Critical Thinking and Computer Conferencing: A Model and Tool to Assess Cognitive Presence

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The adoption of computer-mediated communication (CMC) in higher education has far out-paced our understanding of how this medium should be used so as to best promote higher-order learning. This medium is substantively different, in several important ways, from face-to-face classroom teaching. A number of other scholars are now trying to remedy this deficiency in our understanding by studying various aspects of the use of CMC in this educational environment.

At the heart of the challenge facing us is the need to create a critical community of inquiry – the hallmark of higher education - within a virtual text-based environment. We have, therefore, focused our efforts on developing the means to assess the nature and quality of critical discourse that takes place within a text-based educational environment.

The paper begins with an overview of the model of critical thinking that we have developed as a framework for our study. Within this overall framework, we propose a model of "cognitive presence" that will provide a means to assess the nature of discourse in a text-based educational environment, and its appropriateness as a means to achieve the overall goals of higher education. The body of the paper describes the initial results of the use of this model as a tool to assess evidence of the nature and quality of critical discourse and thinking in an educational computer conference. We discuss the methodological challenges associated with assessing cognitive presence and provide guidelines and suggestions for further research. The results of this investigation are also discussed in terms of their practical educational implications.

Theoretical Context

The conceptual framework for this study has been described previously in a paper by Garrison, Anderson and Archer (2,000). In this paper, the model of a "Community of Inquiry" was described that specifically applied to the practice of computer conferencing in higher education. The three elements of this community of inquiry are cognitive presence, social presence and teaching presence. The focus of this paper is primarily on cognitive presence defined largely in terms of individual critical thinking and collaborative discourse. For this reason we first turn our attention to a discussion of critical thinking.

Cognitive presence. Cognitive presence is a manifestation of practical inquiry. Cognitive presence is defined as the extent to which learners are able to construct and confirm meaning through sustained discourse in a critical community of inquiry (Garrison et al., 2000). In other words, cognitive presence reflects higher-order knowledge acquisition and application and is most associated with the literature and research related to critical thinking. The genesis and context of cognitive presence is more fully explained in Garrison et al. (2000) but, suffice to say here, it is operationalized through the practical inquiry process. The practical inquiry process is most closely associated with John Dewey (1933) and will be discussed subsequently.

The ultimate value of a tool to assess the nature of the critical thinking process will, obviously, depend upon the validity of the critical thinking concept and its ability to reflect educational practice. It is important at the outset to emphasize that the focus here is upon higher-order thinking processes as opposed to specific individual learning outcomes such as deep and meaningful understanding as well as content specific critical inquiry abilities, skills and dispositions. To emphasize, the focus here is on a collaborative process of critical inquiry. This research is an exploration of the nature and quality of critical inquiry as defined and assessed by the phases (i.e., process) of a generalized model of critical thinking and practical inquiry. The assumption is that critical thinking as an outcome is best measured from an individual perspective; that is, as acquired thinking skills and worthwhile knowledge. Judging the quality of critical thinking as an outcome within a specific educational context is the responsibility of a teacher as pedagogical and content expert. From a process perspective, it is assumed that this could be greatly assisted by a tool to assess critical discourse and reflection for the purpose of acquiring intended and worthwhile learning outcomes.

The critical thinking model employed here is a comprehensive model that includes creativity, problem solving, intuition and insight (Garrison & Archer, in press). From this model a parsimonious model of practical inquiry was constructed that was deemed of particular value in studying the formal educational context (Garrison, et al., 2000). As noted previously, cognitive presence is one of three essential elements (social and teaching presence being the others) in a community of inquiry and goes to the heart of higher-order learning and critical thinking. It is this model which will frame our inquiry into assessing critical thinking in a computer conference environment. In terms of a community of inquiry, cognitive presence is operationalized by the practical inquiry model for the purpose of assessing critical discourse and reflection.

Practical inquiry is grounded very much in experience but includes imagination and reflection which leads back to experience and practice (Dewey, 1933). This recognition of the shared and private worlds of the learner is a crucial concept in understanding the creation of cognitive presence for educational purposes. In fact, the first dimension of the model reflects this continuum between action and deliberation (see Figure 1). The second dimension represents the transition between the concrete and abstract worlds. This is the perception-conception dimension. These are the cognitive processes that associate facts and ideas. The model of practical inquiry defines four phases essential to describe and understand cognitive presence in an educational context. These phases are not dissimilar to the basic structure of inquiry suggested by Duffy, Dueber & Hawley (1998) in their article on critical thinking and the design of on-line conferencing systems.

While subsequent sections will discuss the generation of the phase descriptors used to code student responses, and assess the nature and quality of the discourse, we first describe the phases of cognitive presence. The phases are the idealized logical sequence of the process of critical inquiry and, therefore, must not be seen as immutable.

The first quadrant of the mo del reflects the initiation phase of critical inquiry and is considered the triggering event. Here an issue, dilemma or problem is identified or recognized that emerges from experience. In an educational context the teacher often explicitly communicates expectations or tasks that become triggering events. However, in a more democratic and non–hireacrchical application of computer conferencing, any group member may purposively or indirectly add a triggering event to the discourse. A critical role of the teacher (actualizing teacher presence) is to add, shape and in some cases discard triggering events that potentially serve as distract from attainment of intended educational outcomes.

The second phase of the process is exploration. In this phase, participants shift between the private, reflective world of the individual and the social exploration of ideas. Early on in this phase, students are required to perceive or grasp the nature of the problem and then move to a fuller exploration of relevant information. This exploration is greatly aided in a community of inquiry by iteratively moving between the private and shared worlds – that is, between critical reflection and discourse. At the end of this phase students begin to be selective with regard to what is relevant to the issue or problem. This is a divergent phase characterized by brain storming, questioning, and exchange of information.

The third phase, integration, is characterized by constructing meaning from the ideas generated in the exploratory phase. During the transition from the exploratory phase students will begin to assess the applicability of ideas in terms of how well they connect and describe the issue or event under consideration. Again, students move repeatedly back and forth from reflection to discourse. This is the phase that is most difficult to detect from a teaching or research perspective. Evidence of the integration of ideas and the construction of meaning must be inferred from communication within the community of inquiry. This phase often requires active teaching presence to diagnose misconceptions, provide probing questions, comments, and additional information in an effort to ensure continuing cognitive development and to model the critical thinking process.

The fourth phase is a resolution of the dilemma or problem posed by the triggering event, by means of direct or vicarious action. In the everyday world, this would mean implementing the proposed solution or testing the hypothesis by means of practical application. In an educational context, however, this is somewhat more difficult. It usually entails a vicarious test through thought experiments and consensus building within the community of inquiry. As will be noted subsequently, progression to the fourth phase requires clear expectations, students capable of testing ideas/hypotheses, and treatment of content from a critical perspective. Educationally, at the end of this phase, this may mean moving on to a new problem with the assumption that students have acquired a useful piece of knowledge. In a less contrived situation, the test of an idea would very likely simply start the process over. At this point, there may often be an intuitive leap apparently short-cutting the logical inquiry cycle. This process of apparent

skipping of phases or making conceptual leaps introduces the concepts of intuition and insight (see Garrison & Archer, in press).

This four-phase model of critical thinking is the framework within which we will describe the development of an instrument for assessing the nature and quality of the critical thinking process. However, before describing that instrument we will first discuss some assumptions that must be made with regard to the educational implications of using an asynchronous text-based communications medium such as computer conferencing to facilitate critical thinking and discourse. We argue that CMC functions as a powerful communication, intellectual, psychological and social tool. We concur with Vygotsky's claim that:

> By being included in the process of behaviour, the psychological tool alters the entire flow and structure of a new instrumental act, just as a technical tool alters the process of a natural adaptation by determining the form of labor operations" (1981 p. 137 cited in Wells 1999)

Serious questions exist as to the extent and degree to which text-based communication alters the "flow and structure"of higher-order teaching and learning.

Text-Based Communication. There is now a substantial body of literature about the use of CMC for facilitating an educational experience. However, within this literature it is most often simply assumed that, for educational purposes, written communication is essentially equivalent to verbal discourse, with only the carrier of the communication (sound waves or paper/computer screens) changing. . This equivalency assumption is beginning to be considered more closely (Feenberg, 1999; Garrison, 1997; Garrison, Anderson & Archer, 2000; Peters, 2000). Researchers are now questioning statements such as that of Clark (1983) who declares that "media are mere vehicles that deliver instruction, but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition" (p. 445). His argument is that it is the instructional design, mediated through learning activities that effects learning outcomes (Clark, 1983; 1994). While the importance of instructional design cannot be denied, the issue is whether this generalization holds across various intended learning outcomes or, to express it another way, whether characteristics of the medium of communication can, in fact, have a significant influence on higher-order learning (Kozma, 1994). That is, is it reasonable to accept the null hypothesis, as stated by Clark and others, that the means of communication has no effect on facilitating critical thinking and discourse and achieving higher-order learning outcomes?

Much of the research on media that has rather consistently demonstrated no significant differences between different media in quantity of learning (usually measured by examinations) did not control for the nature and quality of learning outcomes. Most often the intended learning outcomes measured in these studies were low-level information assimilation educational experiences (Russell, 2000). But is does the "no significant difference" generalization also hold when higher-order learning outcomes are intended, and where there is a shift in the mode of communication, from oral language to written language?

One pioneer in the use of computer conferencing for educational purposes suggests that it does not. Feenberg (1999) states that writing is "not a poor substitute for physical presence and speech, but another fundamental medium of expression with its own properties and powers" (p. 345). This echoes comments made by researchers in the field of media generally, such as Olson (1994), who asserts that the written language is not just a pale shadow of the spoken language, but rather an independent entity with distinctive characteristics worthy of study in themselves. As Stein (1992) notes, a new, interdisciplinary "science of the text" is emerging (pp. 1-3). The issue of text versus speech was also raised as being of particular importance with regard to higher-order learning in Fabro & Garrison (1998). The present authors argue that differences in the nature of spoken and written communication is, in fact, a key to understanding computer-mediated communication and specifically the use of computer conferencing in a critical community of inquiry (Archer, Garrison, & Anderson, 2000).

A full discussion of the characteristics of text-based communication will not be attempted here. A paper in progress explores this issue more thoroughly (Archer et al.). However, we will note here that there is sufficient evidence to suggest that writing has some inherent and demonstrable advantages over speech when one person or a group is engaged in rigorously thinking through a problem. As noted by Bean (1996), writing has long been used as both a process and product of rigorous critical thinking. The written word serves best to mediate recall and reflection, while spoken word functions most effectively to mediate action – usually in a face-to-face context (Wells, 1999). The contrast in characteristics of written, as compared to spoken, language would appear to affect the value of the former in facilitating higher-order learning through text-based media such as computer conferencing. Therefore, we believe that text-based

communication has considerable potential to facilitate critical thinking, as well as to convey empirical evidence of critical thinking in the transcripts of a computer conference.

It is to the assessment of critical thinking, as reflected in such transcripts, that we now turn.

Assessing the Model

The purpose of this paper is to describe a practical approach to judge the nature and quality of discourse in a computer conference. The cognitive presence model and its phases define the nature of the critical inquiry process. The model also has the potential to assess the quality of critical inquiry in terms of a coherent representation that provides a means to assess the systematic progression of thinking over time. The focus here is very much on the process of critical thinking within a group dynamic as reflected by the perspective of a community of inquiry. Critical thinking as a product is viewed as a learning outcome and perhaps best judged through individual educational assignments. The difficulty of assessing critical thinking as a product is that it is a complex and only indirectly accessible cognitive process. While assessing critical thinking as both process and product are important educationally, it is the process of critical thinking of interest here and of particular importance in terms of asynchronous text-based communications technology such as computer conferencing.

Assessing cognitive presence and the related concept of critical thinking also raises an issue related to assessing the quality of both process and product. Duffy, Deuber and Hawley (1998) argue that research must move beyond assessment of structure to assessment of quality. They suggest that evaluators of critical thinking in CMC context look for absolute characteristics such as accuracy, significance, logic, depth, completeness and adequacy – as if these factors have absolute meaning outside of the context in which they evolve. We reject this notion as being too circumscribed by algorithmic notions of cognitive development. Rather, we look for more heuristic models of assessment in which the process is judged by participants, especially the teacher, and value and "correctness' of result left to these participants in the community of inquiry. One of the characteristics of the community of Inquiry (Lipman, 1991) is that members question one another, demand reasons for beliefs and point out consequences of other's ideas – thus creating a self-judging community when adequate levels of social, cognitive and teacher presence are evident.

Further, we concur with Wells, 1999 observation that "discourse is a means, not an end in itself, and verbal information is valued not for the correctness of the way in which it is formulated, but for its use as a means towards the achievement of some larger purposes" (p. 231). In an educational context, this "larger purpose" can be ethereal and difficult to empirically assess. In a CMC context the task is made even more difficult buacuse of the lean set of clues available to the teacher, participants and educational researchers.

We now return to the cognitive presence model to assess and guide dialogic writing for purpose of facilitating critical thinking. The goal is to generate and validate indices, for purposes of research and teaching, corresponding to each of the phases of the cognitive presence model. Text-based educational environments appear to have certain advantages for facilitating and studying critical thinking by way of the permanent record afforded teachers and researchers. This, of course, is contrasted with the fleeting discussions often associated with a face-to-face classroom environment. Face-to-face conversation is generally less systematic, more exploratory, and less attentive to others' views (Duffy et al. (1998).

Assessing and finding evidence of cognitive presence within the transcripts of text-based dialogue produced during formal CMC courses presents many methodological challenges. Most fundamental is the problem of assessing individual thought processes and even results of group inquiry through the traces of the process that are made visible and public in the transcript. The process is inevitably inductive and prone to observer error. The transcript is valuable in that it provides an accurate record of nearly all the dialogue and interaction that took place. Unlike face-to-face discourse analysis, there is no body language or non-verbal communication that is used by participants to enhance their communication flow. However, the concentrated use of the medium leaves large amounts of "non-class" time in which the ideas presented are recreated and explored. Secondly, observers only view that subset of the cognitive presence that the participants choose to make visible in the conference. There may be a variety of technical, access, or deeper social, psychological and educational inhibitors to participation in the community. Much work needs to be done using triangulated measures to insure that the individual and group cognition is accurately revealed by the investigators interpretation of the transcript.

Methodology. The method used to assess cognitive presence is content analysis, which Gall, Borg, & Gall (19??) define as "a research technique for the objective, systematic, and quantitative description of the manifest content of communication" (p. 357). The first step in this procedure was to develop a set of

categories into which segments of messages are coded. Garrison's model of critical thinking and practical inquiry provided the substance for our categories (Garrison & Archer, 2000). In addition to the four phases, a fifth category was added to categorize messages in which critical thinking was not evident.

The second step was to develop a set of guidelines, or protocol, for assigning data to categories. In our procedure, this meant developing a set of descriptors, indicators, and examples for each of the four categories. Definitions of the four phases were taken from Garrison, Anderson, & Archer (2000). Descriptors are adjectives that characterize the process that is occurring in the particular phase. Indicators are concrete examples of how the socio-cognitive processes of each phase manifest themselves in asynchronous, text-based computer conferencing. The coders reported that they rely on one or a combination of these guidelines when making coding decisions. The guidelines for each of the categories is presented in Tables 1 through 4.

An important step in assigning data to categories is determining the unit of analysis. After experimenting with several types of units, we found that a message-level unit was the most appropriate for our goals. Messages are clearly demarcated in the transcript; therefore, multiple coders can reliably identify when a coding decision is required. The volume of data generated by sub-message level units can make the procedure burdensome and introduce another reliability factor. Sub-message level units may be introduced in future confirmatory studies if increased precision is warranted. The length and content of a message is devised by its author, rather than by coders. Finally, a complete message provides coders with sufficient information to infer underlying cognitive processes. A full discussion of this issue is found in Rourke, Anderson, Garrison, & Archer (unpublished).

However, a unit of this length may contain contradictory categorization cues. Therefore, we have developed two heuristics for coders. Code down— (i.e., earlier phase) - if it is not clear which phase is reflected; code up—(i.e., later phase) - if clear evidence of multiple phases are present. We justify this procedure by noting that higher levels of critical thinking such as integration and resolution borrow characteristics and process from previous phases.

Three one-week exchanges from two computer conference courses were compiled to test the efficacy of the tool. The first transcript was taken from a graduate-level course in workplace learning. This 13-week course was divided into weeklong, self-contained discussions that focused on one or two issues. Fourteen people participated in this discussion, including the instructor, two student moderators selected from the group, and 11 other students. The discussion was lead by the student moderators whose functions included stimulating discussion, adding pedagogical comment, and weaving and summarizing discussion. The instructor passively monitored the discussion, becoming active only to close the discussion by summarizing the students' messages with reinforcement and expert advice. A total of 51 messages were posted during the conference week.

The second and third weeklong transcripts (weeks one & nine) were taken from a graduate-level course in health promotions. This 13-week course was lead by an instructor who actively guided the discussions with questions and expert advice. In the second transcript, the instructor and six students exchanged 20 messages. In third transcript, the instructor and four students exchanged 24 messages.

Two graduate students coded the transcript selections. One of the coders was involved in the refinement of the tool. The second coder was hired specifically for this coding task. The principle investigator discussed the coding protocol with the coders and they coded the first transcript selection. Coders were encouraged to develop and refine the protocol as they coded. Their results were evaluated for inter-rater reliability, and modifications made to the coding scheme based on suggestions from the coders. The second transcript was then coded. Again, results were evaluated for inter-rater reliability and modifications made to the scheme. Finally, the third transcript was coded according to the revised scheme.

Results. Coding decisions of the two coders were evaluated for inter-rater reliability using Holsti's coefficient of reliability (C.R.) (1969) and Cohen's kappa (k). C. R. is a percent agreement measure in which the number of agreements between the first coder and the second coder are divided by the total number of coding decisions (see Holsti, 1969). In kappa, reliability is reported after accounting for the possibility of chance-agreement by coders. In our five-category coding scheme, this is a significant concern. Holsti's coefficient of reliability (C.R.) and kappa (k) for each of the three transcripts were C.R. = .45, .65, and .84; k = .35, .49 and .74.

Riffe, Fico, & Lacy indicate that content studies generally report chance-corrected reliability figures in the .80 to .90 range. However, they note that this criterion applies primarily to categories and coding systems that have been used extensively. They add that "research that is breaking new ground with

concepts that are rich in analytical value may go forward with reliability levels somewhat below that range" (p. 131). After three training sessions, our inter-rater reliability reached a high of $\underline{k} = .74$.

Content analysis is a difficult process under the best circumstances. Asking coders to determine which of four latent critical thinking phases a student is operating in based on manifest transcript evidence is challenging in the least. It has been argued that inter-rater reliability is invariably low in these types of studies because of the "latent projective" nature of what is in essence an internal cognitive process (Potter & Levine-Donnerstein (19). This challenge was compounded by the methodological weakness of a small sample size. That is, we coded only ?? messages from six and four students respectively.

As noted, the first two transcripts were used to refine the coding scheme. The focus then turned to the third transcript coded with the benefit of insights gained from previous training. Coding results for the third transcript are presented in Table 5. These dat represent a general indication of the relative frequency of each of the categories. The first coder's decisions are read horizontally; the second coder's decisions are read vertically. Numbers on the diagonal indicate agreement between the coders. Numbers off the diagonal indicate disagreement.

In reading Table 5, the column labeled trigger indicates that coder 2 categorized two messages as triggering events; one of which coder 1 categorized as trigger, the other as explore. The column labeled explore indicates that coder 2 categorized ten messages as exploration; of these eight, coder 1 categorized eight as explore, one as integrate, and one as other. Numbers on the diagonal indicate agreement between the coders. The column labeled integrate indicates that coder 2 categorized three messages as integration; of these three, coder 1 categorized one as explore and two as integrate. The column labeled resolution indicates that coder 2 and coder 1 both coded the same single message as resolution. Coding discrepancies occurred in each of the categories; however, the main source of discrepancies in each round of coding was between exploration and integration.

Discussion

To summarize, it was found that the first phase of practical inquiry (trigger) had 8% of the responses. This would seem to be reasonable considering the problem or issue is very likely to be well framed by the teacher in an educational context. The second phase, exploration, had the highest frequency (42%) of coded responses in the transcripts. This is also not surprising and consistent with previous research. That is, it is a brainstorming phase where people feel free to share their insights and contribute relevant information. Perhaps because of the democratic nature of the medium and the way it is used, most of the conversation in a computer conference is of a sharing and comparing nature (Kanuka & Anderson, 1998, p. 71). However, the frequency of the responses fell-off rapidly in terms of integration (13%) and resolution (4%).

The issue worthy of special consideration is why the frequency of responses for integration and, especially resolution, were so few. Certainly integration would seem to be more challenging than exploration for most leamers. Integration requires time for reflection to synthesize information. It also may be more risky to offer tentative solutions or hypotheses in that their ideas may be rejected. While this may seem reasonable, what is harder to explain is the virtual absence of responses associated with resolution.

There are several possible reasons to explain why there was so little attention focused on resolution. The first set of variables are associated with the instructional design and facilitation. That is, it may have not been a goal of the lesson that week or the content did not lend itself well to advanced inquiry (e.g., introductory course). On the other hand, there may have been deficiencies in the facilitation in terms of guiding and shaping the discourse toward higher-order cognitive activities such as the testing of ideas and resolution.

The second explanation for the lack of resolution responses could be that the medium (i.e., computer conferencing) does not support this kind of activity. Application or testing of ideas is difficult in a face-to-face educational context given its vicarious and even contrived aspects. Perhaps this is even more challenging in an asynchronous text-based communication environment?

Finally, it could be that the practical inquiry model was not appropriate for framing the type of educational experience reflected in the transcripts of the computer conference analyzed here. The model is based upon the work of John Dewey and, therefore, has a pragmatic focus to it (Garrison & Archer, 2000). That is, it considers education to be based upon lived experiences and learning in an educational context is to be applied to real-life situations. On the other hand, other critical thinking models are based upon abstract logical thinking processes (?references?) such as deductive thinking and analysis of arguments with little consideration of critical discourse. The point is that the practical inquiry model corresponds to the educational beliefs and the nature of desired learning outcomes valued by the present researchers. We

believe such a model and approach to education is more appropriate where applied knowledge is valued - particularly adult continuing and higher education.

In any case, for a computer conference to serve as an educational environment it must be more than undirected, unreflective, random exchanges and dumps of opinions. Higher-order learning requires sustained critical discourse where dissonance and problems are resolved through exploration, integration and testing. The guide (i.e., practical inquiry model) must be the full cycle of the critical thinking process, which includes interations between the public shared world and the private reflective world. The complexity and challenge of facilitating this educational process in an asynchronous text-based environment necessitates skilled facilitation. Collaborative learning in an educational sense is more than a mindless free-for-all. Interaction must be coordinated and synergistic. This requires an understanding of the medium of communication and the process of higher-order learning.

Conclusion

The goal of this research was to create an efficient and reliable electronic assessment tool that could expeditiously provide important teaching and learning information with regard to the nature and quality of the critical thinking process (i.e., cognitive presence) as reflected in a computer conference transcript. It is concluded that the findings are encouraging and worthy of further investigation. We anticipate this could be a valuable tool for a teacher to assess and confirm the nature of the discourse appropriate for the desired learning outcomes.

This paper has proposed the practical inquiry model with descriptors and indicators that could serve as a framework for future research into a much need quest to better understand the cognitive nature of the teaching and learning transaction in an asynchronous text-based conferencing environment. To this end, much systematic and empirical research is required. The research reported here is but a map to provide direction for an approach focusing on the facilitation of higher-order learning. The intent is to continue to focus on facilitation issues with the assumption that higher-order learning can be developed in a computer conference environment with appropriate instructional design and facilitation guidance. We believe such an approach is capable of refining the model presented here to the point it can be a reliable and useful instructional tool for realizing higher-order educational outcomes.

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Table 1

Triggering Events

Descriptor	Indicators	Socio-cognitive processes
Evocative	Recognizing the problem	Presenting background information that culminates in a question.
	Sense of puzzlement	Asking questions. Messages that take discussion in new direction.

Example:
It has been argued that the only way to deliver effective distance education is through a systems approach. However, this approach is rarely used. Why do you think that is?

Table 2

Exploration

Descriptor	Indicators	Socio-cognitive processes
Tentative	Divergence - within the online community	Unsubstantiated contradiction of previous ideas.
	Divergence - within a single message	Many different ideas/themes presented in one message.
	Information exchange	Personal narratives/descriptions/facts (not used as evidence to support a conclusion).
	Suggestions for consideration	Author explicitly characterizes message as exploration, e.g., “Does that seem about right?” “Am I way off the mark?”
	Brainstorming	Adds to established points but does not systematically defend/justify/develop addition.
	Leaps to conclusions	Offers unsupported opinions.

Example:
One reason I think it is seldom used is that it is too complicated to get cooperation. Another may be the mind-sets of those in charge to change practices.

Table 3

Integration

Descriptor	Indicators	Socio-cognitive processes
Provisional	Convergence—among group members	Reference to previous message followed by substantiated agreement, e.g., "I agree because…"
		Building on, adding to others' ideas.
	Convergence—within a single message,	Justified, developed, defensible, yet tentative hypotheses.
	Connecting ideas, synthesis	Integrating information from various sources—text book, articles, personal experience
	Creating solutions	Explicit characterization of message as a solution by participant

Example:
We also had trouble getting cooperation. Often the use of new tools requires new organizational structures. We addressed these issues when we implemented a systems approach, and I think that's why we were successful.

Table 4
Resolution

Descriptor	Indicators	Processes
Committed	Vicarious application to real world testing solutions Defending solutions	None Coded

Example:
How we solved this problem was … ???

Table 5

Coding results for transcript three

		Coder 2					
		trigger	explore	integrate	resolution	other[a]	total
Coder 1	trigger	1					1
	explore	1	8	1			10
	integrate		1	2			3
	resolution				1		1
	other		1			8	9
total		2	10	3	1	8	24

Note:
C. R. = 83.33%, k = .74
[a] messages that were coded as 'not cognitive presence'

Figure 1: Cognitive presence descriptors

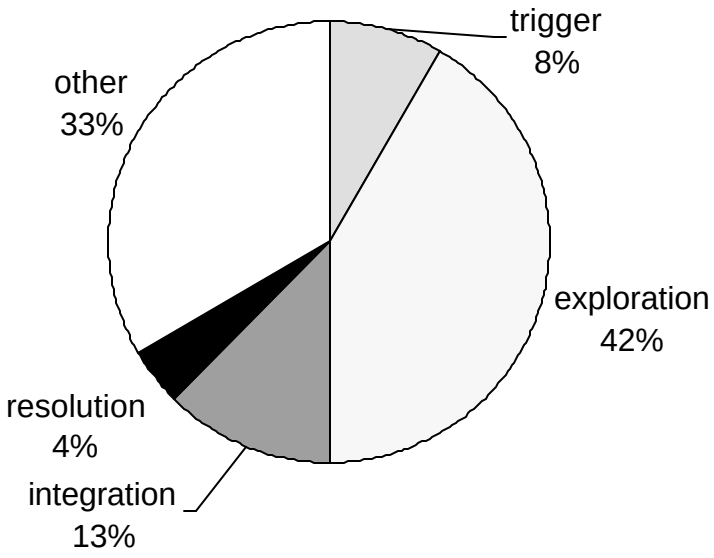

Figure 2. Relative frequencies for cognitive presence categories.

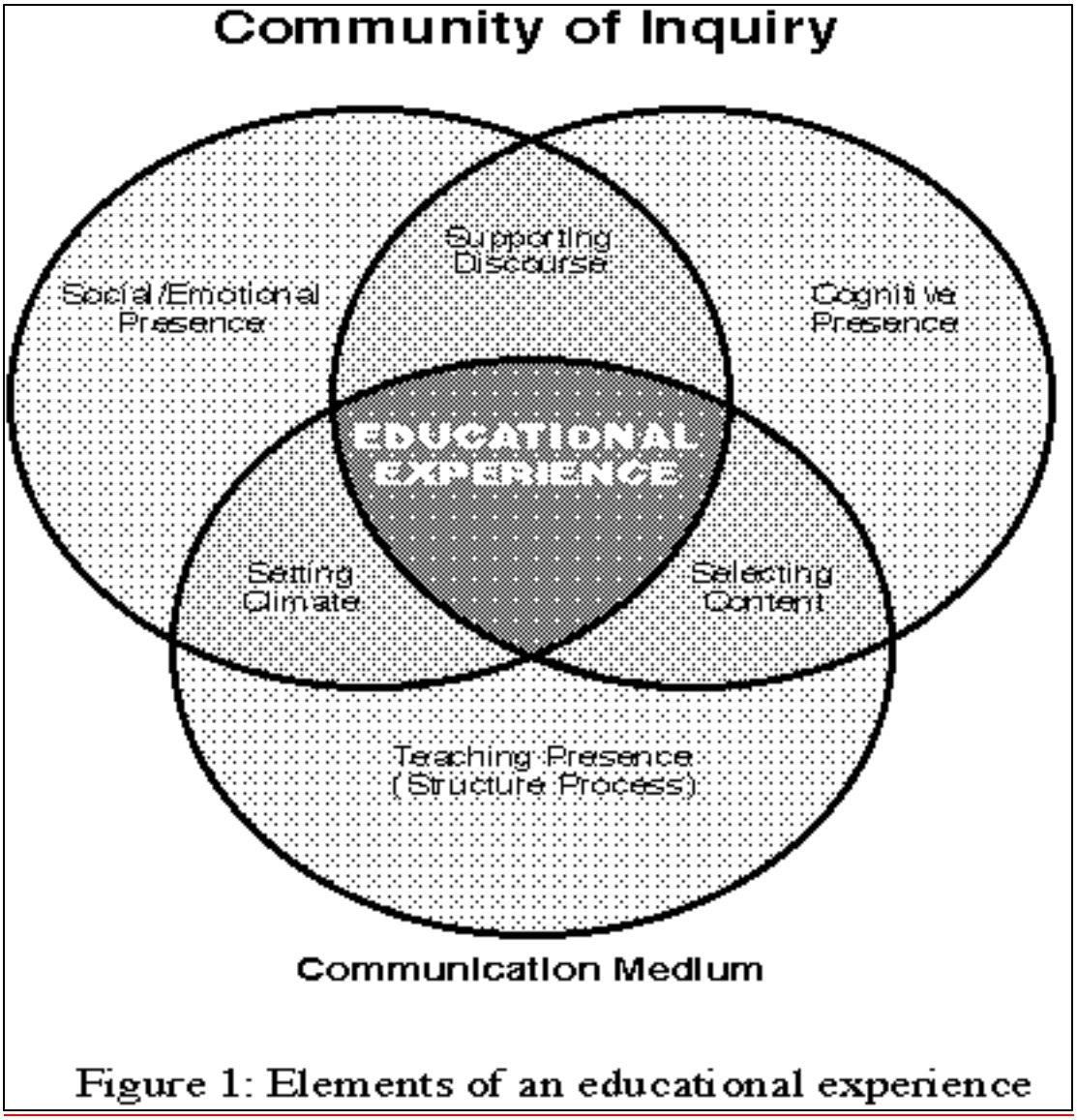

Figure 1: Elements of an educational experience

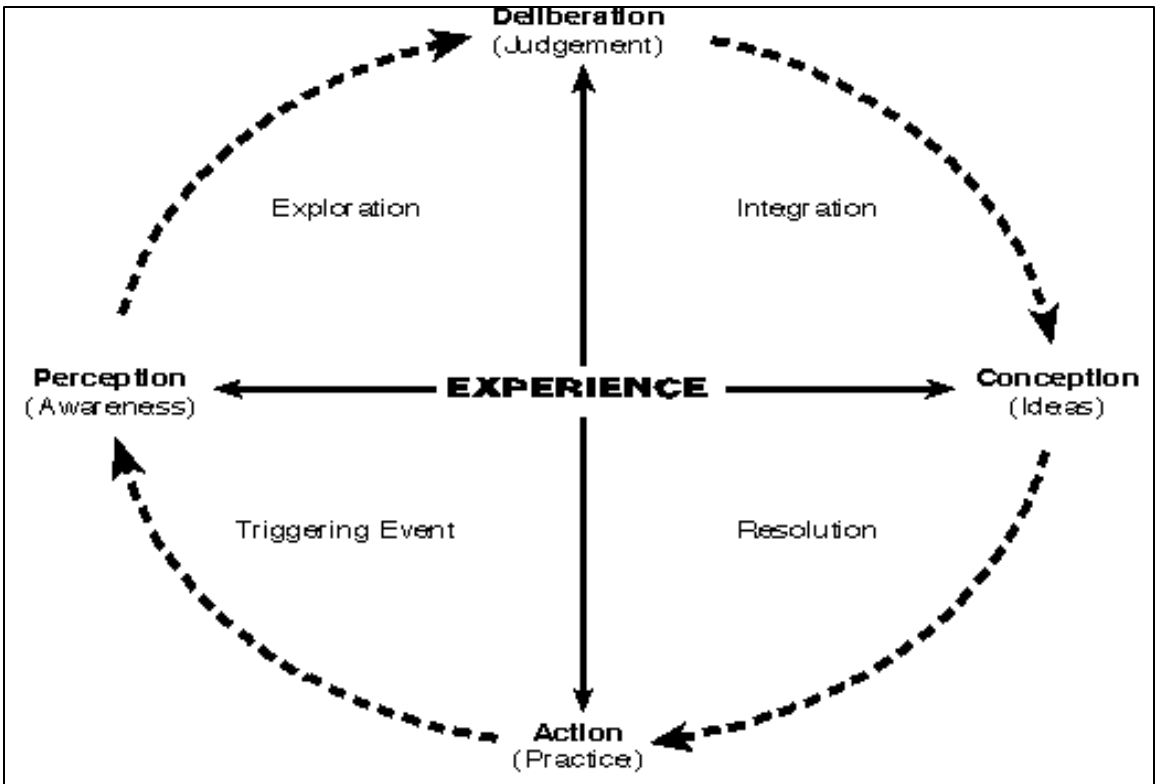

Figure 2: Practical inquiry

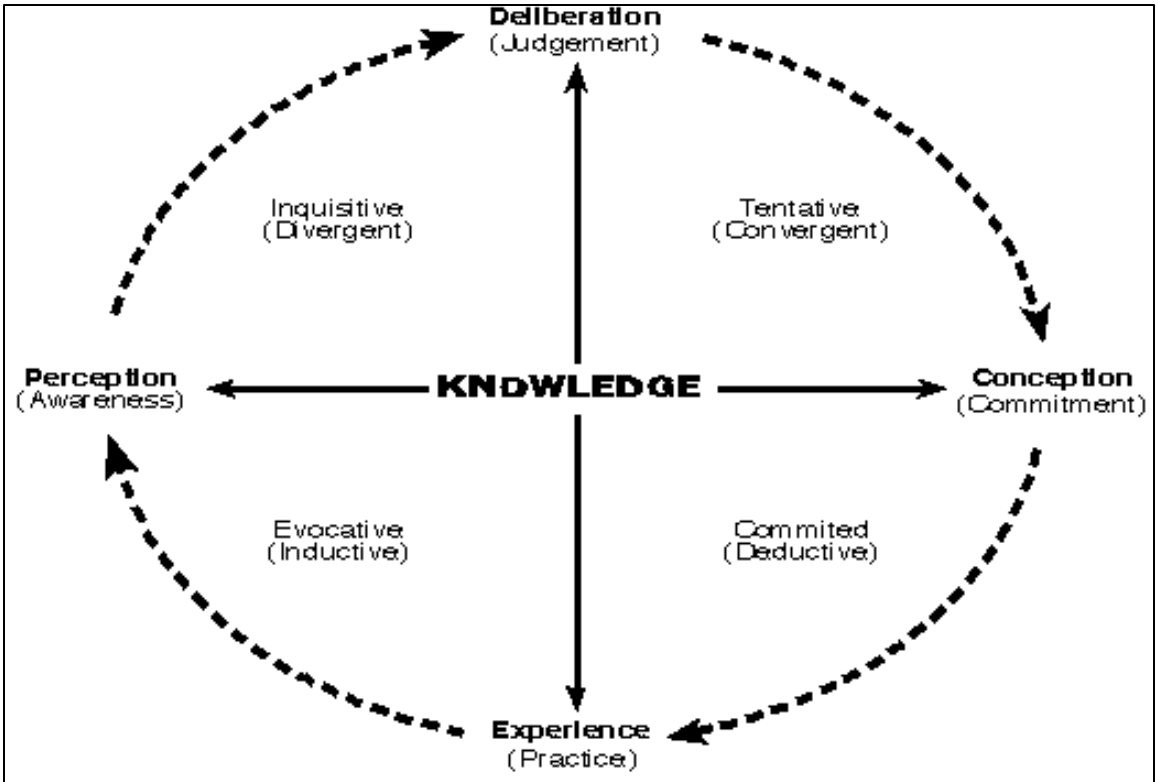

Figure 3: Cognitive presence descriptors