-term studies concerning the main issue: what reinforces the participation at fora and how this contributes to the educational process effectiveness by investigating side questions, such as how much it affects the person who starts the thread (teacher or student), how it starts, the period when the thread starts, how important the time of response in threads, is the groups’ size etc. and their association with the elements concerning the students’ profiles and their performance in course modules of HOU, intending to reach educational conclusions.

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