Effective e - learning in a GTC discussion forum ?

Introduction

In the 21st century with the onset of Computer mediated communication (CMC) the opportunity for changing the way teachers and students interact is greater than ever. In traditional classroom settings the teacher's role has changed from being a conveyor of information / understanding to that of a facilitator. With the increasing awareness of constructive models of education coupled with increasing use of formative assessment students are expected to take far more responsibility for their own learning.

With the development of e-learning a social constructivist learning environment has been reinforced where students negotiate meaning and are involved in extensive dialogue and interaction. Whether or not e-learning offers anything extra over "normal" educational methodology is open to debate. A lot of the research carried out in e-learning is flawed by lack of control groups, non random assignment to groups and questionable reliability and validity. The very nature of e-learning however does not lead itself to traditional methods of analysis.

Computer Supported collaborative learning (CSCL) focuses on how collaborative learning environments foster student learning and teamwork when doing academic tasks. The main focus is to support the creation of knowledge building communities using online discussion, knowledge sharing and evaluation. Learners adopt deep or surface learning approaches. Surface learning approaches include skimming, memorising, and regurgitating whereas deep learning requires a critical understanding of the material. Deep learning is promoted by active learning participation promoted by social interaction. Thus CSCL should promote the use of deep learning styles. However as Chen and Hung (2002) point out this whole debate assumes that during such collaborative processes student's personal understanding is automatically guaranteed; however, the collective representation of knowledge may not necessarily belong to any one student The problem is how do we evaluate the quality of learning activity being conducted online?

The literature on analysing the quality of e-learning has steadily grown over the last ten years with the development of both qualitative and quantitative methodologies.

On the quantitative side analysis of discussion forums has covered among others interaction and content analyses, discourse quality, and message thread analysis. One advantage of online discussion forums is that all communication is easily organised, stored and retrieved so that an analysis of the transcript information can be carried out. However detailed analysis of transcript information is extremely time consuming and labour intensive and there are at the moment few suitable methodologies that lead themselves to ease of analysis. In an analysis of 19 computer mediated communication studies (Rourke et al [2001]) only 3 out of the 19 studies quoted a reliability measure, the unit of analysis ranged from the message (4/19), a thematic approach (7/19) and the illocutionary act (1/19). Variables investigated included interaction, participation, linguistic variation, critical thinking and social, cognitive and metacognitive elements.

It is little wonder that Fahy (2002) pointed out "problems cited by critics include such basic failings as lack of reliability and replicability as well as problems with the methodological complexity of the coding and analytical systems… "
Rourke et al (2001) also indicated that: "The most glaring omission in CMC research continues to be the lack of analytical techniques applied to the transcript……it is remarkable that so few evaluators are willing to tackle this research area."

Levin et al (1990) (cited in Bonk et al [200]) focused on the need to understand the degree of participation amongst participants by constructing message maps which represented the flow of communication within the group. Others have developed methods which look at the learning processes which the participants undergo. One of the earliest methods developed, based on the cognitive domain was Blooms Taxonomy [1956]. The 6 cognitive domains of knowledge, comprehension, synthesis, evaluation, application and analysis are hierarchial in nature. Adaptation of Blooms taxonomy to reflect the more active nature of discourse communication was carried out by Anderson (1995). In her adaptation Anderson argued that the thinking process was an active process and that the noun categories used by Bloom should be replaced by verbs. Her final categories were remembering, understanding, applying, analysing, evaluating and creating.
Another analytical model, for better understanding of the learning processes in online discussion fora was developed by Henri (1992)(cited in Pena-Shaff [2001]). She highlighted 5 dimensions involving participation, interactivity, social events, cognitive events, and metacognitive events. She then developed a second model which investigated the participants depth of processing, surface or in depth, of information. This idea of depth of processing mirrors work done by Ramsden (1992)(cited by Johnson [2002]). According to Henri surface level processing includes such factors as making judgements without justification, agreeing with what has gone on before whilst in-depth processing involves offering new information, and justifying ones arguments. Further details of Henri's methodology is found in Appendix A.

Garrison (1991)(cited in Bonk [2000]) outlined a 5 stage model of critical thinking including problem identification, definition, exploration, applicability, and integration. Newman, Johnson, Cochrane and Web (1996) combined and simplified Henri's and Garrison's models and created a coding scheme for online transcript relevance, novelty, student knowledge, clarity, idea linking, justification, critical assessment, practical utility, and width of understanding and discussion.

Effective e - learning in a GTC discussion forum ?

Hara et al (2000) suggested that Henri's cognitive model was very similar to Blooms (1956) Taxonomy of Educational Objectives for the cognitive domain. Table 1 below indicates the similarities.

Blooms taxonomy	Henri's taxonomy	Definitions for Henri's taxonomy	Indicators for Henri's taxonomy
Knowledge	Elementary clarification	Observe or study a problem identifying its elements, and observe their linkages in order to come to a basic understanding.	Identify relevant elements. Reformulate the problem. Ask a relevant question. Identify previously stated hypotheses. Simply describe the subject matter.
Comprehension	In depth clarification	Analysing and understanding a problem to come to an understanding which sheds light on the beliefs, values and assumptions which underlie the statement of the problem.	Defining the terms. Identify assumptions. Establish relevant criteria. Seek out specialised information. Summarize.
Application	Application of Strategies	Proposing co-ordinated actions for the application of a solution, or following through on a choice or a decision.	Making decisions, statements, appreciations, evaluations, and criticisms. Interacting with those concerned..
Analysis			
Synthesis	Inferencing	Induction and deduction, admitting or proposing an idea on the basis of its link with propositions already accepted as true.	Drawing conclusions Making generalizations Formulate a proposition which proceeds from previous statements.
Evaluation	Judgement	Making decisions, statements, appreciations and criticisms.	Judging the relevance of solutions. Making value judgements. Judging inferences. "I agree" … "I disagree"

Table 1:Henri's cognitive model was very similar to Blooms (1956) Taxonomy of Educational Objectives for the cognitive domain

The only domain where overlap was not complete was that Henri's taxonomy had no analysis equivalent.

I thought that using Anderson's adaptation of Blooms taxonomy would indicate to some extent the depth of online learning. However there is a problem with this approach. As I was working on my own I had no way of determining whether my interpretation was correct. One way of improving things was to use a second method of analysis that could triangulate what I found out with the initial analysis. I therefore decided to look at the surface and deep approaches to learning as described by Henri (see Appendix A) and Ramsden.

One quantitative method of evaluating the depth of learning going on in online fora comes from social network analysis. Hakkarainen et al (2002) suggest that effective discussion in computer mediated forums should consist of a:

- number of contributions and extensive dialogues;
- broad participation with a dense network of interactions;
- non centralized interaction., such that the interaction is not organized around any one participant;

If one assumes that the greater the number of connections the greater the depth of learning going on then a measure of the density of the network could give some measure of the depth of learning going on. The second measure of centrality i.e. the degree to which the interactions are focussed around one person should also tell us if all participants are contributing equally or not.

Hence the evaluation of the depth of e learning is tackled on three fronts involving the use of Bloom & Henri's taxonomies coupled with methodology developed from Hakkarainen (2002).

Setting the context

The Institute of Education London together with the General Teaching Council are currently running a one year course which: "Reflects on professional practices: An e-journal approach". Part of the assessment includes an online participation in debate and discussion (through the GTC discussion web forum) and web publication – hosted by Miranda net.

Originally I felt that it would be useful to evaluate the quality of the discussion fora on the GTC web site. I had hoped to look at two discussion fora, to analyse them and see if the quality of discourse had improved over time. The rational was that the 31 participants on the course were expected to participate in online discussion. As their knowledge of, and familiarity with online discussions increased the quality of interactions would be expected to improve. Two discussion fora, at the beginning (March) and towards the end of the course (June) were to be evaluated. However over the duration of the course participant's online contributions seemed to diminish to disappointingly low levels. Hence I decided to evaluate just one fairly active discussion forum which took place between February 10th through to April 3rd 2003 .

Data collection

A transcript of the online discussion was obtained. Quantitative data involved analysing each of the 71 contributions for word length - using word count in Microsoft Word. A map of the online interactions (see Fig:1) was constructed from the discourse using Omni-Graffle. Data presented below are individual participation rates, density and centralization of interactions and the quality of discourse. Qualitative analysis involved evaluating the individual transcripts for depth of processing and the relevant cognitive domain.

Effective e - learning in a GTC discussion forum ?

Results

The interaction of the 26 participants involved in the forum was analysed for the number of threads:

- per participant that were issued
- sent directly to that participant.

Participant (coded)	[Thread (Word length) Date Time]	No. of Threads out	Threads in
1	[1.2.1 (239 words) 12-Feb 12:24]//	1	1
2	[1.2.1.1.1 (82 words) 15-Feb 14:41]// [2.1.2.2 (90 words) 15-Feb 14:56]// [2.1.1 (31 words) 11-Feb 21:49]// [5.2.2 (38 words) 16-Feb 22:18]// [1.1 (118 words) 10-Feb 22:43]//	5	1
3	[19 (448 words) 01-Apr 01:01]// [20 (356 words) 01-Apr 01:05]// [2 (78 words) 11-Feb 13:35]// [5.1 (101 words) 12-Feb 13:42]// [3 (49 words) 11-Feb 13:43]// [1.2.1.1 (80 words) 12-Feb 13:48]//[14.1.1 (81 words) 16-Mar 0 2:00]// [16.1.2 (199words) 12-Mar 14:07]//[12.1 (132 words) 15-Feb 3:04]//[14 (484 words) 16-Feb 18:08]//[15 (454 words) 16-Feb 18:11]//[16 (469 words) 16-Feb 18:15]//[1.2.1.1.1.1 (69 words) 15-Feb 18:20]//[2.3.1 (111 words) 15-Feb 18:35]//[13.2 (12 words) 15-Feb 18:51]//	15	8
4	[5.2.1.1 (63 words) 13-Feb 1:37]//[5.2 (56 words) 12-Feb 14:49]//[**1** (154 words) 10-Feb 22:21]// [13.1 (88 words) 15-Feb 11:47]//	4	6
5	[2.2 (177 words) 13-Feb 16:42]//	1	
6	[1.2.1.2 (184 words) 13-Feb 02:06]//	1	2
7	[11.3 (77 words) 20-Feb 01:04]//[5.2.1.2 (75 words) 13-Feb 16:35]// [17.1 (49 words) 6-Mar 22:27]//	3	
8	[11 (88 words) 13-Feb 23:31]//	1	4
9	[2.1 (75 words) 11-Feb 21:14]//	1	
10	[8.2 (71 words) 13-Feb 12:39]//	1	
11	[1.2 (275 words) 11-Feb 18:40]//[17 (120 words) 3-Mar 10:47]//	2	5
12	[2.3 (132 words) 15-Feb 13:09]//	1	1
13	[5 (105 words) 11-Feb 22:02]// [22 (453 words) 9-Apr 22:41]//	2	3
14	[9 (267 words) 12-Feb 15:23]//	1	1
15	[6 (116 words) 11-Feb 23:26]//[13 (43 words) 15-Feb 23:32]//[1.2.1.2.1 (78 words) 15-Feb 23:37]// [2.1.2.1 (71 words) 15-Feb 23:45]// [11.1.2 (116 words) 15-Feb 23:56]//	5	2
16	[11.1.1.1 (244 words) 14-Feb 11:17]// [7.1 (176 words) 14-Feb 11:34]// [14.1 (58 words) 24-Feb 11:34]// [11.1 (99 words) 14-Feb 12:47]//	4	2
17	[23 (86 words) 10-Apr 14:40]// [18 (115 words) 16-Mar 00:37]//	2	
18	[5.1.1 (95 words) 13-Feb 12:05]// [8.1 (46 words) 13-Feb 12:07]// [9.1 (41 words) 13-Feb 12:50]//	3	
19	[1.2.1.2.1.1 (95 words) 22-Feb 16:16]// [16.1.1 (72 words) 1-Mar 22:09]// [1.1.1 (85 words) 11-Feb 00:59]//	3	
20	[5.2.1.1.1 (61 words) 14-Feb 01:13]// [11.1.1 (76 words) 14-Feb 01:37]// [5.2.1 (58 words) 12-Feb 23:04]// [21 (502 words) 3-Apr 12:11]// [7 (134 words) 12-Feb 12:32]	5	3
21	16.1 (197 words) 25-Feb 13:06	1	1
22	12 (99 words) 14-Feb 13:23	1	1
23	[4 (88 words) 11-Feb 20:42]// [7.1.(1 89 words) 17-Feb 21:48]	2	
24	[2.1.2 (74 words) 12-Feb 08:00]// [8 (136 words) 12-Feb 08:12]	2	5
25	[10 (94 words) 13-Feb 01:40] //[1.1.1.1 (61 words) 13-Feb 01:45//] [1.2.1.1.1.1.1 (48 words) 20-Feb 02:21]	3	
26	[11.2 (41 words) //14-Feb 00:47]	1	
	No of threads	71	46

Table 2: Participants contribution – thread coding, message length, date and time sent/ messages sent and received.

Effective e - learning in a GTC discussion forum ?

There were 71 messages, average word length was 135 words, Standard deviation was 120. Average number of threads / participant was 2.7. Of the 26 participants 11 contributed 1 message (average length = 143 words), 5 contributed 2 (average length = 147 words), 4 contributed 3 (average length = 65 words), 2 contributed 4 (average length = 117 words), 3 contributed 5 (average length = 107 words) and 1, our course moderator contributed 15 (average length = 208 words).

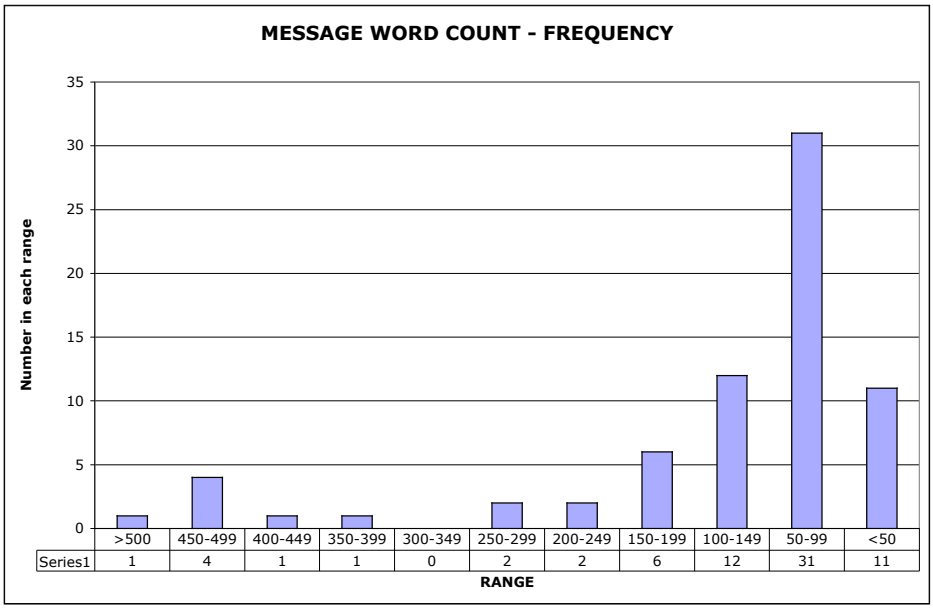

Fig:1 Message word count

Frequency of word count / message is shown in Fig:1 below. 60% (42 out of 71) of the messages are shorter than 100 words. Density provides a measure of the network activity i.e the extent to which the participants are in active collaboration.

A density close to 1 indicates an almost saturated network. With 26 participants the maximum number of interactions is 26 x 25/2 = 325. In the forum the total number of messages was 71. Hence the density of the network was 71/ 325 = 21.8% A graphic representation of the number of messages per thread was drawn and is shown in Figure 2.

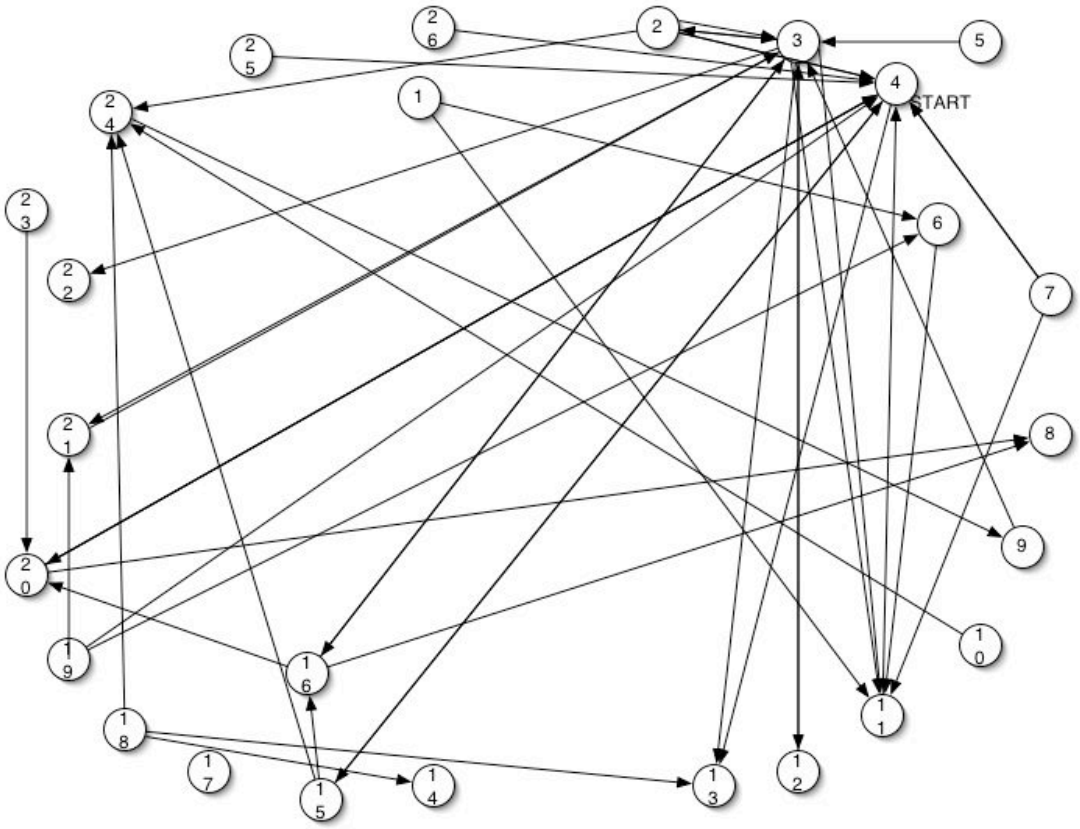

Fig:2 Graphical representation of the network.

Qualitative analysis.

Each thread was inspected for:

a) cognitive learning using Anderson's adaptation of Blooms taxonomy. Each thread was evaluated for knowledge, comprehension, application, analysis, synthesis and evaluation. As the domains are hierarchial only the highest domain was recorded. The results are shown below (Fig: 3).

Knowledge (*Remembering)	Comprehension (*Understanding)	Application (*Applying)	Analysis (*Analysing)	Synthesis (*Evaluating)	Evaluation (*Creating)
6 (8.5%)	7(9.9%)	14 (19.7%)	34 (47.9%)	10 (14.1%)	0 (0%)

Fig 3: Cognitive domains. *(...) signifies Anderson's adaptation [for 71 messages]

b) depth of surface processing as suggested by Henri. The results are shown below (Fig: 4).

Surface processing	Indepth processing
8 (11.3%)	63 (88.7%)

Fig:4 surface/indepth processing

The two processes of depth of information processing and cognitive learning are to some extent similiar. If we regard memorising of information as surface processing whilst indepth processing ranges from understanding to creating then there is a fair degree of agreement between the two measures. This is seen in Figure 5.

Knowledge (*Remembering)	Comprehension (*Understanding)	Application (*Applying)	Analysis (*Analysing)	Synthesis (*Evaluating)	Evaluation (*Creating)
6 (8.5%)	7(9.9%)	14 (19.7%)	34 (47.9%)	10 (14.1%)	0 (0%)
6 (8.5%)	**65 (91.5%)**				
Surface processing	Indepth processing				
8 (11.3%)	**63 (88.7%)**				

Fig: 5 Comparison of cognitive learning and type of information processing

Discussion of the results

In the quantitative analysis the variability of message word length is very high. Over 60% of the participants only contributed 100 words or less. One person, the facilitator contributed over 33% of the total words. This contradicts previous findings (as cited in Pena Shaff et al [2001]) that suggest that those with a higher level of expertise, including the facilitator, do not dominate the discussion.

Density analysis of just over 20% was low. Hakkarainen () indicates that in a small network density values of 0.5 (50%) are regarded as high. Graphical analysis of the network suggests that the majority of the messages are directed to relatively few individuals. 11 participants only contributed once. Differences in participation may be due to the participants apparant need to post at least one message (to satisfy course requirements). Interestingly those that contributed 1 or 2 messages (average length = 143 and 147 words respectively) wrote a lot more than those who contributed 3 or 4 messages (average length = 65 and 117 words respectively). A further problem in lack of participation is that those who lurk may feel that all has been said and they see no point in contributing further.

Qualitative analysis using Anderson's adaptation of Blooms taxonomy proved to be more difficult than expected. The number of higher cognitive components of evaluating and creating were low (14.1%), this could be due to the number of messages being less than 100 words long. It is hard to develop these higher components in a few words. Analysis and application were generally dominant with a combined total of 48 (67.6%) messages. Deciding on whether the message was in the analysing or the evaluating domain was difficult as there was, I felt, considerable overlap

On analysis of the depth of processing 63 out of the 71 messages indicated some indepth processing. Although this value is high the measure does not tell us the what type of indepth processing has been carried out. As such it acts as a useful check on the results from Blooms taxonomy. The agreement between the amount of indepth processing (88.7%) and the amount of learning via the cognitive domains (Understanding to Creating) (91.5%) is encouraging.

Was the exercise a useful one? At times I felt a great deal of frustration with the exercise, it was hard to see where one was going, the literature although extensive was not particularly informative and much of it was written in academic gibberish. If I were to repeat the exercise I would find it useful to work with others, if only to improve the inter rater reliability. It took far longer than expected and the results I feel are not as objective as I would have liked.

Effective e - learning in a GTC discussion forum ?

References

Anderson (1995) cited in http://rite.ed.qut.edu.au/oz-teachernet/training/bloom.html - sighted 10/10/03

Bloom, B.S. (Ed.) (1956) *Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain.* New York ; Toronto: Longmans, Green.

Bonk, C. J., & Wisher, R. A. (2000). Applying collaborative and e-learning tools to military distance learning: A research framework. *(Technical Report #1107)*. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. http://www-ari.army.mil/dtSearch/dtisapi6.dll
(downloaded 10 Oct 2003)

Chen and Hung (2002) Personalised knowledge representations: the missing half of online discussions. *British Journal of Educational Technology* 33 (2) pp279-290

Fahy, P. J. (2001c) Assessing critical thinking processes in a computer conference
http://cde.athabascau.ca/mdde/022Wint/661/4ks/links.htm (downloaded 10 Oct 2003)

Fahy, P. J. (2002) Addressing some Common Problems in Transcript Analysis
http://www.irrodl.org/content/v1.2/research.html#Fahy (downloaded 10 Oct 2003)

Hakkarainen et al (2002) Effective participation and discourse through a computer network: Investigating elementary students' computer supported interaction. *Journal of Educational Computing Research* (in press) http://www.mmi.unimaas.nl/euro-cscl/Papers/102.doc (downloaded Sept 20th 2003)

Hara, Bonk, & Angeli (2000). Content analysis of Online Discussion in an Applied Educational Psychology. *Instructional Science* 28 (2) pp 115 – 152. obtained from http//crlt.indiana.edu/publications/techreport.pdf (downloaded 20 Sept 2003)

Johnson C (2002) Fostering Deeper Learning. ww1.ecom.unimelb.edu.au/tluwww/workingPapers/fostDeepLearn.htm (downloaded 10 Oct 2003)

Newman, Cochrane and Web (1995.) A content analysis method to measure critical thinking in face to face and computer supported group learning. *Interpersonal Computing and Technology Journal (IPCT-J),* 3(2), 56-77
http://www.qub.ac.uk/mgt/papers/abstract.html (downloaded 10 Oct 2003)

Newman, Johnson, Cochrane and Web (1997) Evaluating the quality of learning in computer supported cooperative learning. *Journal of the American Society for Information Science and Technology (JASIS)* , 48 (6) pp 484-506
http://www.qub.ac.uk/mgt/papers/abstract.html (downloaded 10 Oct 2003)

Pena-Schaff et al (2001) An epistemological framework for analysing student interactions in computer mediated communication environments. *Journal of Interactive Learning Research* 12, (1) 41 - 68

Rourke et al (2001) Methodological issues in the content analysis of computer conference transcripts.
International Journal of Artificial Intelligence in Education (2001), 12, 8-22.
http://computing.unn.ac.uk/staff/cgpb4/ijaied/abstracts/Vol_12/rourke.html (downloaded *Oct 10th 2003)*

Effective e - learning in a GTC discussion forum ?

APPENDIX 1

Table A1: Summary of the classifications used in the transcript analysis to measure participation and interaction, based on a slightly modified version of Henri's model (1992; 1993).

Dimension	**Categories**	**Example**
Participation Level of participation	Number of messages	
	Number of message units	
	Length of message unit (lines)	
Structure*	Day and time of posting	
	Subject thread	
Type of participation*	Administrative (A)	Questioning about submission of work
	Technical (T)	Technical problems with
	Content (C)	Self: 'Hi, my name is X and .....
		'Other: 'Hope you all have a good Easter
		'Direct: 'The reading on learning outcomes...'
		Indirect: 'ideas to help with noisy students'
Interactivity		
Explicit interaction	Direct response (DR)	'Hello X, In response to your question about...'
	Direct commentary (DC)	' I agree with X that ...'
Implicit interaction	Indirect response (IR)	'I think that the answer might be ..."
	Indirect commentary (IC)	I agree that students ...'
	Independent statement (IS)	Relating to the subject under discussion, but isn't in reference to a prior contribution

Note: * indicates modification to Henri's model (1992)

Table A2: Summary of the classifications used in the transcript analysis to assess the cognitive and metacognitive dimensions of Henri's model

COGNITIVE

Critical thinking	
Elementary clarification	Introducing a problem; posing a question; passing on information without elaboration. Simply describing the subject matter. Identifying previously stated hypotheses. Reformulating the problem.
In depth clarification	Analysing a problem, identify assumptions. Defining the terms. Establishing relevant criteria. Seeking out specialised information. Summarizing.
Inference	Concluding based on evidence from prior statements; generalising. Formulating a proposition which proceeds from previous statements.
Judgement	Expressing a judgement about an inference, relevance of an argument, theory, or solution. Judging the relevance of solutions. Making value judgements. Judging inferences. “I agree” … “I disagree”
Strategy	Proposes a solution; outlining what is needed to implement the solution. Making decisions, statements, appreciations, evaluations, and criticisms. Interacting with those concerned..

Effective e - learning in a GTC discussion forum ?

Surface processing	**In depth processing**
Repeating the information contained in the statement of the problem without making inferences or offering an interpretation.	Linking facts, ideas and notions in order to interpret, infer, propose and judge.
Repeating what has been said without offering anything new	Offering new elements of information.
Stating that one shares the ideas or opinions stated, without taking these further or adding any personal comments;	Generating new data from information collected by the use of hypothesis and inferences.
Proposing solutions without offering explanations;	Setting out the advantages and disadvantages of a situation or solution., pros and cons etc
Proposing judgements without offering any justification;	Proposing judgements supported by justification;
Asking questions which invite information not relevant to the problem or not adding to the understanding of it;	Asking questions designed to provoke content related responses or investigations and further discussions
Offering several solutions without saying which is the most appropriate	Providing proof, supporting examples, counter examples, relevant analogies or metaphors
Perceiving the situation in a fragmentary, short term manner.	Perceiving the problem within a larger , connected or more long term perspective.
Failing to suggest how an idea fits within a larger scheme or framework	Developing strategies and ideas within a wider framework or integrative model.

METACOGNITIVE

Knowledge	
Person	Comparing self to others as a cognitive being, e.g, student perspective vs.teacher perspective.
Task	Showing an awareness of one's approach to a cognitive task, e.g, preparing a lecture.
Strategy	Commenting on strategies used to reach an objective and assess progress, e.g, I find do X when trying to ....'
Skills	
Evaluation	Questioning the value of one's ideas or way of going about a task, e.g, 'I do not……
Planning	Evidence of organising steps needed and predicting what is likely to happen.
Regulation	Evidence of implementing a strategy and assessing progress made. e.g, 'I know I feel .....' / 'I found learning about ... interesting'