

# Evaluating Interactivity and Learning in Computer Conferencing Using Content Analysis Techniques

Kwok Chi Ng<sup>a\*</sup> and David Murphy<sup>b</sup>

<sup>a</sup>*School of Education and Languages, Hong Kong;* <sup>b</sup>*Centre for Research in Distance and Adult Learning, Open University of Hong Kong*

This paper outlines the application of a particular model of content analysis to the evaluation of an online discussion group. A set of online discussion data from a group of students enrolled in an educational management course offered by the Open University of Hong Kong (OUHK) was examined. The provision of the online discussion facility for this group of students was mainly for enrichment purposes and their participation was completely voluntary. Overall, the analysis confirmed the usefulness of Henri's model in examining the interaction and learning processes in an online forum. It also provided insights towards increased understanding of the complex processes and methodological considerations involved in analysing online conferences.

## Introduction

One of the key features of online delivery is that it can create an interactive learning environment for students and teachers through computer-mediated communication (CMC). In asynchronous conferencing situations, sufficient time is given for the participants to reflect on their responses to discussion topics and to clarify their understanding of concepts. Thus, this form of interaction has the potential to engage students in developing academic discourse and to facilitate higher-order learning (Fox & MacKeogh, 2003).

To better understand the nature of online interactivity and the learning processes in a CMC environment, analysing the content of computer conferencing transcripts is seen as a promising method. Mason (1992) considers that content analysis of conference messages is a key methodology for establishing the educational value of this medium.

---

\*Corresponding author. School of Education and Languages, Open University of Hong Kong, 30 Good Shepherd Street, Homantin, Kowloon, Hong Kong. Email: kcng@ouhk.edu.hk

The issue of interaction has been an area of much discussion in the practice of distance education. Some often-debated questions include:

- What type and level of interaction is essential for effective learning?
- Does interaction facilitate learning and knowledge construction?
- Is interaction more important for certain types of learners?
- What balance is required between independent and interactive activities/learning media?

This study examines the nature and quality of discourse in a computer conference using content analysis techniques. It provides research evidence for analysing the relationship between interaction and learning for a particular group of adult distance learners and increases our understanding of the issues outlined above. At the same time, researchers are, of course, reminded to pay particular attention to the unique attributes and contextual factors of each computer conference.

### **Context of the Study**

The Open University of Hong Kong (OUHK) has been seriously engaged with online learning for about 6 years. A central focus of online developments has been the development of a platform for its courses, known at the OUHK as the Online Learning Environment (OLE). The OLE was first introduced in 1999, using WebCT software for English course materials and Lotus software for Chinese courses.

The OLE has had an evolutionary, rather than revolutionary, development in that the OUHK does not aim to become a virtual university. Online course components are introduced progressively as appropriate, and comprise part, rather than all, of the course components. Other components include print-based study units, face-to-face tutorials, multimedia CD-ROM material, and so on.

The primary use of the OLE has been as a tool of communication between students, tutors, and course coordinators (CCs). Asynchronous discussion boards have for the most part proved to be much more popular than synchronous technologies. For most courses such communication is optional, though for a minority (such as courses with a focus on IT) it is mandatory.

The present study examines a set of discussion board data from a group of about 20 students enrolled in the course *E805—Effective Leadership and Management in Education*—a postgraduate-level course in the Master of Education programme. Most participants were primary or secondary school teachers or administrators, and all had appropriate English skills to cope with a course at this level. The course aims to improve participants' professional capabilities in educational management through developing knowledge of educational management theory and critical reflection on practice. As the CC of this course, the first author considers that online discussion can provide a very useful platform for distance learners to share their experience and views on management issues.

It should be noted that the provision of the E805 OLE was mainly for enrichment purposes. Students' use of online communication is optional and their

participation in the OLE was completely voluntary. Printed course materials were provided along with online course materials, and students could also gain support from face-to-face tutorials and telephone tuition—the university’s traditional modes of delivery.

### **The Importance of Interactivity**

In a landmark article back in the 1970s, Daniel and Marquis introduced the phrase “getting the mixture right,” referring to the mix between independent and interactive learning activities. The principal aim of the article was to address “the difficult synthesis which distance learning systems have to effect between those activities in which the student works alone and those which bring him [*sic*] into contact with other people” (Daniel & Marquis, 1979, p. 30). It was a timely discussion, highlighting the challenges faced in structuring and designing distance education courses. The challenges are still present, of course, with new components being emerging information and communication technologies on the media side, and the increasing efforts to create constructivist learning environments for students on the pedagogical side. In particular, the Internet is proving to be the common ground where teachers and students work to find better ways to achieve desired learning outcomes (Murphy, 1999).

The aim of well-designed courses is increasingly perceived as ensuring that they are student centred, emphasizing “learners as constructors of knowledge, the importance of context in understanding, and the essential nature of experience in learning” (Hannafin & Land, 1997). One of the most prolific writers on the role of constructivism in learning is David Jonassen, who, in discussing constructivist learning environments (CLEs) states that:

Contemporary conceptions of technology-supported learning environments assume the use of a variety of computer-mediated communications to support collaboration among communities of learners. ... Learning most naturally occurs not in isolation but by teams of people working together to solve problems. CLEs should provide access to shared information and shared knowledge-building tools to help learners to collaboratively construct socially shared knowledge. (Jonassen, 1998, p. 2)

The notion of interaction is clearly implicit in such claims, especially that which takes place among groups of learners, and can be at least as important as the interaction between teacher and learner.

Interaction has continued to be an important issue in distance education (Sims, 2003) and a recent contribution by Anderson (2003) adds a useful dimension to the discussion. Anderson proposed an “equivalency theorem” with the claim that:

Deep and meaningful formal learning is supported as long as one of the three forms of interaction (student–teacher; student–student; student–content) is at a high level. The other two may be offered at minimal levels, or even eliminated, without degrading the educational experience. High levels of more than one of these three modes will likely provide a more satisfying educational experience, though these experiences may not be as cost or time effective as less interactive learning sequences. (Anderson, 2003)

He further explains that “this theorem implies that an instructional designer can substitute one type of interaction for one of the others (at the same level) with little loss in educational effectiveness—thus the label of an equivalency theory. There are a number of other corollaries and implications based on the current post-industrial education context that can be drawn from this theorem ...” (Anderson, 2003). Some of these in particular relate to the growing use of new and emerging technologies to promote student learning. If Anderson is correct, then perhaps we need not be so concerned that we are not able to supply the highest level of interaction for all types of learning, and can still achieve an effective educational experience for our students.

### **Models of Analysis**

A number of models for the evaluation of the quality of learning in computer conferencing are available in the literature. The focus of these frameworks varies, depending on the purposes of the evaluation and the interest of the researchers. For example, Henri’s (1992) model focuses on the level of participation and interaction in the discussion group, as well as analysing the content of the messages according to a cognitive view of learning. Newman, Webb, and Cochrane (1995) apply Henri’s model and Garrison’s (1992) critical thinking approach to develop strategies to measure critical thinking in face-to-face and computer-supported group learning. Gunawardena, Lowe, and Anderson (1997) develop methods for analysis of an online debate and look for evidence for the social construction of knowledge. Also, Gunawardena, Carabjal, and Lowe (2001) present a “Systems Component Contexture Model” for conceptualizing the evaluation of online learning networks. Another interaction analysis model that has been developed for understanding learning in computer-mediated environments is Garrison, Anderson, and Archer’s (2001) model, which describes the nature and quality of critical discourse in a computer conference. Obviously, no single approach fits all evaluation purposes.

The model developed by Henri (1992) has been influential in content analysis. As noted by McKenzie and Murphy (2000), this model allows for analysis of a range of aspects of CMC activities. In this model, the transcripts are analysed according to five broad dimensions, these being participative, interactive, social, cognitive, and metacognitive. This framework also fits the present study because it provides insights for examining the nature of online interactivity between contributors (i.e., the interactive dimension) and the learning processes through an analysis of the message content (i.e., the cognitive/metacognitive aspects).

### **Methodology**

#### *Procedures for Content Analysis*

Message texts in the discussion board were first copied to a Microsoft Word file, organized according to the “threads” of discussion topics and the chronological order of the online conversation. The coding was then done on a hard copy of the

Table 1. A note on the coding symbols

Type of participation	Interactive dimension	Cognitive skills	Information processing	Metacognitive dimension
Administrative (A)	(Explicit interaction)	Elementary clarification (E/C)	Surface (SU)	(Knowledge)
Technical (T)	• Direct response (DR)	In-depth clarification (I/C)	In-depth (DE)	• Person (KP)
Social (S)	• Direct commentary (DC)	Inference (IN) Judgement (JU)		• Task (KT) • Strategy (KS)
Content (C)	(Implicit interaction)	Strategy (ST)		(Skills)
	• Indirect response (IR)			• Evaluation (SE)
	• Indirect commentary (IC)			• Planning (SP)
	(Independent statement) (IS)			• Regulation (SR)
				• Self-awareness (SS)

transcript. The coding symbols are outlined in Table 1 and a sample of the data organization matrix is shown in Table 2.

The quantitative characteristics of participation were first examined: the frequencies of students' and the tutor's/CC's contributions to discussion were counted and the number of inputs by individual students in each item title was indicated. In total, there were 74 messages generated, among which the students and the tutor/CC each accounted for 50% of the inputs. Six students had posted messages and three of them were more active in discussion (Students A, E, and F posted 13, 8, and 12 items, respectively). The average number of messages per student was 6.2, with a standard deviation score of 5.6. The types of messages were then examined and grouped into four themes/categories, namely, *Social*, *Administrative*, *Technical*, and *Content*.

Following Henri's (1992) idea, the messages were further divided into "message units" for analysis. A message unit can be divided "by words, by a group of words, by proposition, by sentence, or by paragraph" (Henri, 1992, p. 134). Henri also notes that an objective determination of the unit of meaning is difficult to make. In the present study, however, it turned out that message units tended to correspond to paragraphs, as this is the way that written communication is organized.

Eighty-nine message units were identified and were classified into four theme categories: Social (7 items), Technical (16 items), Administrative (25 items) and Content (41 items). The final step was to analyse each message unit in turn, along the interactive, cognitive, and metacognitive dimensions. For the interactive dimension, all message units from students and the tutor/CC were examined. For the cognitive and metacognitive dimensions, however, only message units related to the theme of content from students were taken into account.

Table 2. Sample discussion board data coding

	Message units	Type of participation	Interactive dimension	Cognitive skills	Information processing	Metacognitive dimension
<p>1 Article No. 16: posted by <b>Student A</b> on Fri, May 7, 1999, 17:40</p> <p>Subject: What is management?</p> <p>Hi everybody,</p> <p>Following are some definitions of management:</p> <ul style="list-style-type: none"> <li>• “The process of coordinating and integrating work activities so that they are completed efficiently and effectively with and through other people”, Robbins S. P. and Coulter M. (1998) Management, Upper Saddle River, Prentice-Hall, p. 8</li> <li>• “Management is the process of planning, organising, leading, and controlling the use of resources to accomplish performance goals”, Schermerhorn, J. R. (1996) Management, 5th ed., New York, John Wiley &amp; Sons, p. 4</li> <li>• “Management is the process of planning, organising, leading, and controlling the work of organisation members and of using all available organisational resources to reach stated organisational goals”, Stoner J. F., Freeman, R. E. and Gilbert D. R. (1995) Management, 6th ed., Englewood Cliff, Prentice Hall, p. 7</li> <li>• “The process of planning, organising, leading, and controlling the activities of employees in combination with other resources to achieve organisational objectives”, Mosley D. C., Pietri P. H. and Megginson L. C. (1996) Management—Leadership in Action, 5th ed., New York, Harper Collins Publishers, p. 15</li> </ul> <p>If you compare these definitions with the definition given in our course materials, which one do you think is best?</p>	# 1	C	IS	E/C	SU	Not applicable
	# 2	C	IS	E/C	SU	Not applicable

Table 2. *Continued*

	Message units	Type of participation	Interactive dimension	Cognitive skills	Information processing	Metacognitive dimension
2	<p>Article No. 17: [Branch from no. 16] posted by <b>Student E</b> on Sat, May 8, 1999, 08:23            Subject: re: What is management?            In my opinion, I think the listed definitions are similar; it's just about what kinds of wording you want to use.            In general, the definition of management should include some processes such as planning, organising, staffing, coordinating, controlling, leading, delegating, etc., and to complete the works efficiently and effectively. Do you agree?</p>	C	DR	JU	DE	Not applicable SE
3	<p>Article No. 18: [Branch from no. 17] Posted by <b>Student F</b> on Sat, May. 8, 1999, 11:54            Subject: re: What is management?            I agree with Student E's view, i.e., the definitions are basically the same.            I think the key words are: organising, planning, resourcing, controlling, reviewing ... and last but not the least: the organisational goal is achieved.</p>	C	DC	JU	SU	Not applicable SE
4	<p>Article No. 19: [Branch from no. 16] Posted by <b>Tutor</b> on Wed, May 12, 1999, 13:17            Subject: re: What is management?            Personally, I like the definition given by Stephen Robbins. The other definitions emphasise the mechanism or the cycle of management, mainly elaborating the functions within the management cycle.</p>	C	IR	Not applicable	Not applicable	Not applicable

Table 2. *Continued*

Message units	Type of participation	Interactive dimension	Cognitive skills	Information processing	Metacognitive dimension
<p>#6</p> <p>On the other hand, Robbins centres on the macro aspect of management. In management, people are the important tool to accomplish the task and goals. Robbins clearly spells out that management has to work with and through the people. Management should also take in consideration of effectiveness and efficiency. Robbins' definition takes care of this.</p>	C	IC	Not applicable	Not applicable	Not applicable
<p>5 Article No. 20: [Branch from no. 19]                      Posted by <b>Student A</b> on Wed, May 12, 1999, 22:08                      Subject: re: What is management?                      Yes. I agree that the definition given by Robbins is more comprehensive. On the other hand, when I go through some of the older management books, I find a definition that is more interesting.                      "Management is the process of designing and maintaining an environment in which individuals, working together in groups, accomplish efficiently selected aims", Koontz, H. and Wehrich, H. (1989) Management 9th ed., New York, McGraw-Hill.</p>	C	DR	JU	SU	Not applicable
<p>#8</p> <p>This definition is unusual as it emphasises the point that management is "designing and maintaining an environment" in which people can accomplish aims. It is different from the process approach that is more popular in the other management books. In other words, management may not need to worry (directly) about planning, organising etc. ... All she/he really has to do is to design and maintain an environment which allows such activities to be carried out effectively.</p>	C	IC	E/C	SU	Not applicable
<p>#9</p>	C	IC	I/C	DE	SE



Table 2. *Continued*

	Message units	Type of participation	Interactive dimension	Cognitive skills	Information processing	Metacognitive dimension
6 Article No. 21: [Branch from no. 20] Posted by <b>[Tutor]</b> on Tue, May 18, 1999, 09:26 Subject: re: What is management? The term "management" can have very broad meaning. Different people may have different emphases on certain aspect of the term. Under the systems theory, an organisation is an open system and its environment has an impact on the organisation and hence the people in the organisation will be affected by the environment as well. Thus, the definition emphasising "designing and maintaining an environment" is legitimate. But this does not mean that planning, organising, leading and controlling are unnecessary. The authors believe that a suitable environment would motivate people to work better. This at the same time would achieve the effects of the management functions.	#10	C	IC	Not applicable	Not applicable	Not applicable

The authors were fully aware of the limitations in applying the content analysis techniques. As noted by Rourke, Anderson, Garrison, and Archer (2003), while the idea of message units can break up the content into units of meaning according to the analytical objectives, it also invites subjective and inconsistent identifications of the unit. Also, judging whether CMC can facilitate quality learning from the discussion transcripts involves the examination of “latent variables” such as cognitive/metacognitive processes. Thus, the consistency and adequacy of the coder’s interpretations of the meaning of the content are crucial and reliability issues need to be taken into account.

To ensure the reliability and adequacy of the data coding, a sample data script (see Table 2) was selected and coded independently by the two authors, based on the framework outlined in Table 1. There were some discrepancies between codings, in particular in dividing message units and classifying units in the metacognitive dimension. For example, the percentage agreement between the two coders on an initial selection of six message items was 50%. After some discussion, a consensus was reached (see Table 2) for the completion of the coding of all the data.

### *Focus of the Analysis*

This study examines the extent to which the conferencing system in the OLE supports student interaction and learning in the course concerned. Two issues are addressed in the analysis:

- for the nature of interaction among the student and tutor/CC contributors all the message units are examined; and
- for the quality of learning which takes place in the E805 discussion board only the content message units from students are examined.

### *Ethical Considerations*

An ethical concern in exploiting CMC technologies for teaching is the issue of student privacy (Miller, 2002). Unlike face-to-face interactions, electronic communication messages can be stored, analysed and redistributed. Also, the details of students’ logins to the online system are automatically tracked in some Web-based course management systems. Students are not always aware that their Web access is being recorded, and that their discussion board postings may be of interest outside the class. Therefore, it is important to ensure that students understand the monitoring that is taking place.

In the present study, participants accessing the OLE home page were alerted that general information about their visits would be collected and used for student and university administration purposes. A code of confidentiality and anonymity of participants was ensured in the data collection and reporting processes. Also, verbal consent from the tutor and students for using the online data for research and

publication was obtained through personal contact. These actions were in accord with the university's guidelines for researchers of online learning communities.

## **Presentation of Data**

### *Interactive Dimension*

In this dimension, contributions to the online discussion are differentiated between explicit, implicit, or independent. Explicit interactions can be either in response to a question posted (direct response DR) or a commentary on someone else's message (direct commentary DC). Implicit interactions are defined as including a response to (indirect response IR) or commentary on (indirect commentary IC) a prior message or idea, but without specifically mentioning the connection. The independent statement category refers to cases where a message contains new ideas and is not connected to others expressed previously in the discussion forum. Table 3 gives an explanation of each dimension of interactivity and some examples found in the E805 discussion content.

The number of students' and tutor's/CC's independent and interactive message units along each theme category were then counted. The interactive message units were also classified as explicit interactions (i.e., DR and DC) and implicit interactions (i.e., IR and IC). The distribution of these message units is outlined in Table 4.

As shown in Table 4, 36% of the message units posted were identified as independent and 64% were classified as interactive. A higher percentage of interactive message units show that participants had used the discussion forum to respond to messages posted by others or engage with prior contributions which were generated from a chain of interaction. Also, the two categories of message units transmitted by students and the tutor/CC were at a fairly similar level; students accounted for 17% of independent and 36% of interactive message units, whereas the tutor/CC accounted for 19% of independent and 28% of interactive message units. This suggests that neither the student nor the tutor/CC contributors had dominated the interactive behaviour in the forum.

The distribution of explicit and implicit interactive message units along each theme category is worth noting. For the Administrative, Social, and Technical categories, all the interactive message units were identified as "DR." On the other hand, for the Content category, 20 message units were classified as DC/IC but only 8 message units were classified as DR/IR. A higher proportion of commentary message units in the Content category might relate to the nature of E805, which encourages learners' reflections and experience sharing. Therefore, in replying to others' messages, the participants tended to take up ideas and express their views, rather than responding to questions in a straightforward way.

The interactive behaviour among contributors in the Content category is of particular interest to the present study. An analysis of "who was responding to whom" in this category was then undertaken. This was to determine whether there were any

Table 3. Classifications to measure interactivity based on Henri's (1992, p. 127) model—explanations and examples

Dimensions of interactivity	Explanations	Examples in E805
<i>Independent statement (IS)</i>	Any statement relating to the subject under discussion, but which is neither an answer nor a commentary and which does not lead to any further statements	<ul style="list-style-type: none"> <li>• If you compare these definitions with the definition given in our course materials, which one do you think is best?</li> </ul>
<i>Explicit interaction</i>	Any statement referring explicitly to another message, person, or group	
Direct response (DR)	Any statement responding to a question, using direct reference	<ul style="list-style-type: none"> <li>• The listed definitions (of management) are similar; it's just about what kinds of wording you want to use (Student A)</li> </ul>
Direct commentary (DC)	Any statement taking up and pursuing an expressed idea, using direct reference	<ul style="list-style-type: none"> <li>• I agree with Student E's view, i.e., the definitions are basically the same. The key words are: organising, planning, resourcing, controlling, reviewing ...</li> </ul>
<i>Implicit interaction</i>	Any statement referring implicitly to another message, person, or group	
Indirect response (IR)	Any statement obviously responding to a question, but without referring to it by name	<ul style="list-style-type: none"> <li>• Personally, I like the definition given by Stephen Robbins</li> </ul>
Indirect commentary (IC)	Any statement taking up and pursuing an expressed idea, but without referring to the original message	<ul style="list-style-type: none"> <li>• Robbins clearly spells out that management has to work with and through the people</li> </ul>

distinctive patterns of communication (e.g., interaction patterns between teaching staff and students or between students themselves). Such an analysis gives some further insight into the chains of interaction in the E805 forum. Henri (1995) distinguishes between two levels of interactivity, i.e., genuine versus quasi-interactive communication. In brief, the former situation involves a chain of three or more interactions between a transmitter and a receiver, whereas the latter involves a chain of only two interactions.

Table 5 outlines the distribution of independent and interactive message units posted by students and the tutor/CC in the Content category. The contributors of the message units are also indicated (alphabetic capital letters in parentheses indicate individual students) so that the chains of interaction can be followed.

Table 4. Distribution of independent and interactive message units by students and the tutor/CC along each theme category

Message units	Themes											
	Students						Tutor/CC					
	A	S	T	C	A	S	T	C	A	S	T	C
<i>Independent statement</i>	2	0	3	10	11	2	1	3				
Independent message units (%)	15/89 (17%)			17/89 (19%)			32/89 (36%)					
<i>Direct response</i>	6	5	6	4	6	0	6	1				
<i>Direct commentary</i>	0	0	0	4	0	0	0	6				
<i>Indirect response</i>	0	0	0	1	0	0	0	2				
<i>Indirect commentary</i>	0	0	0	6	0	0	0	4				
Interactive message units (%)	32/89 (36.0%)			25/89 (28.0%)			57/89 (64%)					
Total message units in each theme category	8	5	9	25	17	2	7	16				
Total message units (%)	47/89 (53%)			42/89 (47%)			89/89 (100%)					

Note. A: Administrative; S: Social; T: Technical; C: Content.

Table 5. Distribution of independent and interactive (student-tutor/CC and student-student interaction) message units in the content category

Content-related discussion topics	Number of independent message units—initiated by students	Number of independent message units—initiated by the tutor/CC	Number of interactive message units—student-tutor/CC interaction	Number of interactive message units—student-student interaction	Total
1 <b>Statistical figures</b>	1 (1E)	0	3 (1CC, 1E, 1T)	2 (1F, 1E)	6
2 <b>What is management?</b>	2 (2A)	0	6 (2T, 3A, 1T)	4 (2E, 2F)	12
3 What are taken-for-granted assumptions?	2 (2E)	0	2 (1CC, 1T)	0	4
4 Question in Section 6	2 (2E)	0	1 (1CC)	0	3
5 The reform of Education Department in Hong Kong	0	1 (1CC)	0	0	1
6 Examples of leadership in secondary school	1 (1A)	0	0	0	1
7 Leadership and the curriculum	2 (2E)	0	3 (1CC, 2T)	2 (2A)	7
8 <b>Chat on 13/10</b>	0	1 (1CC)	4 (2A, 1CC, 1T)	1 (1F)	6
9 Chat on 20/12	0	1 (1CC)	0	0	1
Total	10	3	19	9	41
Percentage	10/13 (77%)	3/13 (23%)	19/28 (68%)	9/28 (32%)	

Note. The alphabetic letters in parentheses indicate individual students; “CC” refers to Course Coordinator, and “T” stands for tutor. Items 1, 2 and 8 (in bold) indicate a genuinely interactive sequence.

The analysis shows that the majority of discussion topics were initiated by students (i.e., 10 out of 13 independent message units). Both students and the tutor/CC reacted to these topics and about one-third of the message units involved student–student interaction (i.e., 9 out of 28 interactive message units). On three occasions (i.e., Items 1, 2, and 8), a genuinely interactive sequence was found. However, overall, the number of message units involving a chain of three or more interactions was very limited.

The content-related message units posted by students were further examined according to the cognitive and metacognitive dimensions in order to understand the quality of learning of students in the E805 forum.

### *Cognitive and Metacognitive Dimensions*

*Cognitive dimension.* There are two aspects of cognitive skills to be evaluated in the cognitive dimension. The first aspect focuses on reasoning skills, which reflect the nature of learning processes such as “understanding, reasoning, the development of critical skills, and problem resolution” (Henri, 1992, p. 129). In this aspect, five levels of reasoning skills are outlined: elementary clarification; in-depth clarification; inference; judgement; and strategies. The second aspect of cognitive skills links to the level of information processing evident in the message content, classified according to the dichotomy of surface versus in-depth processing. In-depth processing reflects organization and critical evaluation of information. The opposite of this is surface processing, exhibited by repetition and the absence of evidence of elaboration and justification. The explanations of the elements used in measuring the cognitive aspects, and related examples found in the E805 forum, are given in Table 6.

*Metacognitive dimension.* A distinction between metacognitive knowledge and metacognitive skills is made in this dimension. In brief:

metacognitive knowledge refers to declarative knowledge concerning the person (what is known about the person as a “cognitive being”); the task (appreciation of the task and information available); and strategies used (how a cognitive task is successfully completed). The expression of metacognitive skills reflects knowing how to assess one’s knowledge, skills and strategies (evaluation); predict and organise what is needed to complete a cognitive task (planning); initiate and supervise progress toward reaching one’s objectives (regulation); and recognise and understand one’s feelings and thoughts about the task (self-awareness). (McKenzie & Murphy, 2000, p. 248)

Examples from only one of the metacognitive dimensions were found. This was with respect to the metacognitive skill of evaluation (labelled SE in Table 2), which basically means questioning the value of one’s ideas or way of going about a task. For example, a student posted the following:

I would like to point out that the reform of the Education Department (ED) is not necessarily an educational problem. ED is not a school; it is a very bureaucratic government department. As an organisation, there is no basic difference between ED and a

Table 6. Classifications to measure cognitive dimension based on Henri's (1992) model—explanations (quoted from McKenzie & Murphy, 2000, p. 247) and examples

Dimensions of cognitive skills	Explanation	Examples
<i>Reasoning skills</i>		
Elementary clarification (E/C)	Introduce a problem; post a question; pass on information without elaboration	<ul style="list-style-type: none"> <li>• What are taken-for-granted assumptions? Any factual example of taken-for-granted assumptions?</li> </ul>
In-depth clarification (I/C)	Analyse a problem; identify assumptions	<ul style="list-style-type: none"> <li>• When I read through the Reader 4, Chapter 10, "Curriculum evaluation as review and development ..." by M. Coles. The writer had emphasised the role of the curriculum leader in the curriculum planning and renewal within a community of enquiry. So my questions are ...</li> <li>• This definition (for management) is unusual as it emphasises the point that management is "designing and maintaining an environment" in which people can accomplish aims. ... In other words, management may not need to worry (directly) about planning, organising etc ...</li> </ul>
Inference (IN)	Concluding based on evidence from prior statements	<p>I think there is no appropriate leadership style that fits all the cases. The appropriate style really depends on the situation</p> <ul style="list-style-type: none"> <li>•(No relevant example was found)</li> </ul>
Judgement (JU)	Expresses a judgement about an inference, relevance of an argument, theory, or solution	<p>I think there is no appropriate leadership style that fits all the cases. The appropriate style really depends on the situation</p> <ul style="list-style-type: none"> <li>•(No relevant example was found)</li> </ul>
Strategies (ST)	Proposes a solution; outlines what is needed to implement the solution	<ul style="list-style-type: none"> <li>• I agree with Student E's view, i.e., the definitions are basically the same</li> </ul>
<i>Information processing</i>		
Surface (SU)	Repetition without adding new information; statement without justification; suggesting a solution without explanation	<ul style="list-style-type: none"> <li>• I agree with Student E's view, i.e., the definitions are basically the same</li> </ul>
In-depth (DE)	Brings in new information; shows links; solutions proposed with analysis of possible consequences; evidence of justification; present a wider view	<ul style="list-style-type: none"> <li>• I believe the so-called appropriate leadership style really depends on your power (reward, coercive, expert, legitimate, referent etc.). Perhaps we can apply Fiedler's contingency theory where the so-called appropriate style depends on leader-member relationship, task structure, and position power</li> </ul>



Table 7. Distribution of message units at each level of cognitive and metacognitive dimensions

Dimension	Category	Level	Percentage of message units
Cognitive skills	Reasoning skills	Elementary clarification	9/25 (36%)
		In-depth clarification	6/25 (24%)
		Judgement	5/25 (20%)
		Inference	2/25 (8%)
		Unclassified	3/25 (12%)
	Information processing	Surface	15/25 (60%)
		In depth	7/25 (28%)
		Unclassified	3/25 (12%)
Metacognition	Metacognitive skills	Evaluation	7/25 (28%)
		Unclassified	18/25 (72%)
	Metacognitive knowledge	Nil	

water-works department. Hence, I wonder if all the discussion about schools and professional organisations can be applied to it.

In total, there were 25 message units posted by students in the Content category. Each message unit was then analysed in turn along the measures in the cognitive and metacognitive dimensions. Table 7 shows a breakdown of these message units into the levels of reasoning skills, information processing, and metacognitive process dimensions.

### *Reasoning Skills*

Sixty per cent of the message units were classified as either elementary or in-depth clarification (36% + 24%). This result reflects the way in which the learners used the forum to post questions and clarify theoretical concepts in course materials. They also shared their understanding of management issues and other sources. The judgement and inference categories (20% + 8%) mainly reflect responses that were summative in nature, or expressing the authors' view on a particular issue, rather than an exploration of a problem. One observation is that the learners did not use the forum for sharing of management experience or seeking advice from others (although this was a major pedagogical consideration when introducing the OLE system to E805 students); therefore, no message units related to proposing solutions or deciding on actions (i.e., the strategies category) were found. Finally, items were labelled as "unclassified" if the above categories did not apply.

### *Information Processing*

Henri (1992) gives a list of paired opposites, one an indicator of surface, one of in-depth processing. For example, "repeating the information contained in the

statement of the problem without making inferences or offering an interpretation” versus “linking facts, ideas and notions in order to interpret, infer, propose and judge” (Henri, 1992, p. 130). It should be noted that, in the present study, all those items classified as “elementary clarification” in the reasoning skills category relate to surface-level processing. Other items (e.g., those classified as in-depth clarification, inference and judgement) might also exhibit features of surface-level processing—for example, if participants contributed information about extra resources without elaboration or made judgements without supporting evidence. Therefore, a higher percentage of message units were classified as surface-level processing (60%). Messages demonstrating deeper levels of processing (28%) involved those offering new elements of information, critically evaluating ideas and providing supporting examples.

### *Metacognitive Process*

This aspect seems less evident in the context of the present study. Seventy-two per cent of the message units did not fit the measures in this dimension, so they were labelled as “unclassified.” The remaining 28% of message units all related to the measure of metacognitive skills of evaluation (SE). As noted in the above analysis, the learners tended to express their views on some management concepts in responding to prior contributions. Therefore, it is a logical consequence that the metacognitive process found in these message units was mainly about assessment of the person’s approach to a task or questioning whether their ideas of a task were well justified. However, the fact that most items were unclassified in this dimension and there was no incidence of message units reflecting elements of metacognitive processes other than SE suggests that this part of the analysis should be viewed with caution.

## **Discussion**

As noted at the outset, this study examined the nature of online interactivity and the associated learning processes. Interaction is one of the most important components of any learning experience and it is a crucial concept in distance education. The approach used, based on Henri’s (1992) model of analysis, offered insights into understanding how the online discussion operated in the context of a particular course (E805) in a Master of Education programme.

In examining the kind of interactivity among the voluntary contributors, the data showed that about one-third of the message units were monologues/independent, and other message units were classified as interactive. Overall, there was little evidence that the learners participated collectively and built on each other’s contributions, because the number of genuinely interactive message units was very limited. However, some students took an active role in the forum by, for example, initiating discussion topics and responding to prior contributions. Their involvement in the CMC environment did not seem to rely on the tutor’s/CC’s inputs.

In considering learning effectiveness in the E805 OLE, a particular focus in this study was the depth at which students engaged with the course material and showed evidence of cognitive skills in their responses. In general, participants were using the E805 forum for studying in two ways: seeking clarification about course concepts and exchanging views or personal comments on management issues. Through analysing students' contributions to the discussion board, evidence of their engagement in the cognitive process, such as "clarification," "inference," and "judgement" was displayed. However, they did not use the forum to share experience or self-reflections on management issues/problems (or proposing solutions/actions). Therefore, higher-order reasoning skills such as critical thinking and problem resolution were not demonstrated. This might explain why measures of the metacognitive processes in Henri's model were not evident in the present study.

However, any attempts to evaluate the effectiveness of an online forum applying content analysis techniques should be made with caution. As noted by Cook and Ralston (2003), it is important to identify the central parameters underpinning the conference such as its purpose, background of participants, and the approach to moderation in analysing an e-conference.

In the present study, E805 was an already well-operated distance course and students were using CMC in addition to their usual course load. The use of the OLE was for enrichment purposes and the learning tasks were unstructured. Also, the tutor's and students' participation in the OLE activities was completely voluntary; therefore, it would be difficult to control the level or nature of their involvement. Because there was only limited online discussion data, the potential educational benefits of CMC learning may not have been fully explored and the findings on the learning benefits of the CMC media should be taken as tentative.

While analytic techniques are helpful in gaining understanding of what takes place in e-conferencing environments, appropriate methodological considerations need to be taken into account. For example, the classification of message content could be subjective, so measures for ensuring the reliability of data coding are necessary. Also, each CMC environment has its unique characteristics which impact upon the nature of interactions. Therefore, selection of appropriate models or analytic tools is a significant step for meaningful content analysis. Researchers and evaluators should thus carefully consider what they need to know, as well as what they want to find out with respect to the aims of the course they are investigating, before making the choice of a model or tool. To state the obvious, if an online course is being evaluated with respect to the extent to which it engaged students in metacognitive activities and responses, then there is little point in using an instrument that concentrates on other measures.

Finally, from an alternative perspective, the analysis can be viewed in the light of the earlier mentioned "Anderson's Equivalency Theorem" (Anderson, 2003). If he is correct, then it doesn't necessarily matter that some important aspects of interaction were not achieved in the online discussion board, as long as they were achieved in some other aspect of the teaching and learning environment. As was explained, students were provided with alternative opportunities for interaction with tutors and

fellow students, mostly in face-to-face tutorial sessions. Any lack of evidence of interaction would become significant only if other means were not available. The effectiveness or otherwise of online interaction should thus be considered not in isolation but within the overall context of the total learning environment, which may include effective alternatives.

### Notes on Contributors

Kwok Chi Ng is an Assistant Professor at the Open University of Hong Kong. He works in the School of Education and Languages and coordinates courses in educational management and educational psychology.

David Murphy is an Associate Professor at the Open University of Hong Kong. He currently heads the Centre for Research in Distance and Adult Learning, and is also a Senior Course Designer with the Educational Technology and Publishing Unit.

### References

- Anderson, T. (2003). Getting the mix right again: An updated and theoretical rationale for interaction. *International Review of Research in Open and Distance Learning*, 4(2). Retrieved November 13, 2004, from <http://www.irrodl.org/content/v4.2/anderson.html>
- Cook, D., & Ralston, J. (2003). Sharpening the focus: Methodological issues in analysing online conferences. *Technology, Pedagogy and Education*, 12(3), 261–276.
- Daniel, J. S., & Marquis, C. (1979). Independence and interaction: Getting the mixture right. *Teaching at a Distance*, 14, 29–44.
- Fox, S., & MacKeogh, K. (2003). Can e-learning promote higher order learning without tutor overload? *Open Learning*, 18(2), 121–134.
- Garrison, D. R. (1992). Critical thinking and self-directed learning in adult education: An analysis of responsibility and control issues. *Adult Education Quarterly*, 42(3), 136–148.
- Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education*, 15(1), 7–23.
- Gunawardena, C. N., Carabajal, K., & Lowe, C. (2001). *Critical analysis of models and methods used to evaluate online learning networks*. Seattle: American Educational Research Association. (ERIC Document Reproduction Service No. ED456159)
- Gunawardena, C. N., Lowe, C. A., & Anderson, T. A. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research*, 17(4), 397–431.
- Hannafin, M. J., & Land, S. M. (1997). The foundations and assumptions of technology-enhanced student-centred learning environments. *Instructional Science*, 25, 167–202.
- Henri, F. (1992). Computer conferencing and content analysis. In A. R. Kaye (Ed.), *Collaborative learning through computer conferencing*. Berlin and Heidelberg: Springer.
- Henri, F. (1995). Distance learning and computer-mediated communication: Interactive, quasi-interactive or monologue? In C. O'Malley (Ed.), *Computer-supported collaborative learning*. Berlin and Heidelberg: Springer.
- Jonassen, D. (1998). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional theories and models* (2nd ed., pp. 1–21). Mahwah, NJ: Lawrence Erlbaum.

- Mason, R. (1992). Evaluation methodologies for computer conferencing applications. In A. R. Kaye (Ed.), *Collaborative learning through computer conferencing*. Berlin and Heidelberg: Springer.
- McKenzie, W., & Murphy, D. (2000). I hope this goes somewhere: Evaluation of an online discussion group. *Australian Journal of Educational Technology*, 16(3), 239–257.
- Miller, K. W. (2002). Ethical considerations. In H. H. Adelsberger, B. Collis, & J. M. Pawlowski (Eds.), *Handbook on information technologies for education and training*. Berlin: Springer.
- Murphy, D. (1999, September). Still getting the mixture right: Increasing access on the Internet. In R. Mills & A. Tait (Eds.), *Proceedings of the 8th Cambridge Conference on Open and Distance Learning: Learning and Teaching with New Technologies*, Milton Keynes: Open University (pp. 104–113).
- Newman, D. R., Webb, B., & Cochrane, C. (1995). A content analysis method to measure critical thinking in face-to-face and computer-supported group learning. *Interpersonal Computing and Technology*, 3(2), 56–77.
- Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2003). Methodological issues in the content analysis of computer conference transcripts. In D. R. Garrison & T. Anderson (Eds.), *E-learning in the 21st century: A framework for research and practice*. London: RoutledgeFalmer.
- Sims, R. (2003). Promises of interactivity: Aligning learner perceptions and expectations with strategies for flexible and online learning. *Distance Education*, 24(1), 87–104.

Copyright of Distance Education is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.