

ASSESSING CRITICAL THINKING PROCESSES IN A COMPUTER CONFERENCE

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Abstract

The practical enquiry model describes a process by which experience leads to understanding through a cyclical process of deliberation-action, perception- conception. The four-phases cycle begins with a triggering event, moves through exploration and, as exploration reveals possible insights, integration, and concludes with resolution. Using the practical inquiry model as conceptual grounding, in this study Garrison, Anderson & Archer's (2001) procedure for analyzing conference transcripts at the message level was compared with a sentence-level method, using the *Transcript Analysis Tool* (TAT). Three categories of the TAT were developed, aligning it with the critical inquiry model under different assumptions about and interpretations of the model's four phases. One of the alignments was shown to accord almost perfectly with the critical inquiry model, with both procedures showing that exploration was most common, followed by integration, triggers and resolution. Other alignments showed different proportions, suggesting that further research (preferably at the sentence level) might be useful in establishing the variation of the proportions of the model's elements in online interactions of different types and purposes, conducted under different conditions of social and moderator presence.

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Background

The use of CMC in distance education and training has increased interest in assessing the impact of mediated communication on social processes and outcomes, including collaboration and interaction, as well as, of course, learning (Garrison, 2000; Roblyer & Ekhaml, 2000). Investigators early identified the unique nature of online communications (Collot & Belmore, 1996), including the various costs and benefits of high interactivity (Collins, 1996). Investigations using various transcript analysis approaches have accompanied these conceptual insights, leading to some interesting if incomplete initial findings of online text-based interaction (Henri, 1992; Zhu, 1996; Herring, 1996; Yates, 1996; Gunawardena, Lowe & Anderson, 1997; Kanuka & Anderson, 1998; Rourke, Anderson, Garrison & Archer, 1999; Rourke & Anderson, 2000; Anderson, Rourke, Garrison & Archer, 2001). One of the most important discoveries has been the importance of interaction (perceived and actual), and its relationship to both satisfaction and achievement in online learning situations (Fulford & Zhang, 1993).

Despite some helpful discoveries, however, overall progress in understanding the processes at work in online interaction has not been remarkable. Some observers, in fact, in proposing changes to research methods, have noted consistent inefficiencies and

inadequacies in the methodologies and approaches commonly used in transcript research (Fahy, 2001a; Fahy, Crawford & Ally, 2001; Rourke, Anderson, Garrison & Archer, 2001).

Promising work has recently been done by Garrison and his colleagues (Garrison, Anderson & Archer, 2000; Garrison, Anderson & Archer, 2001), to guide researchers and practitioners in approaching online communication as a vehicle for directed, collaborative inquiry. An important part of this work is a model of critical thinking in computer conferencing, which explains the processes by which a “community of inquiry,” formed and sustained through computer-mediated communication (CMC), uses collaboration to engage in higher-order thinking (Garrison et al., 2001). As part of this work, a preliminary demonstration of an analysis at the message level of a sample of online interaction, involving an admittedly small transcript corpus, was produced by Garrison and his colleagues to illustrate the model.

At the same time, my colleagues and I (Fahy et al., 2001) have offered a different approach, focusing on content and interaction patterns at the component level of the transcript: the sentences of which it was composed. Using a tool based on Zhu’s (1992) work, the *Transcript Analysis Tool* (TAT) we showed that a sentence-level analysis might reveal salient internal elements of the conference, including the proportional presence of interactions of various kinds, and differences in communication styles and approaches which might not necessarily be evident in a message-level analysis (Fahy, 2001b; Fahy, 2001c).

This paper compares the results of a message-level approach to transcript analysis developed by Garrison et al. (2001) with a sentence-level analysis my colleagues and I have developed, to show how each detects and displays evidence of higher-level thinking within the conference. The theoretical grounding of the paper is the *community of enquiry*, and the phases of interaction associated with that model, as described below. Garrison et al. (2001) rightly describe evidence of critical thinking as “complex and (only indirectly) accessible” (p. 8). We look in this study for a way to detect indirect indicators of higher-order thinking within the text of an online conference, using as evidence the patterns and types of interaction produced in the text of the conference by its participants.

Conceptual context

The practical inquiry model and cognitive presence in transcripts

Previous attempts to understand and demonstrate the nature and processes of online communication through transcript analysis have reported problems of various kinds (Kanuka & Anderson, 1997; Gunawardena et al., 1998), or have been suspected of failing to reveal the richness of the medium. Among the problems cited by critics were such basic failings as lack of reliability and replicability, as well as problems with the methodological complexity of the coding and analytic systems used (including the number and vagueness of coding categories), inadequate training of coders, and the choice of illogical or cumbersome units of analysis (Fahy, 2001a; Rourke et al., 2001).

Upon this methodological confusion some needed order was imposed by Garrison and his colleagues. From the position that theory could influence practice (both teaching and research) “by focusing perspective, revealing knowledge and suggesting alternatives,” Garrison et al. (2000, p. 9) suggested a model for detecting critical thinking, based on the concept of “practical inquiry.” The practical inquiry concept contains two dimensions: action-deliberation, and perception-conception. According to the model, within a community of inquiry participants move back and forth from the shared to the private world, alternately engaging as they do so in public discourse and private reflection. The inquiry process incorporates four phases: an initial *triggering* problem or idea, collaborative and individual *exploration* of the trigger,

integration of ideas generated in exploration of the problem, and, ultimately, *resolution* through identification of a solution or explanation for the trigger.

In preliminary work, Garrison's team was able to provide some evidence that their model related to actual online behaviour, although the number of study participants and the transcript corpus size were small, and it was recognized that challenges continued to exist for the model in measuring "latent projective variables" such as cognition (p. 22). It may be instructive to examine Garrison et al.'s procedures as a way of better understanding why some of these challenges arose and persisted.

The Garrison study involved a small corpus of 24 postings. The transcript showed evidence of critical thinking as described by the practical enquiry model, with two-thirds of the postings comprising one of these critical thinking elements: *triggers*, *exploration*, *integration* and *resolution*. The model suggested that, in a true community of enquiry, interaction progresses through the sequence above, as each phase contributes, ideally, to a final resolution. The phases of the model, and their characteristics, were described as follows (Garrison et al., 2001, pp. 10 – 11):

- A **triggering event** begins the enquiry process. A trigger is a problem or dilemma, initially defined or identified (in educational situations) by the instructor.

- **Exploration** postings involve both the private, reflective world, and the shared, collaborative world, with participants moving fluidly and alternately from

reflection to discourse, as they strive to grasp or perceive the problem and understand its nature better. This phase is typified by brainstorming, questioning and information exchanges. Students may resist moving out of this phase into the next, unless prodded by the instructor-moderator.

- **Integration** is the phase where meaning is constructed from the ideas generated in the previous phase. Ideas should be evaluated on how well they connect with and describe the problem. Participants may continue to move repeatedly from private reflection to public discourse in this phase of the enquiry process. This is the most difficult phase to detect; integration must be inferred from group communications.

- **Resolution** occurs as a vicarious or practical application of a test of the adequacy of the proposed resolution is made. If the resolution is perceived as incomplete or inadequate in any way, or a new problem is identified by the discussion, the process may repeat.

Garrison et al.'s method for detecting the above phases in an online conference involved classification of whole messages into one of the above four categories. Not unexpectedly, when classification difficulties were encountered (Fahy, 2001a; Rourke et al., 2001), further clarification in the form of "descriptors" was added. Other language in the model adds further detail on the perspective or purview of the participant. The phases, with their descriptors and perspectives, were as shown below.

Table 1: Phases, descriptors and perspectives in the Cognitive Presence model

<u>Phase</u>	<u>Descriptor</u>	<u>Perspective</u>
Triggering	<i>Evocative</i>	<i>Shared world</i>
Exploration	<i>Inquisitive</i>	<i>Private world</i>
Integration	<i>Tentative</i>	<i>Reflection</i>
Resolution	<i>Committed</i>	<i>Discourse</i>

The process of coding whole messages into the above four phases produced coefficients of reliability (*CR*, a simple ratio of agreement to total number of judgments made by raters) of 0.45 to 0.84, and Cohen's *kappa* values from 0.35 to 0.74 (Garrison, et al., p. 18). (*Kappa* is a chance corrected measure of agreement; University of Colorado, 1999; Agreement observer, 2000). These values were acknowledged by the authors to be rather low, but the not unreasonable argument was made by the team that in research breaking new ground lower reliability levels should not be seen as an impediment.

Results of analysis of the 24-message transcript using this procedure showed that one-third (8) of the postings did not relate to any of the four phases of the critical thinking model (p. 19); of the sixteen which did, the number classified in each of the four phases was as follows:

<u>Phase</u>	<u>#</u>	<u>%</u>
Trigger	2	8
Exploration	10	42
Integration	3	13
Resolution	1	4
Other	8	33

The researchers remarked on the rarity of “integration” and, especially, “resolution” in their results, musing that the nature of the lesson, the medium (computer conferencing) and its lack of support for the higher phases of the cognition process, or the model itself might explain the low frequency of resolution (pp. 20-21).

The TAT model

In transcript analysis work at the sentence-level, my colleagues and I (Fahy et al., 2001) have concluded that the selection of message-level units of analysis, among other methodological decisions (Fahy, 2001a), might at least partially explain problematic results such as those reported by Garrison et al. In our work with conference transcripts, and in reviews of the work of others, we have concluded that the finer granularity of sentence-level analysis results in several advantages:

- Reliability. Kappa values of 0.45 to 0.65, and CRs of up to 0.94, have been achieved with the TAT.) (Keller, 1999; Fahy et al., 2001).
- Ability to detect and describe the nature of the widely varying social interaction, and differences in networking patterns, in the interactive behaviour of an online community (Fahy, 2001a), including measures of social network density and intensity (Ridley & Avery, 1979).
- Confirmation of gender associations in epistolary/expository interaction patterns (Fahy, 2001b), and in the use of linguistic qualifiers and intensifiers (Fahy, 2001c).

Analysis of transcripts at the sentence level is based upon recognition that CMC postings contain both social- and task-related material, in proportions which reflect individual differences in concern for or interest in social and content outcomes. Recognizing that perceived levels of interaction are related to both affective and cognitive outcomes (Fulford & Zhang, 1993), sentence-level classification of interaction reflects the importance of both social and task-related content and outcomes in transcript analysis research.

The TAT, developed from Zhu's (1996) work, classifies each sentence of the transcript into one of eight categories (five primary), as follows:

Figure 1: TAT Categories

Type 1 ***Questions:***

1A includes *vertical questions*, which assume a “correct” answer exists, and the question can be answered if the right individual is asked, or the right source contacted.

1B are *horizontal questions*: there may not be one right answer; others are invited to help provide a plausible or alternate “answer,” or to help shed light on the question.

Type 2 ***Statements:***

2A (non-referential statements) contain little self-revelation and usually do not invite response or dialogue; the main intent is to impart facts or information. The speaker may take a matter-of-fact, a didactic, or even a pedantic stance, providing information or correction to an audience which he or she appears to assume is uninformed or in error, but curious and interested, or otherwise open to information or correction. *Statements* may contain implicit values or beliefs, but usually these are inferred, and are not as explicit as they are in *reflections* (TAT type 3).

2B (referential statements) comprise direct answers to questions, or comments making reference to specific preceding statements.

Type 3 **Reflections (significant personal revelations)** show the speaker expressing thoughts, judgments, opinions or information which are personal and are usually guarded or private. The speaker may also reveal personal values, beliefs, doubts, convictions, and ideas acknowledged as personal. The listener/reader receives both information about some aspect of the world (in the form of opinions), and insights into the speaker. Listeners are assumed to be interested in and empathetic toward these personal revelations, and are expected to respond with understanding and acceptance. The speaker implicitly welcomes questions (even personal ones), as well as self-revelations in turn, and other supportive responses.

Type 4 **Scaffolding/engaging:** these are intended to initiate, continue or acknowledge interpersonal interaction, and to “warm” and personalize the discussion by greeting or welcoming. Scaffolding/engaging comments connect or agree with, thank or otherwise recognize someone else, and encourage or recognize the helpfulness, ideas and comments, capabilities, and experience of others. Also included are comments without real substantive meaning (“phatic communion,” “elevator/weather talk,” salutations/greetings, and closings/signatures), and devices such as obvious rhetorical questions, and emoticons.

Type 5 **Quotations/citations:**
5A: quotations or fairly direct paraphrases of other sources.

5B: citations or attributions of quotations or paraphrases.

Methodology

As noted above, Garrison et al. (2001) obtained a description of the prevalence of the four phases of critical thinking in an online conference using a procedure involving coding of whole postings into one of four phases, described above. Their analysis showed that a substantial proportion of postings (one-third) did not contain any of the cognitive presence categories, and that “triggers” and “exploration” were most common, with “integration” and, especially, “resolution” relatively uncommon.

An examination of the cognitive presence model suggested that the categories of the TAT might be capable of being aligned with the phases in Garrison et al.’s model, the resulting alignments reflecting different assumptions about the linguistic and social behaviour associated with the model’s phases. From three such alignments an analysis was produced, allowing a comparison of both the analytic processes involved and the resulting richness of the insights provided. In aligning the TAT with the phases of the cognitive presence model, interpretation was required. Just as Garrison et al. found that elements fit multiple categories within the model (p. 14), three different alignments of the TAT categories with the model were produced, based upon different assumptions

about what interactive behaviour is apparent in the four phases of cognition. The three TAT alignments with the phases of the model are shown in Table 2.

Table 2: Three alignments of Garrison et al.'s critical enquiry phases with the TAT

Alignment	“Triggers”	“Exploration”	“Integration”	“Resolution”
#1	1A, 1B	2A, 4	2B, 5A, 5B	3
#2	1A, 1B, 2B	2A	4, 5A, 5B	3
#3	1A, 1B, 2B	2A, 4	3	5A, 5B

The three alignments conformed as follows with Garrison et al.'s four phases (TAT categories in *italics*, and TAT code numbers in parentheses):

Table 3: Comparison of interactive elements in the three alignments

	“Triggers”	“Exploration”	“Integration”	“Resolution”
# 1	- questions (1A, 1B) only	- non-referential statements (2A), and scaffolding/engaging (4)	- referential statements (2B), and citations/quotations (5A, 5B)	- reflections (3) only
# 2	- questions (1A, 1B), and referential statements (2B)	- non-referential statements (2A) only	- scaffolding/engaging (4), and quotations/citations (5A, 5B)	- reflections (3) only
# 3	- questions (1A, 1B), and referential statements (2B)	- non-referential statements (2A), and scaffolding/engaging (4)	- reflections (3) only	- quotations/citations (5A, 5B)

The cause of the differences in the above alignments arose from different interpretations of the elements of the practical inquiry model. The different interpretations resulted in different views of the process by which shared, mediated interaction contributes to collaborative critical enquiry. Critical thinking was defined by Garrison et al. as both a process and a product: as a process, it consists of behaviour which online collaborators exhibit; as a product, it contributes to a deeper or more adequate understanding of some content, capable (in an educational context) of being judged by an instructor moderator (p. 8).

“Triggers” in the critical thinking model were defined as events which result in recognition of an “issue, dilemma or problem” (p. 10). In the educational context, triggers were characterized by Garrison et al. as often communicated directly by the teacher, but “in more democratic and nonhierarchical” situations triggers might also be provided by other members of the group. Alignment 1 fits the typical educational (undemocratic?) definition, considering only *questions* (1A, 1B), probably from the instructor, as triggers. Alignments 2 and 3 add *referential statements* (2B) to triggers, as these incorporate postings which, by containing statements of fact and references to others’ statements, “purposely or indirectly add a triggering event to the discourse” (p. 10).

“Exploration” demonstrates that the reader has perceived or grasped the problem or issue contained in the trigger. In TAT terms, *non-referential statements* (2A) are most likely to contain statements on the “nature of the problem,” but *scaffolding/engaging* remarks (4) can also indicate the “moving between the private and shared world” (p. 10) which often accompanies this phase. The degree to which the interaction is private or shared will be seen in the *scaffolding/engaging* elements.

“Integration” arises from ideas generated in phase 2, assessed by application to the issue of concern. Garrison et al. remark that this is the most difficult phase to detect in teaching and research, and that it must be inferred from statements which suggest that new ideas have been generated and interrelated in some way. *Scaffolding/engaging* (4), *referential statements* (2B), and *quotations/citations* (5A, 5B) may all be evidence of integration, as in alignment 2. If the interest shown in integration is more personal than

general, *reflections* may be the only form (alignment 3); if integration is tentative, or limited to the local discussion, it may take the form of *scaffolding/engaging* (4) and *quotations/citations* (5A, 5B), including references to and quotes of other participants, as in alignment 2. A more general or cosmopolitan integration would probably be reflected in a combination of *referential statements* (2A) and *quotations/citations* (5A, 5B), as in alignment 1.

“Resolution,” like integration, may either be public, part of a shared conception collaboratively developed, in which case it may be related to “published” (public) thought (5A, 5B; alignment 3); or it may be more reflective and personal, even semi-private (as in *reflections*). In either case, there is an application or test of the new understandings against existing knowledge and beliefs resulting from the process, by reference to some practical situation or, in the educational context, the original instructor-proposed problem or question. In TAT terms, resolution is seen either in *reflections* or in references to external ideas – at least in educational contexts.

Procedure and findings

The study proceeded as follows. First, all the sentences in a corpus (transcript) consisting of approximately 53,671 words (44,599 words and 2,550 sentences produced by students), in 356 postings, was coded using the TAT. Next, the three TAT alignments with Garrison et al.’s phases of the critical thinking process were developed and applied to the corpus. Finally, an analysis was performed to determine the degree to which the

TAT proportions of sentences corresponded to the phases postulated by the critical thinking model.

The following proportions of messages (Garrison) and sentences (TAT) were found when the alignments of the TAT were compared with Garrison et al.'s model.

Table 4: Comparison of phases of the critical enquiry model with TAT category alignments

Phases	Garrison et al. (2001)	TAT #1	TAT #2	TAT #3
Triggers	13%	3%	12%	12%
Exploration	63	62	52	62
Integration	19	14	15	21
Resolution	6	20	21	5

The data in Table 4 suggest the following observations:

- The two methods of analysis both showed that exploration was clearly the most common type of posting/sentence, followed by integration.
- TAT alignment #3 showed virtually identical sentence-level proportions of the four phases of the model as were found by Garrison et al.'s analysis at the message level.

- Resolution, the terminal phase of the cognitive process, was shown to vary from 5 to 21% on the three TAT alignments, while triggers ranged from 3 to 13%. Triggers might be expected to be less common than resolution in cases where an authority (the instructor) led the discussion, or at least set the initial directions. Resolution on two of the TAT alignments comprised about one-fifth of all sentences, a proportion which Garrison et al. would likely regard as more plausible and desirable, given their surprise and chagrin at the rarity of these in their corpus.

Discussion

If all three of the TAT alignments with the cognitive presence model are assumed to be potentially valid indicators of actual levels of the different types of interaction they represent, and assuming that a comparison between message-level and sentence-level analyses is a contrast of two equally valid analytic approaches, then the difference between the three TAT alignments and Garrison et al.'s findings demonstrate the potential real variation in the proportion of transcript content which might be found to relate to the four components of the model. That is, the following ranges might be expected to occur in each of these four elements in online communications:

<u>Critical enquiry element</u>		<u>Proportion of transcript content</u>
Triggers	-	3 – 13 %
Exploration	-	52 – 63
Integration	-	14 – 21

Resolution	-	5 – 21
None of the above; other	-	0 – 33

It is interesting to note that Garrison's estimates, based on a very small sample and a limited corpus, were on the high side of estimates of two elements of the critical enquiry model ("triggers" and "exploration") as estimated by the TAT, but on the low side of the TAT's estimate for "resolution." Whether the true value is a mean of these, or whether these differences reflect true variances for different types of interaction, under different interpersonal conditions, is an important question which remains to be addressed.

The analysis supports Garrison et al.'s view that the critical enquiry model is a useful conceptual framework for describing and investigating interactive behaviour in online conferences in relation to specific phases cognition in the collaborative inquiry process. The phases of the model (triggers, exploration, integration, resolution and other) appear to describe the types of exchanges which might actually be observed among participants in an online community of enquiry. (The content of the intriguing category "other" remains to be investigated.)

The *TAT* contributes a means for analyzing the content of online interaction at the level of the sentence. The categories of the *TAT* conceptually describe network behaviour within the social environment of the online conference. The proportions of sentences, or, when aligned as in this study, the relative types of transcript activity in the various *TAT* categories, reflect the climate of the conference, and may reveal facts about

the social and interpersonal maturity of the resulting network; the more mature the network, the more inclusive, attentive, responsive and democratic the interaction patterns (Ridley & Avery, 1978; Fahy, 2001a, b).

In this study, the discovery that one alignment of the *TAT* corresponded almost perfectly with results from the Garrison et al. (2001) message-level analysis suggests that the models are capable of relating to one another usefully. At the same time, the variation within the three *TAT* alignments, and between the *TAT* and the Garrison et al. approach, suggests that there may be some (perhaps considerable) variation in the manner in which an actual collaborative online critical enquiry process proceeds: “triggers” may comprise as little as 3% of the content, or as much as 13%; “exploration” always comprises the majority of exchanges, but the proportion may vary considerably (from one-half to two-thirds); “integration” varies between one-fifth and one-seventh of the total; and “resolution” may constitute more of the online interaction than originally found in Garrison and colleagues’ initial results, perhaps as much as a fifth of overall interaction.

Another result of this analysis is evidence of the usefulness of what Garrison et al. (2001) called the “sub-message” unit of analysis, the sentence, as compared to analysis at the level of whole messages. As Garrison et al. commented, “Sub-message level units may be introduced in future confirmatory studies if increased precision is warranted” (p. 17). This study suggests that one type of greater precision may be found in the ability of sentence classification to show variations and mixes of interaction types within the postings, not merely between them. The results presented here

demonstrated that the phases of the cognitive presence model can be detected in sub-message units (sentences). Also, the contribution made to the resulting conclusions by discrete linguistic elements of the transcript (sentences) can be directly observed. This greater level of detail is important: simply knowing that “triggers” occurred in an collaborative enquiry is not the same as knowing that there were, in all, 70 direct questions posed, over 60% of which were horizontal, and that women posed 59% of them. Or that, of the 1577 “statements” (TAT type 2) posed by students, only 246 were *referential* (2B). These are the types of insights the sentence-level analysis permits, to which message-level analysis is oblivious.

Conclusions

The results of this comparison of the two approaches to analysis of critical enquiry in online interaction lead to several conclusions. First, it appears that the conceptual elements of the model are indeed reflected in transcripts – that is, in online communication behaviour. This is confirmation that the community of enquiry model applies to actual interactive behaviour observable among CMC participants. The finding also confirms that use of constructs such as “cognitive presence” may be helpful in isolating important online communication strategies: as groups interact, they traverse the phases predicted by the critical enquiry model, with the transcript record containing evidence of progress made as the discussion moves from initial triggers to eventual resolution.

Another encouraging finding of this study is that two dissimilar approaches to transcript analysis, proceeding from different assumptions and using different tools, nevertheless arrived at a similar picture of the resulting content and processes occurring within the conference. The consistency of the findings that “exploration” predominates, that “integration” follows, and that “triggers” and “resolution” appear to vary (for reasons which subsequent research should attempt to illuminate) suggests both how conferences work, and, on the same evidence, how they may differ in important ways. These findings also increase the importance of investigating the other factors contributing to differences in the interactive environment, such as aspects of the group task (DeSanctis & Gallupe, 1987), the available resources and the conditions under which the group works (Walther, 1996), and instructor and social presence (Rourke et al., 1999).

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