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Using content and process scaffolds for collaborative discourse in asynchronous learning networks

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ABSTRACT

USING CONTENT AND PROCESS SCAFFOLDS FOR COLLATORATIVE DISCOURSE IN ASYNCHRONOUS LEARNING NETWORKS

by
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Discourse, a form of collaborative learning, is one of the most widely used methods of teaching and learning in the online environment. Particularly, in large courses, discourse needs to be 'structured' to be effective. Historically, technology-mediated learning (TML) research has been inconclusive with often conflicting results. To address this issue, TML research needs greater breadth and depth in pedagogical grounding. The purpose of this research is to build and test an original, technology-mediated, discourse-centered model called the Asynchronous Learning Network Cognitive Discourse Model (ALNCDM) grounded in pedagogy. Cognitive discourse is defined as discourse on conceptual subject matter. The model is aimed at structuring discourse to effect conceptual mastery at the Application level of Bloom's taxonomy. The ALNCDM applies pedagogic principles to provide content and process scaffolding during discourse to increase learning. (Scaffolding is defined as providing support for the learner at his/her level until the support is no longer needed.) The content scaffold consists of a concept structure in the form a matrix, which is unfolded in a sequence following the Vee-heuristic. The process scaffold consists of an individual process, modeled after Gagne's Nine Events of Instruction, embedded within a group process, modeled after Gunawardena, Lowe and Anderson's Critical Thinking Model. A research approach was designed and a field experiment conducted to validate the ALNCDM. In the research

approach, content and process scaffolds formed the two manipulated variables while the dependent variable, learning effectiveness, was measured using a combination of cognitive and affective assessments. A motivation measure, self-expectancy, was also included in the dependent variables. The main study, a 2X2 between-subjects, pre- and post-test field experiment, was conducted between Fall 2004 and Spring 2005, yielding 172 participants in 58 groups. A major finding from the study is students with Synthesis-Analysis learning approach performed significantly better in two out of three cognitive assessments. While the ALNCDM research approach requires further refinement, correlation/contextual analyses support the overall ALNCDM. Another finding from the study is the lack of undergraduate student motivation.

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by
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CHAPTER 1

RESEARCH ISSUES

The Issue

As indicated by the National Center for Education Statistics (2003), the current explosion in distance learning has resulted in over 2 million students in the United States taking online courses. Discourse, a form of collaborative learning (Vygotsky, 1980), is central to learning in this environment. Particularly in large courses, discourse needs to be 'structured' to be effective. The Asynchronous Learning Networks (ALN) literature has consistently shown that open-ended discourse without clear structure remains the norm (Pincas 1998, McLoughlin and Luca 2000, Meyer 2003, Jeong 2003, Oliver 2003). Consequently, ALN empirical study results have been mixed, with Orr (1997) suggesting a significant difference in outcomes, while Russell (1999) suggesting there is no significant difference in outcomes. Alavi and Leidner (2001) attributed this state of affairs to "...a paucity of theoretically grounded and rigorous research..." to guide the development of Technology Mediated Learning or TML.

The Challenge

In order to improve the quality of TML research, Alavi and Leidner (2001) suggested a framework for research based on broadening the scope and delving deeper into the issues. Herein lies the challenge: *research needs to advance a body of knowledge grounded in educational theories and practices, guiding the application of technology-mediated learning.* It is no longer sufficient to build a new tool in search of an instructional use. TML research should begin with an educational theory (such as Constructivism), adapt

this theory within an ALN context (such as collaborative discourse), and introduce technology (such as cognitive processing aids and CMC process structures) to enable the teaching and learning process.

Hara, Curtis, Bonk and Angeli (1998) expressed the same need for pedogagically grounded research, specifically related to electronic discourse. They said: "(there is) a pressing need to develop pedagogy that motivates students to electronically participate in class discussions beyond standard course requirements". They further claimed "such pedagogical issues must be addressed before anyone can claim electronic learning success".

Swan (2002) further elaborated on the nature of the pedagogic issue by stating, "further research... should ... look for ways to successfully employ collaborative strategies online."

The Literature Review

In answer to the need to advance a body of knowledge grounded in educational theories specifically for ALN collaborative discourse, a literature review drawing from multiple disciplines including communications, educational technology and cognitive psychology was performed. In addition, a survey of twenty-two ALN collaborative discourse empirical studies (see Table 1.1) was conducted. These studies were drawn from the last five years of twelve ALN related journals: Computers and Education, American Journal of Distance Education, Distance Education, Education at a Distance, The Internet and Higher Education, Journal of Interactive Online Learning Research, Journal of Interactive Media in Education, Educational Technology, Educational Researcher, Journal of Educational Research, Journal of Research on Technology and Education, and Journal of

Asynchronous Learning. In addition, two conference proceedings were included: Teaching and Learning Forum, and Computer Supported Collaborative Learning.

Table 1.1 Twenty-two Empirical ALN Discourse Studies

1.	Swan, K. (2002). Building learning communities in online courses: the importance of interaction. Education, Communication & Information, 2(1).
2.	Vrasidas, C. and McIsaac, M. S. (1999). Factors influencing interaction in an online course. The American Journal of Distance Education, 13(3).
3.	Meyer, K. A. (2003). Face-to-face versus threaded discussions: The role of time and higher-order thinking. Journal of Asynchronous Learning Networks, 7(3).
4.	Aviv, R., Erlich, A., Ravid, G., and Geva, A. (2003). Network analysis of knowledge construction in Asynchronous Learning Networks. Journal of Asynchronous Learning Networks, 7(3).
5.	Nussbaum, E. Michael and Sinatra, G. M. (2003) Argument and conceptual engagement. Contemporary Educational Psychology. 28.
6.	Chiu, D.H., Huang C.C., and Change, W.T. (2000). The evaluation and influence of interaction in network supported collaborative concept mapping. Computers and Education, (34).
7.	Jeong, A.C. (2003). The sequential analysis of group interaction and critical thinking in online threaded discussions. The American Journal of Distance Education, 17(1).
8.	Ravenscroft, A. (2000). Designing argumentation for conceptual development. Computers and Education, (34).
9.	Oliver, M. and Shaw, G.P. (2003). Asynchronous discussion in support of medical education. JALN. 7(1).
10.	Kakitalo, K., Hakkinen, P., Leinonen, P. and Jarvela, S. (2002). Mechanisms of common ground in case-based web discussions in teacher education. Internet and Higher Education. 5.
11.	Bonk, C., Angeli, C., Malikowski, S. and Supplee, L. (2001). Holy COW: Scaffolding case based conferencing on the Web with preservice teachers. Education At a Distance. 15(8).
12.	McLoughlin, C. and Luca, J. (2000) Cognitive engagement and higher order thinking through computer conferencing: We know why but do we know how? In Herrmann, A. & Kulski, M.M. (Eds.), Flexible futures in tertiary teaching. Proceedings of the 9th Annual Teaching Learning Forum, 2-4 February 2000. Perth, Western Australia: Curtin University of Technology.
13.	Crawford, P. (2000). Self directed learning unit- Muresk Institute of Agriculture. In Herrmann, A. & Kulski, M.M. (Eds.), Flexible futures in tertiary teaching. Proceedings of the 9th Annual Teaching Learning Forum, 2-4 February 2000. Perth, Western Australia: Curtin University of Technology.
14.	Hara, N., Bonk, C.J., and Angeli, C. (2000). Content analysis of online discussion in an applied educational psychology. Instructional Science, 28(2).
15.	George, S., and Leroux, P. (2001). Project-based learning as a basis for a CSCL environment: An example in educational robotics. Paper presented at the Euro conference of Computer-Supported Collaborative Learning, Maastricht, the Netherlands.
16.	Baker, M., de Vries, E., Lund, K. and Quignard, M. (2001). Computer-mediated epistemic interactions for co-constructing scientific notions: Lessons learned from a five-year research programme. Paper presented at the Euro conference of Computer-Supported Collaborative Learning, Maastricht, the Netherlands.
17.	Veerman, A. (2004) Constructive discussions through electronic dialogue. In Arguing to Learn. Andriessen, J., Baker, M., and Suthers D. (Eds.) Kluwer Academic Publishers.
18.	Van Boxtel, C., and Veerman, A. (2002) Diagram-mediated Collaborative Learning Diagrams as tools to provoke and support elaboration and elaboration. Euro Computer Supported Collaborative Learning 2001.
19.	Suthers, D. D. (2001) Towards a systematic study of representational guidance for collaborative learning discourse. Journal of Universal Computer Science. 7(3).
20.	Stoyanova, N., and Kommers, P. (2001) Learning effectiveness of concept mapping in Computer Supported Collaborative Problem Solving Design.
21.	Rourke, L., and Anderson, T. (2002) Using peer teams to lead online discussions. Journal of Interactive Media in Education. (1).
22.	Vonderwell,S. (2003). An examination of asynchronous communication experiences and perspectives of students in an online course: a case study. The Internet and Higher Education (6).

The literature review yielded Clark and Brennan's (1991) Grounding in Communications theory that serves as an overall theoretical framework that has been adapted in Chapter 3 as an ALN discourse model. Several pedagogical theories were extracted from the literature including the use of concept structures for knowledge representation, Ausubel's (1963) Assimilation theory for progressive cognitive elaboration, the Vee-heuristic (Novak 1998) as a meta-cognitive learning sequence, Gagne's Nine Steps of Instruction as conditions of learning, Gunawardena's Critical Thinking Model as a group discourse process model for higher cognitive processing, and best practices in online discourse strategies for the purpose of engaging students more fully. These theories lay the pedagogical foundation for this thesis and are presented in this chapter. As a preface, the role of ALN as a technology-mediated learning environment is discussed, followed by the literature review findings.

1.1 ALN and Technology-Mediated Learning Environment

Definition of ALN

ALN is "a teaching and learning environment located within a Computer-Mediated Communication (CMC) system designed for *anytime/anyplace* use..." (Hiltz 1997). ALNs function best when they create a sense of community, a feeling of belonging to a group bonded together for learning and sharing of knowledge. In this respect ALN differs from CMC, which has been narrowly focused on work relationships and task coordination. ALNs view exchange of information *and* emotional support equally important. In this respect, it is not only a CMC but also a Virtual Community (Fernbeck and Thompson 1995):

> "The term virtual community is ... indicative of an assemblage of people (with social relationships) being ... virtually ... a community than ... a real community in the nostalgic sense."

In other words, ALNs are CMCs that bring together a dispersed group of members who share information and support each other with *interpersonal processes* for the purpose of teaching and learning. As ALNs are communities of teaching and learning, an ALN needs to enable the principles of teaching and learning as a foremost design principle. As we shall see in the next section, this aspect of interpersonal support plays an important role in Collaborative Learning (e.g., discourse), a learning modality in Constructivist Learning Theories.

Learning Theories

Learning theories fall into three major schools of thought: behavioral, cognitive and constructivist. Each learning theory is discussed below in brief.

Behaviorism learning theory

Behaviorism is based on stimulus-response theory (Skinner 1989): learning is a change in behavior. The underlying assumption is that knowledge is transferred rather than personally constructed. Teaching is the transfer of correct knowledge from the teacher to the learner through conditioning (i.e., the use of rewards and punishment). The main modality of teaching is lectures, which is teacher-centered and teacher-controlled. Hence, students may abdicate their learning to the teacher and take less responsibility for their learning.

Cognitivism learning theory

Cognitivism came about as a rejection of behaviorism. This learning theory focuses on an observable change in mental knowledge that is not necessarily reflected in behavioral changes. One of the chief tenets of cognitivism is learning involves the formation of mental structures that are extended by relating new information to existing knowledge structures. One proponent of cognitivism is Novak (1998).

Constructivism learning theory

Constructivism (Gruber and Voneche 1995) is based on the idea that knowledge (or reality) is what is conceived/constructed in an individual's mind. Hence the emphasis in this learning theory is knowledge as the product of individual construction. Therefore the main modality of teaching is facilitation. The student controls the pace of learning, interacts with the world, discovers patterns in the world, abstracts representations of what is observed, and constructs the knowledge as internal *mental models*. This is student-centered learning. The teacher must move from 'sage on the stage' to the sidelines for this to happen.

There are two strands within Constructivism- cognitive constructivism and social constructivism. Cognitive constructivism is based on the work of Swiss developmental psychologist Jean Piaget (1983). According to Piaget's theory of development, children develop cognitive abilities in stages based on their age. On the other hand, social constructivism (Vygotsky 1980, Slavin 1990, Whipple 1987, Flynn 1992) emphasizes the importance of culture and context in constructing knowledge. One instructional theory popular with this learning theory is the use of discussion/discourse as a social activity to

engage individuals to construct knowledge. The goal is the construction of shared understanding.

A major proponent of social constructivism is Vygotsky (1980). Vygotsky believed that knowledge is embedded in the culture, that the culture decides what to think and how to think. In this sense, knowledge is constructed through social interaction particularly through the use of scaffolding to guide the learner from his/her actual to the potential developmental level. This gap between the actual and potential developmental level is called the zone of proximal development (ZPD). The basic rationale for ZPD is that students can, with the help of instructors or peers who are more advanced, master concepts and ideas that they cannot understand on their own. Some of the learning activities emphasized in this form of constructivism include case-based instruction, situated learning and collaborative learning.

ALN and New Paradigms for Teaching and Learning

While ALNs have the distinct advantage of being anytime/anyplace, they have the disadvantage of medium leanness[1] (Daft and Lengel 1986). This can be a handicap in collaborative learning when group consensus/convergence is needed, such as when a group report has to be produced. Therefore, in order for ALN to be effective as a teaching and learning environment, a key research question is what does ALN have to offer that not only overcomes this apparent limitation but also provides unique opportunities for new paradigms of teaching and learning?

The answer can be found in several CMC theories including:

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[1] Medium leanness is the lack of a media's ability to provide immediate feedback (immediacy), number of cues (text, voice, body language, etc.), personal focus and language variety (number of linguistic symbols). According to Daft and Lengel, text-based media is a lean media (vs. voice or video).

- Media Synchronicity Theory: Dennis and Valacich (1999) suggest that the information processing capabilities of a medium can be as important as media richness in effective communications. In particular, information overload reduction (e.g., threaded-discussion boards) and cognitive processing features (e.g., technology-mediated concept structures) are especially important under the cognitive information processing pedagogy.

- CMC is interpersonal: Walther (1996) observed that CMC/ALN can be just as effective as face-to-face, provided the groups have an established history of working together and can expect to continue to do so. That CMC/ALN can be as effective in interpersonal communications implies its suitability for social constructivistic approaches to teaching and learning such as discourse.

- CMC is reflective: Veerman (2004) has found that the asynchronous nature of CMC enhances reflection and enables more in-depth information exchange. CMC is also a persistent media providing for reviewability and editability of information (Clark and Brennan 1991). These inherent CMC/ALN features can be leveraged to enhance deeper cognitive processes.

Integrating the above viewpoints, an ALN paradigm for teaching and learning encompasses the following student-centered learning guidelines to promote on task and guided learning:

- build interpersonal support structures for learning by forming small discourse groups,

- shift the students' focus to student-centered learning by fostering self-regulated learning (O'Neil and Herl 1998), and

- provide technology-mediated learning environments that can scaffold collaborative learning activities (e.g., discourse) by providing system features that can:

    - reduce information overload (e.g., threaded discussion boards and structured activities); and

    - enhance cognitive processing and mental knowledge extension (e.g., technology-mediated learning artifacts)

By emphasizing the above teaching and learning guidelines, ALN has the potential to overcome its major shortcoming of media leanness by leveraging its

technology-mediated environment to engage (via enhanced cognitive information processing) and motivate (via small study groups) students into more reflective learning (via asynchronous communications).

1.2 Grounding in Communications

Collaborative learning involves interpersonal processes as students work together on learning activities (Hiltz and Goldman 2003). In collaborative learning, the students engage each other to negotiate different perspectives and to reconstruct knowledge (Veerman, Andriessen, and Kanselaar 1999). While these statements describe collaborative learning, they describe a more fundamental process called communications.

In a seminal work, Clark and Brennan (1991) suggested that to succeed in communications, the parties have to coordinate both the 'content' and 'process' of what they are doing. For example, two pianists playing a duet need to coordinate the content (e.g., Mozart) as well as the process (entry, exit, pace etc.) of playing. The common denominator is the establishment of a "common ground", or shared meaning, through a process called "grounding". Grounding is described as the moment-to-moment update of shared meaning on both the content and process dimensions of communications.

To validate that Clark and Brennan's model on communications is valid in ALN discourse, evidence on two research threads is required: that the use of a) 'content' grounding and b) 'process' grounding result in more effective discourse (measurable in quantitative or qualitative terms). Of the twenty-two empirical studies in Table 1.1, there is evidence of the importance of the 'process' of discourse in the form of structured activities in eight studies (Vrasidas and McIsaac 1999; Aviv, Erlich, Ravid and Geva

2003; Hara, Bonk and Angeli 2000; George and Leroux 2001; Baker, deVries, Lund and Quignard 2001; Stoyanova and Kommers 2001; Suthers 2001;Vonderwell 2003). Although fewer studies fall into this category, there is also evidence of the use of knowledge representation for the purpose of grounding in six studies (Nussbaum, Michael and Sinatra 2003; Chiu, Huang and Change 2000; Veerman 2004; Van Boxtel and Veerman 2002; Suthers 2001; Stoyanova and Kommers 2001). Yet only one study (Suthers 2001) incorporated both 'content' and 'process' grounding in the study. Hypothetically, if there is evidence that the use of 'content' and 'process' grounding result in measurable improvement in discourse, then the use of both 'content' and 'process' grounding should result in higher levels of discourse as well. Moreover, not only should there be 'content' and 'process' grounding, but these two dimensions need to interact so that the 'content' is updated reflecting the negotiated meaning from the discourse process. Clearly, the use of both 'content' and 'process' grounding in discourse is a promising area for research.

With Clark and Brennan's Grounding in Communication theory as backdrop, the next two sections pull together pedagogical theories to fill in a theoretical framework for scaffolding discourse based on the dimensions: a) scaffolding the discourse content via a knowledge representation, and b) scaffolding the discourse process via structured learning activities. These two dimensions of coordination are not pure, but intertwined. There is an interaction as the discourse is scaffolded by the knowledge representation, interacts with it, and updates it as the discourse unfolds.

1.3 Content Scaffold

According to Merrill (2000), one of the greatest impact on learning results from the representation (and organization) of knowledge to be learned. Knowledge representation, in fact, is Merrill's first rule in principles of instruction, known as the Cognitive Structure Principle:

> The purpose of instruction is to promote incremental elaboration of the most appropriate cognitive structure to enable the learner to achieve increased generality and complexity of the desired learned performance.

In a recent article, Jonassen (2003) states that 'problem representation is the key to problem solving among novice learners as well as experts.' He further elaborates on the importance of problem representation by saying: 'instruction must help learners to construct problem representations that integrate their problem representations with domain knowledge.'

In the next two sections, this paper discusses two types of knowledge representations: a static knowledge representation called the concept structure (see Section 1.3.1); and a progression of concept structures based on the Vee-heuristic for the purpose of progressive elaboration of concepts (see Section 1.3.2).

1.3.1 Concept Structures

Shavelson and Ruiz-Primo (2000) defined a concept structure as "a hypothetical construct referring to the organization of the relationships of concepts". The main formats for the representation of concept structure are: content structure, matrix (or cross classification table), concept map, and networking. Table 1.2 represents a comparison of

the main concept structure representations, their advantages and disadvantages, as well as their published empirical studies.

Of particular interest to the thesis is the matrix (i.e., cross classification tables), which is especially suited for comparison and contrast (Schwartz 1971, Jonassen 2003) learning objectives. (Comparison and contrast is a recommended strategy to assess mastery of learning objectives at the application level of Bloom's taxonomy.) While there are many formats for the matrix, the cross-classification table is the most basic form. The cross-classification table represents an organization of information much like how information is organized in frame theory (Minksy 1975). Table 1.3 shows a frame and slot representation. The frame represents categories of information that are repeated for every party, such as the date, place, attendees and menu. The slot represents specific information about a party. For example, Table 1.3 describes a Christmas party at Dr. Hiltz and Dr. Turoff's house serving turkey, wine and chestnuts for the ALN research group.

Table 1.2 Comparison of Main Concept Structure Representations

	Concept Structures	**Advantages/ Disadvantages**	**Empirical Studies**
Text	Text	+ No training required. + No special software beyond a word processor. - Lack of organization. - Information overload.	Control condition in studies with asterisk.
	Content Structure	+ Requires minimal training. + No special software beyond a word processor. + Enhances recall.	Frase* (1969), Meyer* (1975).
Matrix	Cross Classification Tables (and Conceptual networks)	+ Requires minimal training. + No special software beyond a word processor. + Enhances recall and deeper processing of information. + Especially suited for comparison and contrast. - May promote study by rote.	Jones, Amiran, and Katims, 1985. Craik & Lockhart, 1972. Schwartz* 1971.
Visual	Concept map (and Graphic Organizers)	+ Enhances level of comprehension. + Increases standardized achievement test score. - Requires training to read/construct. - Requires special software. - May be confusing because of ambiguity in link types and granularity of nodes.	Mitchell, and Taylor* (1991). Jegede, Alaiyemola, and Okebukola.* (1990).
	Networks	+ Enhances level of comprehension and recall. + Requires some training in fixed link types. - Requires special software. - Fixed link types may be too restrictive in some contexts.	Holley et al.* (1979). Rewey et al.* (1989).

Table 1.3 Minsky's Frame Theory

FRAME	SLOT
Date	12/25/03
Place	23 Any Street, Any Town, Any State
Attendees	ALN research group
Menu	Turkey, Hot Mulled Wine, Chestnuts

From an instructional strategy point of view, by using frame and slot, an expectation is set up in the learner like an advance organizer (Ausubel 1963) to see certain types of information. This increases familiarity with the new knowledge and aids comprehension and assimilation. Table 1.4 shows a full example of a cross-classification table, which will be referred to as the matrix for the purpose of this paper.

Table 1.4 The Matrix (Cross Classification Table)

	Date	Place	Attendees	Menu
Christmas Party	Dec. 25, 2003	Any Street, Any Town, Any State	ALN Research Group	Turkey, hot mulled wine, chestnuts
Birthday Party	Aug. 11, 2003	Penn Estates, E. Stroudsburg, PA	Tuesday night class	Spinach lasagna, three bean salad

The ability of the matrix to enhance recall and deeper levels of processing has been well validated through empirical studies. Jones, Amiran, and Katims (1985) have found that students demonstrated better recall and produced higher quality essays when they used matrices. Craik and Lockhart (1972) have shown that students demonstrated deeper levels of processing of information by writing conclusions based on a matrix. Not only has the matrix been empirically proven to be effective, Schwartz (1971) has also found that matrix representations were substantially superior to text groupings and graphs

because they clearly defined needed information. Matrix representations, according to Schwartz, provide consistency checks for partial solutions. As such they are especially effective for comparing and contrasting of knowledge. While the matrix has been demonstrated to increase deeper levels of processing of information, one potential drawback is some students may rely on the structure too much for rote memorization (to the detriment of meaningful learning).

Knowledge Representation Bias and Scaffolding

Related to the choice of representational formats is the subtle issue of bias. According to Suthers (2002), who has done extensive research on the issue of knowledge representation and bias, a representational format (such as a matrix or graph) implements a representational language with a certain syntax and grammar. The syntax of a language has two effects on the representation: a) the syntax *constrains* the vocabulary that can be used for expression, and b) the syntax determines the structure of the representation, which can make *salient* certain aspects of the structure. For example, if a matrix was chosen as a representational format, it will make salient all possible combinations. But if a graph representation were chosen, there is the option to include (i.e., make salient) certain combinations in the matrix while excluding (i.e., make less salient) other combinations. These effects on representation are known as representational bias. Suthers suggests that representational bias can be leveraged to constrain, and focus attention. Furthermore, when the representation is used as a shared medium of expression as in discourse, it can constrain, focus attention and direct discussions.

This use of representational bias to focus attention and direct discourse is a subtle form of learner support. Learner support (aka scaffolding) is grounded in Vygotsky's

theory of zone of proximal development (ZPD)- the distance between the actual developmental level and the level of potential development under expert guidance, peer collaboration or under scaffolding. Cates and Bruce (2002) suggest a multi-dimensional learner support space defined by the intrusiveness of the support and the prescriptiveness of the content of the support. An intrusive support prevents the learner from proceeding until an error is corrected. In contrast, a non-intrusive support may display a background icon indicating optional guidance is available. Prescriptiveness is the quality of authority in the content of the guidance. Generally, a non-intrusive and non-prescriptive learner support is more supportive of a constructivistic approach as opposed to behaviorist approaches. The use of representational bias for the purpose of learner support is an example of *non-intrusive and non-prescriptive learner support.*

1.3.2 The Vee-heuristic (a meta-cognitive sequence)

The Vee Diagram (Novak and Gowin 1984) is a meta-cognitive process[2] for learning and creating knowledge (Figure 1.1). It is a progression of knowledge representations for the purpose of successive elaboration of concepts based on *Ausubel's Assimilation Theory.* According to Ausubel (1963), the most important factor in learning is what the learner already knows. Ascertain this and teach him/her via a process of 'meaningful' learning. 'Meaningful' learning is a process by which new information is related to existing knowledge structures to form modified knowledge structures (i.e., learning). This is the

[2] A meta-cognitive process provides knowledge about the process of producing knowledge.

core principle known as *subsumption*[3] in Ausubel's theory. Other significant principles in Ausubel's theory include *progressive differentiation*[4], and *integrative reconciliation*[5]

The Vee-heurisitic ties together knowledge to be created with the methodology by which knowledge is created. The Vee-heuristic is driven by a series of *focus questions* that guide the meta-cognitive process. The heuristic begins at the bottom of the Vee- the '*Record of Events*'- and progresses to the top of the Vee- the '*Value Claims*'. On the left side of the Vee, the knowledge structure to be created is enumerated from the atomic concepts to the collective whole (i.e., world view). The left side of the Vee is referred to as the *thinking* or *conceptual* side. On the right side of the Vee, the methods for creating knowledge are introduced. The right side is referred to as the *doing* or the *methodological* side. There is a continuous interplay between the *doing* and *thinking* sides as the student works up the Vee. For example, in reading an article (i.e., *record of events*), the learner encounters the *concepts* (or terms). By applying *constraints* to the article, a list of significant source statements may be used to focus attention on the underlying *principles*[6]. Next, the significant source statements may be *transformed* into logical groupings, which present an underlying *theory*[7]. The students then compile a group report making explicit the significant theories. These significant findings are the answers or *knowledge claims* to the *focus questions* at the top of the Vee. To complete the Vee-

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[3] Subsumption is the interactive process by which new information is assimilated into existing concepts (subsumers). As a result, the existing concept is modified.

[4] Progressive differentiation is the process by which subsumed concepts evolve and get elaborated into finer concepts. As a result, the knowledge structure is more detailed and shows more differentiated nodes.

[5] Integrative reconciliation is the process by which subsumed and differentiated nodes get further assimilated into the knowledge structure. As a result, the knowledge structure has new cross-links between the nodes.

[6] Principles are significant relationships between two or more concepts.

[7] Theories are similar to principles. While principles tell *how* concepts are related; theories are more general and often encompass many principles to tell us *why* the principles work. Theories are predicative; principles are descriptive.

heuristic, the *knowledge claims* should be useful and valuable to the learner. The value to the learner is stated explicitly in the Vee as *value claims*.

While often omitted in education, Novak and Gowin (1984) emphasize the importance of *value claims* by placing them at the height of the Vee-heuristic. Value claims touch on the affective or feeling component of learning. They give answers to questions that are of a personal nature. By bringing the affective component into the Vee, Novak and Gowin have completely integrated the three dimensions of learning- thinking, doing, and feeling. This is the essence of Novak's Theory of Education (1998) where learning is assessed holistically- in thoughts, actions and feelings.

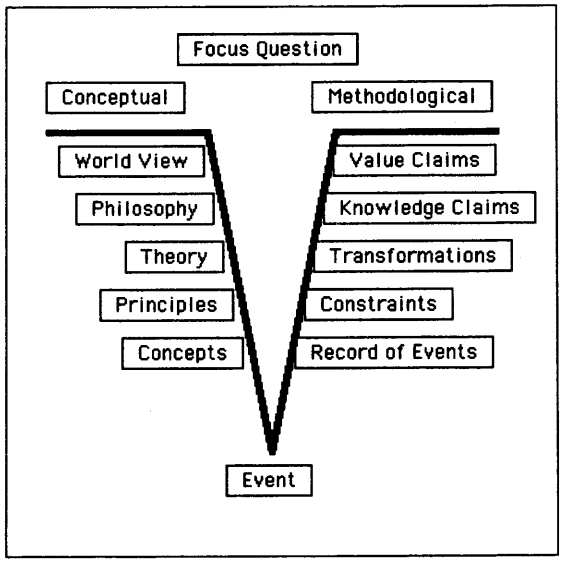

Figure 1.1 The Vee-heuristic.

The Vee-heuristic offers a unique, but complementary, perspective to Gagne's Nine Steps of Instruction (see Section 1.4.1) in that it ties together the sequence of learning activities with the content of instruction. This is the interaction, the update of the shared knowledge representation, which is essential as the discourse progresses. Without this interaction, the students will not be able to 'ground' on the content of discourse.

Taking this to its logical conclusion, the 'grounding' in discourse content should result in more in-depth cognitive processing.

1.4 Process Scaffold

The second dimension of effective communications is grounding the 'process' in communications. To elaborate on this dimension more fully, this paper distinguishes between two dimensions of 'process' grounding: a) grounding the *sequence* of events, and b) grounding the *texture* of events. To perform an intuitive check on this separation, let us return to the example of the Mozart duet. In order to coordinate the 'process' of playing Mozart, the players not only have to communicate on when to begin, pause and end the piece (i.e., the sequence of events); but they also need to communicate on the tempo, the tone, the cadence etc. of the piece (i.e., the texture of events). Similarly, in order for discourse to be effective, it needs to be structured in these two dimensions as well. Again drawing from educational technology and cognitive psychology, the next two sections adapt Clark and Brennan's 'process' grounding within the context of ALN collaborative discourse. Specifically, the overall *sequence* of events is based on Gagne's Nine Steps of Instructions (see Section 1.4.1) and the use of Discourse Triggers (see Section 1.4.2) based on Gunawardena's Cognitive Processing Model. The *discourse texture* (see Section 1.4.3) is based on best practices drawn from the survey of 22 ALN empirical studies in Table 1.1.

1.4.1 Gagne's Nine Steps of Instruction

According to Hara, Bonk and Angeli (1998), electronic learning cannot claim success until pedagogy has been found to motivate students above and beyond the basic course requirements- that is, discourse has yet to be able to fully engage the students. Here, Hara et al. are alluding to the educational principle of student motivation. While there are varying theories of motivation, a widely accepted theory of motivation is the Expectancy-for-Success construct (Atkinson 1957). At the core of this theory is the idea that most learners will not choose to do a task or continue to engage in a task when they expect to fail. This is the key idea behind 'expectancy'. While students may be interested in (and intrinsically value a task), they will not continue to engage in the task if they expect to fail. While other motivation theories stress interest or value, Atkinson's theory emphasizes the importance of the 'expectancy' construct. As a result, much empirical research in achievement motivation has focused on the role of the expectancy construct, not value or interest constructs (Parsons & Goff 1978).

Table 1.5 Gagne's Nine Events of Instruction

Events
Gain Attention
Inform Learner of Objectives
Stimulate Recall of Prior Learning
Present Stimulus Material
Provide Learner Guidance
Elicit Performance
Provide Feedback
Assess Performance
Enhance Retention and Transfer

The idea that students will persist at intermediate task difficulty (neither too easy nor too difficult) is one of the most often cited findings from achievement motivation research. The use of scaffolding (whether it be peer, teacher, process, or other types of resources) can reduce task difficulty so that students will be able to persist at tasks. Variations on this idea can be found in Gagne's Nine Steps of Instruction (i.e., a process scaffold), Merrill's (1994) principles of instruction (i.e., a process scaffold), Vygotsky's (1980) zone of proximal development (e.g., teacher/peer scaffold) etc. Of these, Gagne's Nine Steps of Instruction (see Table 1.5) is detailed and straightforward in its application, as well as classic in the educational technology discipline.

Gagne introduced the Nine Events of Instruction as a methodology to provide for the conditions of learning. He believes that these events of instruction activate mental processes needed for effective learning. The Nine Events of Instruction are:

Gain attention- to capture the attention of the student; to motivate the student's interest.

Inform learner of objectives- to set up the internal process of expectancy; to motivate the student to complete the lesson.

Stimulate recall of prior learning- to associate new knowledge with existing knowledge structure. (This is the central theme in *Ausubel's Assimilation Theory*.)

Present stimulus material- to present new knowledge organized in a meaningful manner.

Provide learner guidance- to provide examples/illustrations to bridge the gap between new and existing knowledge structures as necessary.

Elicit performance- to demonstrate correct understanding of new knowledge for the purpose of confirmation and further guidance.

Provide feedback- to provide specific and immediate feedback (aka formative feedback) to elicited performance for the purpose of further guidance and confirmation.

Assess performance- to demonstrate mastery of new knowledge without further guidance or confirmation.

Enhance retention and transfer- to use new knowledge in real world situations.

While Gagne's Nine Steps of Instruction were developed prior to the explosion in ALN, it is still as relevant: the basic principles of instructional design as a set of necessary learning activities- from setting forth the learning objectives, presenting what is to be learned, ascertaining students' progress, providing student feedback, to assessing performance- represent core principles that apply in any learning environment including ALN. What is unique to ALN is the opportunity to enable the nine steps via technology-mediated learning. For example, to what extent can technology enhance 'attending to' the topic of learning? Enforce recall of prior learning? Present stimulus to learning?

1.4.2 Discourse Triggers

In reviewing the twenty-two empirical ALN discourse studies (see Table 1.1), a plethora of discourse strategies were found, ranging from specifying clear discourse topics (Aviv et al. 2003; Vrasidas et al. 1999; Hara et al. 2000; Vonderwell 2003), well-defined discourse schedules (Aviv et al. 2003; George et al. 2001), clear reward mechanisms

(Aviv et al. 2003), roles and responsibilities such as starter and wrapper (Hara et al. 2000), discourse dialogue interface structure (Baker et al. 2001), group formation strategies such as maximal conceptual differences (Baker et al. 2001), to step-by-step instructions (Suthers 2001).

An underlying theme in these studies is the principle that by structuring discourse, students spend more time cognitively on relevant material, which brings more on-task engagement and more in-depth processing (Hara et al. 1998). A closer examination of the types of discourse strategies reveals a two tier classification: a) an overall task structure that can be subsumed under Gagne's Nine Steps of Instruction (e.g., clear discourse topics, well-defined discourse schedules, clear reward mechanisms, step-by-step instructions), and b) 'trigger' activities that provide rhythm and punctuation moving the discourse forward (e.g., roles and responsibilities such as starter and wrapper, group formation strategies such as maximal conceptual differentiation on the outset, dialogue interface structure which transitions/morphs the dialogue to conclusion).

At another level, if one were to examine the phases of discourse specifically related to depth of cognitive processing, the Critical Thinking Model by Gunawardena, Lowe and Anderson (1997) is a five-phase model that can provide rhythm and punctuation to discourse. Specifically, the Critical Thinking Model classifies five phases of critical thinking. Although no empirical study has been performed to validate this, the Critical Thinking Model is a potential discourse group process structure. If it can be shown that Critical Thinking Model is a valid discourse group process structure, then an important step has been taken in prescribing a discourse structure that can be repeatedly employed to encourage deeper levels of cognitive processing. Only then can discourse

fully engage the student and become more than 'undirected, unreflective, random exchanges and dumps of opinions' (Garrison, Anderson and Archer 2001)[8]. Table 1.6 outlines the five phases of the Critical Thinking Model.

[8] An assumption here is convergent discourse is the goal of discourse. While this may not apply to all discourse, this is very much the goal of the ALNCDM which is evidence-based discourse.

Table 1.6 Gunawardena's Critical Thinking Model
(Adpated from Gunawardena, Lowe and Anderson 1997)

Indicator	Definition
Sharing/Comparing Knowledge.	-Statement of observation or opinion. -Statement of agreement. -Corroborating examples. -Asking and answering questions. -Definition, description, or identification of a problem.
Discover/Explore disagreements.	-Identifying and stating areas of disagreement. -Asking and answering questions to clarify the source of disagreement. -Advancing arguments by references to evidential data.
Synthesis via negotiated meaning.	-Negotiation or clarification of meaning. -Negotiation of relative weighting of types of argument. -Identification of agreement among conflicting concepts. -Proposal of new statements embodying co-construction. -Proposal of integrating metaphors or analogies.
Testing/modifying synthesized meaning.	-Testing the proposed synthesis against "received fact" as shared by the participants. -Testing against existing cognitive schema. -Testing against personal experience. -Testing against formal data collected. -Testing against contradictory testimony in the literature.
Proof of cognitive change of knowledge.	-Summarization of agreements. -Applications of new knowledge. -Metacognitive statements by the participants illustrating their understanding that their ways of thinking (cognitive schema) have changed.

1.4.3 Discourse Texture

In addition to discourse sequence, the second dimension in 'grounding the discourse process' is the qualitative aspect of discourse, referred to as *discourse texture* in this paper. The purpose for discourse *texture* is to identify best practices that should constitute a backdrop, or a pre-requisite environment, for ALN discourse. A survey of 22 ALN discourse studies (see Table 1.1) reveals two main *discourse texture* dimensions: the use of evidence-based discourse and the use of *in situ* leadership roles. Each of these

dimensions stem from the unique nature of ALN collaborative discourse: the need to deepen cognitive processing during discourse, and the need for ALN discourse to be self-regulated due to large ALN class sizes.

1.4.3.1 Evidence-based Discourse (Individual Cognitive Processing) Although the need to promote (individual) cognitive processing during discourse is a widely accepted research agenda (Miller and Miller 1999; Herring 2004), there is no clear consensus among the research community on how this can be done. However, if a segmentation is done at the level of the type of cognitive processing desired (as in higher or lower levels of cognition in Bloom's taxonomy), two promising threads of research stand out: the use of evidence-based (Ravenscroft 2000; Kakitala et al. 2002; Baker et al. 2001; Veerman 2004; Suthers 2001) versus argumentation-based (Nussbaum et al. 2003; Jeong 2003; Veerman 2004; deVries, Lund and Baker 2002) discourse. Of the two strategies, evidence-based discourse is the building block for argumentation-based discourse. While argumentation is a more direct form of knowledge co-construction, it is only effective if these conditions are met: the topic must be debatable, *the students have sufficient knowledge*, and the social context must encourage free expressions (deVries, Lund, and Baker 2002). If the students do not have sufficient knowledge, argumentation-based discourse tends to be highly opinionated and ungrounded (Bonk et al. 2001; Jeong 2003). On the other hand, evidence-based discourse offers several widely accepted benefits such as helping the students externalize, organize, and clarify knowledge. In the process, the students often detect and repair gaps in their knowledge resulting in knowledge restructuring. Evidence-based discourse is therefore especially suited for lower levels of

conceptual learning in the Bloom's taxonomy (i.e.. knowledge, recall, application rather than analysis and synthesis of concepts).

The use of evidence-based discourse is also reflective of cognitive processing constructivism (vs. cognitive constructivism). According to Miller and Miller (1999), there are two epistemological perspectives in discourse (of a constructivistic stance) which is often misunderstood: cognitive processing and cognitive constructivism.

In brief, cognitive processing (Dole and Sinatra 1998; Jonassen et al. 1995) is focused on processing (and representation) of knowledge (i.e., information processing, symbolic reasoning). Under this perspective, prescriptive strategies to promote accurate learning include instructional methods to promote 'attention to' content (for example, the attention to supporting evidence). The challenge in this perspective is to construct an environment so that it accurately reflects the expert's knowledge structure. Hence, the use of evidence-based discourse reflects this epistemology as it is an instructional strategy to promote accurate learning.

On the other hand, cognitive constructivism (Cronin 1997; Jonassen et al. 1995) is focused on the processes of knowledge construction. Under this perspective, instruction is not focused on prescriptive strategies; rather the emphasis is on consensual knowledge, say among experts. The instructional strategy is focused on building communities of learning, language as a medium for communication, and conversation as the process by which meaning is constructed. The use of argumentation-based discourse reflects this epistemology, as it is a process by which new knowledge is co-constructed through direct communication.

One common misunderstanding concerning cognitive processing is the rejection of knowledge representation and instructional sequence by cognitive constructivism advocates as learning by rote. As Anderson, Reder and Simon (1995) pointed out, cognitivism does not imply outright rejection of decomposition- both in terms of knowledge into organized structural components nor instructional sequences for progressive assimilation of knowledge. What is at issue here is meaningful learning (Novak 1998) that is defined as the assimilation of knowledge in an integrated manner with the learner's internal knowledge structure. Both cognitive processing and cognitive constructivism can affect meaningful learning, just as they can affect learning by rote. What needs to drive the selection of either perspective is the learning outcome desired. For example, if the desired learning outcome is the application of concept knowledge (i.e., one of the lower levels in Bloom's taxonomy), then the cognitive processing perspective is quite appropriate. On the other hand, if the learning outcome is the 'evaluation' of concept knowledge (i.e., one of the higher levels in Bloom's taxonomy) which is based on a more expert[9] viewpoint (presumably because the knowledge domain is not well-researched) then cognitive constructivism, which emphasizes consensual knowledge, may be more appropriate.

1.4.3.2 *In Situ* Leadership Roles (Self-Regulated Learning). Although the need for self-regulated learning (i.e., the ability to plan one's study and adjust one's strategies to achieve a goal), in the absence of an instructor, is an operational necessity in ALN discourse (due to large class sizes), its value in education is also widely acclaimed. Pintrich and Schunk (1995) have correlated student motivation to self-efficacy (self perception of student capabilities). Research has shown that students who have higher

[9] 'Expert' is used in this context as a student who has mastered the first three levels of Bloom's taxonomy.

self-efficacy are also self-regulated (in learning) and are able to seek challenges, expend more effort to learn, and persist at difficult tasks. Hence, self-regulated learning may be viewed as a learning outcome because of its direct relationship to self-efficacy. In this sense, self-regulated learning is a higher level learning outcome than test grade in the sense that its impact is longer term, more lasting, and increases student motivation, a necessary condition for learning.

One pedagogical strategy to enhance student's ability for self-regulated learning is to have the student learn within Vygotsky's Zone of Proximal Development (1980). In order for this to occur, the student requires scaffolding from either the teacher, a peer or, in self-regulated learning, a number of resources (e.g., procedural scaffold, metacognitive scaffold, task support etc.). Supporting students via roles is one form of procedural support. White (2004) identified four metacognitive roles: planning, productivity, revision and reflection. Strijbos, Martens, Jochems and Kirschner (2004) identified four CSCL roles: project planner, communicator, editor and data collector. The roles that appear in both White and Strijbos et al. are: facilitator (planning/ project planner), report writer (revision/ editor) and Feenberg's (1980) weaver (reflection/ communication). These roles[10] have defined responsibilities as follows: the facilitator is responsible for overseeing the overall progression of the collaborative inquiry, the report writer is responsible for producing/editing the final group product, and the weaver is responsible for summarizing and synthesizing the communication while it is in-progress.

[10] By mapping White's internal metacognitive roles onto Strijbos et al.'s, CSCL roles, the student also externalizes the internal roles, making them explicit so other students can help him/her with the roles.

CHAPTER 2

LEARNING EFFECTIVENESS

How do we measure learning effectiveness? This is the question that determines to what extent a learning activity (e.g., discourse) enables effective learning. It is a crucial question that requires careful consideration. This section begins with background literature on the principles (e.g., reliability and validity), dimensions (e.g., cognitive vs. affective) and methods (e.g., test or projects or participation, etc.) of learning assessment. A second section (see Section 2.2) highlights content analysis as a form of alternative assessment based on participation.

2.1 Background

A fundamental premise in learning assessment is that it measures what is taught in the curriculum. Herein lies some of the most confounding issues with learning assessment because what is taught/learned depends on: what specific instructions were given, what the pre-existing knowledge structure was of the learner, and what the conditions were under which the learning assessment was taken. All these can affect the conditions of learning and the conditions of recall (during learning assessment) that will affect measurable learning effectiveness.

After controlling for the conditions of learning and the conditions of recall to the extent possible, a learning assessment needs to satisfy two basic principles: reliability and validity.

Reliability and Validity

Reliability is the extent to which a test is repeatable. A test is repeatable if a) the same student takes the test again, without changes in his/her knowledge structure, and obtains the same score; and b) two students with the same knowledge structure take the test and obtain the same score. *Validity* is the extent to which a test measures what it is supposed to measure. There is no easy way to ascertain test validity. Often experts reduce it to a judgment call; or it may be reduced to a correlation of test scores to a standardized test that has been widely accepted.

Ruiz-Primo (email communication 2003) suggests another way to ascertain test validity is to interview a sample of students using some criterion (e.g., can they verbalize the knowledge intelligently). Their ability to answer the question is one way to validate whether they understood the question, as intended by the experimenter.

Learning Assessment Format

There are also a variety of widely accepted learning assessment formats (Elliott 1995). Some of the most common formats for student assessments include a) students' selection of multiple choice responses, b) students' construction of open-ended responses, c) direct observation of student performance such as portfolios or projects, and d) recording students' thinking processes, or talk aloud. According to Swan (email communication, 2004), it is also possible to ask students to what degree they learned and/or what they learned.

Meaningful Learning Assessment

Although it is one of the most reliable assessment formats, there is strong criticism among the research community against the use of multiple choice response questions

(Novak 1998; Shavelson 2000). While multiple choice response questions can be scored objectively (i.e., without using judgment), and provide high reliability (i.e., repeatability), they measure learning extent (i.e., breadth of facts) and not learning structure (i.e., meaningful assimilation of knowledge structures). As an alternative, Ruiz-Primo (personal conversation 2003) suggests the use of multiple choices with *justification* as one format for meaningful assessment. With justification, it is possible to elicit the underlying knowledge structure through the students' construction of open-ended responses. This is a viable format for quantitative studies with a large number of subjects.

Multi-Method Assessment

A major criticism in using a test as a learning assessment is its bias against students with test anxiety. Students with test anxiety will not perform as well as other students with the same knowledge structure. Another bias in using a test is its limitation in assessing meaningful learning because of constraints by either the test format or time limit. To overcome these biases, multi-method learning assessment is recommended. Arbaugh and Hiltz (2004) recommend several alternative learning assessments including:

Collaborative examination- students work together in all phases of the exam process from construction of exam questions, to the responses, to the grading; subsequently the instructor assigns the final score;

Portfolios- students construct an artifact (e.g., computer program, essays) that documents evidence of understanding of important concepts; and

Direct measurement of online participation (i.e., content analysis)- student's contribution to the ALN discussion board is measured by quantity and quality.

Cognitive Learning Outcomes

Analogous to different formats for learning assessments, there are different levels of cognitive learning assessments. Bloom (1956) has presented a classification of types of

questions appropriate for eliciting learning outcomes at different levels of abstraction in the cognitive learning domain (Table 2.1).

Table 2.1 Bloom's Taxonomy

Competencies	Assessment Questions
Knowledge[11] (Recall)	list, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc
Comprehension [12] (Understanding)	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
Application [13] (Use information in new situations or Transfer)	apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover
Analysis [14] (Recognition of hidden meanings)	analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer
Synthesis [15] (Create new information)	combine, integrate, modify, rearrange, substitute, plan, create, design, invent, what if, compose, formulate, prepare, generalize, rewrite
Evaluation [16] (Make subjective choices)	assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize

Of particular interest to this thesis is the Application level of the cognitive learning domain. Application (Krumme 2003) is defined as 'the use of previously learned information in new and concrete situations to solve problems that have a single or best answer'. It represents the next developmental stage in cognitive learning premised on mastery of Knowledge and Comprehension. Questions appropriate in a learning assessment, at this level, include 'apply', 'classify', 'relate', etc. For example, "given the five philosophies of Mowshowitz (1981), classify Keen (1981) as one of the five philosophies". It is interesting to note that at this level of learning the question should

[11] Knowledge of terminology; facts.
[12] Understanding the meaning of informational materials.
[13] Use of previously learned information in new situations to solve problems that have single or best answers.
[14] The breaking down of informational materials into their component parts to infer divergent conclusions or making generalizations
[15] Creatively apply prior knowledge to produce new knowledge
[16] Judge an end product with a given purpose based on personal values without right or wrong answers.

have single or best answer. This is not the case in the last developmental stage of learning, the Evaluation stage, where the answer is based on personal values with no right or wrong answers.

Affective Learning Outcomes

In *Learning, Creating and Using Knowledge*, Novak (1998) suggests three types of evaluations: cognitive (related to knowledge), affective (related to feelings) and psychomotor (related to skills). While it may be argued that affect is not a learning outcome, but a necessary condition of learning or, in other words, a concomitant factor to learning, it is central to learning. In Novak's Theory of Education (1998), he states as the first condition of learning:

> "There must be motivation to learn. No learning will take place unless the learner chooses to learn".

The measurement of affect is very different from the measurement of cognitive skills. It is a self-reported measure by the student as opposed to an objective measure by the instructor. These measures take the form of satisfaction surveys such as satisfaction with the course, satisfaction with the instructor, etc. As much as educational literature widely accepts the importance of affect in learning, the use of affective learning assessments is not a common practice in educational research. However, this type of assessment is more prevalent in CMC research as well as collaborative learning studies (Arbaugh and Hiltz 2004). It is a form of learning assessment that is grounded in educational theories and just as important as objective learning assessments.

2.2 Content Analysis

With the emergence of ALN as a computer-mediated teaching and learning environment, the use of content analysis to consider the dynamics of discourse and how it facilitates student's cognitive processing has become a popular research methodology. A good definition of (quantitative) content analysis can be found in Berelson's (1952) writing: "a research technique for the objective, systematic, and quantitative description of the manifest content of communication". (Quantitative) Content analysis is systematic in the sense that a set of categories is constructed into which communication content is classified. It is objective in that classification is rule-based, and reliability is testable by multiple coders classifying the same content. It is quantitative in that the results of the rule-based conversion can be interpreted using statistical inference techniques.

While there are many content analysis schemas, they can be categorized into three types: cognitive presence[17] indicators, social presence[18] indicators, and teaching presence[19] indicators (Garrison Anderson and Archer 2000). Of the twenty-two empirical studies in Table 1.1, cognitive presence was measured in 13 studies (Meyer 2003; Aviv et al. 2003; Nussbaum et al. 2003; Chiu et al. 2000; Jeong 2003; Ravenscroft 2000; Kakitalo et al. 2002; Bonk et al. 2001; McLoughlin et al. 2000; Hara et al. 2000; Veerman et al. 2004; Van Boxtel et al. 2002; Suthers 2001), social presence indicators in three (Swan 20002; Oliver et al. 2003; Hara et al. 2000) and instructional presence indicators in one (Rourke et al. 2002).

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[17] Cognitive presence is defined as critical or practical inquiry.
[18] Social presence is defined as the ability of learners to project their personal characteristics into the community of inquiry, thereby presenting themselves as 'real people.'
[19] Teaching presence is defined as the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educational worthwhile learning outcomes

Cognitive Presence Indicators

Henri (1992), one of the pioneers of content analysis, identified five key dimensions for content analysis: a) participation rate (e.g., raw number of messages and their frequencies), b) interaction type (e.g., direct or indirect), c) social cues, d) cognitive skills (e.g., surface or deep processing), and e) metacognitive skills (e.g., study plan). Specifically, Henri classified five categories of observable cognitive skills- elementary classification, in-depth classification, inferencing, judgment and application of strategies. These categories, while comprehensive in the sense that there is rough correspondence to Bloom's taxonomy of cognitive levels, lacked detailed specifications for reliable codification by multiple coders. Moreover, Henri's model lacked the ability to categorize critical thinking achieved by the group, as a separate dimension from critical thinking achieved by the individual.

In contrast, Gunawardena, Lowe and Anderson (1997) suggested a five-phase, well demarcated, Interaction Analysis Model that addresses knowledge construction achieved at two levels: a) at the group level by analyzing the dominant cognitive phase, and b) at the individual level by analyzing individual comments. Specifically, the Interaction Analysis model classifies messages into five phases of Critical Thinking (see Table 2.2). The significance of the Interaction Analysis Model is its value as a model of critical thinking that operationalizes the concept of cognitive presence, one of the three core elements in a community of inquiry (Garrison, Anderson, and Archer 2000). Since critical thinking is both a *process* and an *outcome*, the Critical Thinking Model is suitable both as a discourse group *process* structure as well as a content analysis *codification schema.*

Social Presence Indicators

The second category of content analysis schema is social presence indicators, which operationalizes Garrison et al's 'social presence' in a Community of Inquiry. The importance of this element is its function as a support for cognitive presence[20]. Swan (2002) defines three sets of indicators to quantify this dimension. They are: affective (personal expressions of emotion, feeling, beliefs and values), cohesive (verbal behaviors that sustain and build a community) and interactive indicators (behaviors that support interactivity and negotiated meaning).

[20] According to Tu and Isaacs (2002): "if social presence is low the foundation of social learning, social interaction, does not occur" (p. 30).

Table 2.2 Social Indicators (Adapted from Swan 2002)

Affective Indicators	**Definition**
Paralanguage	Features of text outside formal syntax used to convey emotion.
Emotion	Use of descriptive words that indicate feeling.
Value	Expressing personal values, beliefs and attitudes.
Humor	Use of humor- teasing, cajoling, sarcasm, understatement.
Self-disclosure	Sharing personal information, expressing vulnerability.
Cohesive indicators	**Definition**
Greetings and salutations	Greetings, closures.
Vocatives	Addressing classmates by name.
Group reference	Referring to the group as 'we', 'us', 'our'.
Social sharing	Sharing information unrelated to the course.
Course reflection	Reflection on the course itself.
Interactive indicators	**Definition**
Acknowledgement	Referring directly to others' messages.
Agreement/disagreement	Expressing agreement/disagreement with others' messages.
Approval	Expressing approval, offering praise or encouragement.
Invitation	Asking questions or otherwise inviting response.
Personal advice	Offering specific advice to classmates.

Of special interest to this thesis is the 'interactive indicators' which indicates two-way communication among group members. Two-way (versus one-way) communication is a necessary condition for 'grounding' (i.e., the establishment of common group knowledge). Within the context of ALN discourse, this indicates the condition necessary for the construction of shared meanings, that is, the co-construction of knowledge. This is the quintessential goal of socio-cultural learning.

Unit of Analysis

An important step in assigning data to content analysis categories is the choice of the unit of analysis. Researchers have used a variety of units of analysis ranging from messages (Aviv, Erlich Ravid and Geva 2003; Meyer 2003; Oliver and Shaw 2003; Kakitalo, Hakkinen, Leinonen and Jarvela 2002; Bonk, Angeli, Malikowski and Supplee 2001), events (Chiu, Huang and Change 2000), and meaning (Jeong 2003) to speech acts (Ravenscroft 2000). The use of messages (or a complete posting) has the benefit of clear demarcation and reduces subjectivity among multiple coders (in determining the unit of analysis). For this reason, it is most widely used in empirical studies. However, a unit of this length (i.e., a complete posting) often contains contradictory categorizations or multiple phases of cognitive presence. Thus, heuristics such as code down (i.e., to the earlier phase) or code up (i.e., to the later phase) or code multiple (i.e., code down and up) have to be employed. This inevitably results in a level of subjectivity during coding and is one of the major drawbacks of using a message as the unit of analysis.

Content Analysis Validity

Content analysis is a difficult process under the best of circumstances. Rourke, Anderson, Garrison and Archer (2000) state that it can be "difficult, frustrating and time-consuming". In particular they warned researchers of the need to use coding schemes that are objective and reliable. Two particularly vexing issues that plague most studies are:

1. Unit of analysis: The most common units of analysis are a sentence, a paragraph, and a message. Each has advantages and disadvantages: a sentence is a reliable unit of analysis but yields too many cases; a paragraph is a reliable unit of analysis, has fewer cases, but may yield multiple codes per paragraph or multiple paragraphs per

code; and a message has all the benefits of a paragraph and is touted by Rourke et al. (2000) as having unique benefits since it is the author's unit of communication.

2. Nature of content: Rourke et al. distinguishes between manifest content (content that resides on the surface and is easily observable) and latent content (content that infers latent behavior such as higher-order cognitive processes). While the former is objective, reliable and replicable, the latter is inherently subjective and interpretive. One popular technique to overcome latent content bias is to define manifest indicators of the latent content. For example, 'surface processing' may be operationlized as 'repeating what has been said without adding any new elements'.

Despite these challenges, the issue worthy of special consideration is the value of content analysis as a tool to assess effective discourse-centered teaching and learning. Unlike traditional assessment, which is biased against students with test anxiety, content analysis has potential as an alternative means of student assessment, provided it is executed objectively and reliably (provided the students are conversant in English).

2.3 Summary

In the final analysis, a comprehensive learning assessment strategy should incorporate the applicable dimensions (i.e., cognitive, affective, and psychomotor (Novak 1998)) of learning and multiple formats (e.g., participation, test grade (Arbaugh and Hiltz 2004)) of learning assessments. This will ensure the validity of the measure (i.e., it is measuring multiple dimensions of learning) and remove test-anxiety bias. In addition, regardless of the assessment modality chosen, the assessment (whether it be test grade or participation) needs to be valid and reliable. In particular, if content analysis is used as a form of

participation assessment, caution is advised in the choice of codification schema so that it can be executed reliably. This usually means using codification that operates on manifest (versus latent) content.

CHAPTER 3

RESEARCH HYPOTHESES

3.1 The ALN Cognitive Discourse Model

Adapting Clark and Brennan's communications grounding theory, this thesis proposes that, by leveraging *technology-mediated learning environments*, ALN collaborative discourse is more effective when it is scaffolded along two dimensions: a) that the content of discourse be scaffolded by the use of a *technology-mediated* concept structure unfolded via a Vee-heuristic (Novak and Gowin 1981) sequence, and b) that the discourse process be scaffolded by an overall *technology-mediated process structure* following Gagne's Nine Steps of Instruction punctuated by 'discourse triggers' that transitions/morphs the discourse to conclusion. The underlying discourse texture is evidence-based (vs. argumentation based) with assigned *in situ* leadership roles (facilitator, report writer and weaver). The use of evidence-based discourse places (and limits) the discourse model for learning objectives within the Application level of Bloom's taxonomy (Table 2.1). Presumably, for higher levels of cognitive goals in the Bloom's taxonomy, argumentation-based discourse may be more effective. However, argumentation-based discourse is only effective if certain conditions are met: one of which is *the student must have sufficient knowledge* (deVries, Lund, and Baker 2002). This model is called the ALN Cognitive Discourse Model and it is depicted in Figure 3.1. (Note: The ALN Cognitive Discourse Model is applicable for conceptual learning at the Application level of Bloom's taxonomy).

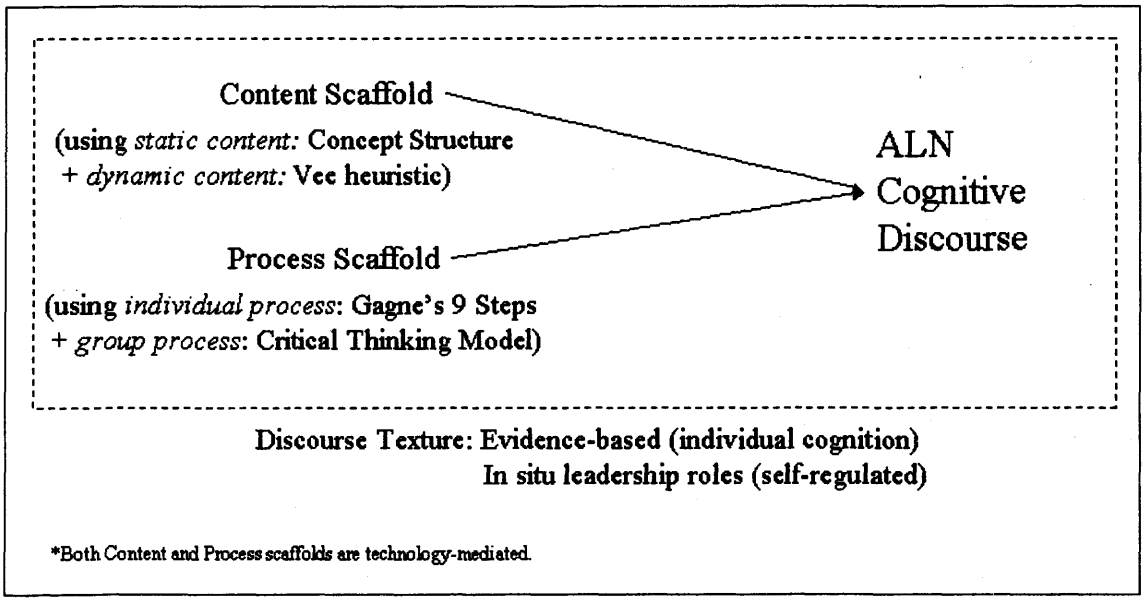


Figure 3.1 The ALN Cognitive Discourse Model.

Content Scaffold

More specifically, the content needs to be scaffolded by a technology-mediated concept structure that is unfolded in a metacognitive sequence based on the Vee-heuristic (Novak and Gowin, 1984). This sequence of unfolding (i.e., dynamic content) begins with the full text version of an article (the record of events) which progresses through progressive elaborations from significant source statements (constraining the record of events) to the final learning artifact (i.e., static content) transforming the record of events into a conceptual framework.

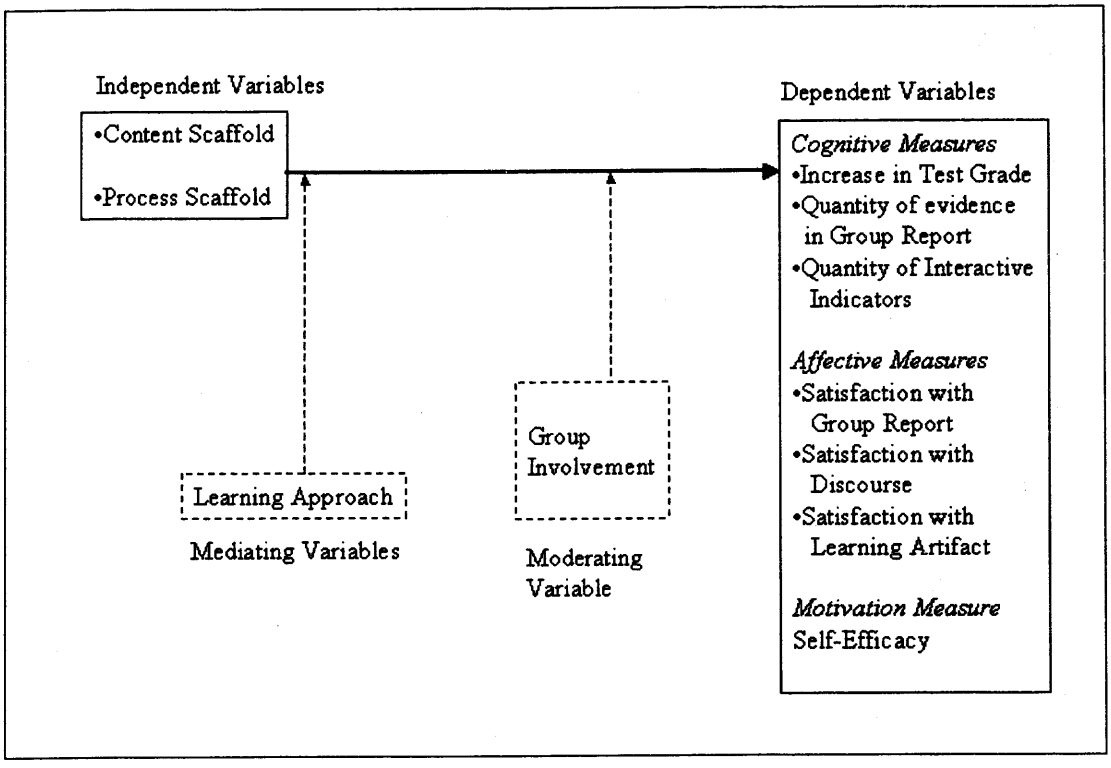
Process Scaffold

In parallel, the discourse process is scaffolded at two levels: at the micro/individual level and at the macro/group level. At the individual process level, each student is required to follow Gagne's Nine Steps of Instruction- from reading the discourse assignment objectives (i.e., gaining attention and informing learner of objectives), presenting their individual solutions prior to discourse (i.e., stimulating recall of prior learning),

reviewing each other's individual solutions (i.e., presenting stimulus material) prior to discourse, providing evidence throughout their discourse (i.e., the use of evidence is a form of non-intrusive and non-prescriptive learner guidance; discourse is a means of eliciting performance), providing feedback to each other (i.e., the use of *in situ* leadership roles is a form of self-regulated learning aimed at providing peer feedback) to taking the post-test (i.e., assessing performance) after discourse. At the group process level, the discourse progresses through a series of 'discourse triggers' based on a five-phase technology-mediated group process structure following Gunawardena's Critical Thinking Model. The hypothesis is that each phase of the Critical Thinking Model takes the discourse to deeper levels of cognitive processing which results in increased learning effectiveness.

These two dimensions of communications 'grounding' form the two manipulated variables of the study. The full research model is depicted in Figure 3.2.

3.2 The Research Model



Note: Cognitive and affective measures represent "learning effectiveness". Whereas, self-efficacy is a higher learning outcome which measures motivation (see Section 2).

Figure 3.2 The research model.

Independent Variables

Content Scaffold (CS): Absence or presence of a technology-mediated matrix concept structure unfolded using the Vee-heuristic.

Process Scaffold (PS): Absence or presence of an individual learning process following Gagne's Nine Steps of Instruction (except for enhancing recall and transfer) integrated within an overall technology-mediated group process structure based on the five phases of Gunawardena's Critical Thinking Model.

Dependent Variables

The dependent variable 'learning effectiveness' is measured in two categories: cognitive and affective measures. This represents two of the three categories of learning outcomes

(cognitive, affective and psychomotor) according to Novak (1998). Of the cognitive measures, a multi-method assessment strategy is applied incorporating test grade, essay and participation. (Arbaugh and Hiltz 2004) recommend multi-method assessments to avoid test anxiety bias among students.)

Cognitive measures: test grade; quantity[21] of evidence in group report; and quantity of interactive indicators (Swan 2002). (While interactive indicators are one of the 'social' indicators in Swan's schema, it is applied here as an operational indicator of the presence of co-construction of knowledge, that is a cognitive activity indicator.)

Affective measures: satisfaction with group report; satisfaction with discourse; and satisfaction with learning artifact.

A final category of 'learning effectiveness' is the change in self-efficacy (i.e., self-perception of one's ability to complete the assignment successfully). Although it is a self-reported measure, it is listed separately because of its motivational nature (Ruiz-Primo personal email May 2005). While test grades and content analysis measure learning effectiveness on a specific learning objective, self-efficacy is related to a student's motivation and measures the student's ability to succeed in future learning objectives. It measures a more lasting accomplishment and represents a higher learning outcome.

Mediating Variable

Learning Appoach (Synthesis/Analysis SA or non SA): Synthesis-Analysis indicates the ability of students to glean organization from a unit of material as well as the ability to reorganize it. There is a general consensus in the research literature (Marton, Hounsell, and Entwistle 1984; Richardson, Eysenck, and Warren Piper 1987) that students in higher

[21] Although this is a quantitative measure, it is a weighted measure that rewards the correct evidence.

education manifest a number of different approaches to learning that are dependent upon the context, the content, and the demands of the learning task. In particular, they may adopt a "deep" approach insofar as they acknowledge the more abstract forms of learning that are demanded in higher education; or they may adopt a "surface" approach insofar as they encounter an overloaded curriculum and methods of assessment which emphasize the superficial properties of the material that is to be learned. In a cognitive processing assignment such as this study which requires comprehension, students with a synthesis-analysis learning style may perform with an advantage.

Moderating Variable

Group Involvement: This construct is adapted from the Social Space scale (Kreijns, Kirschner and Jochems (in press)), which is a self-reporting scale for assessing the perceived quality of social space in distributed learning groups. The test items are based on literature on psychological health and well being in the group, and on social psychology (e.g., effects of trust, friendship). Presumably, groups with sound 'social space' will have more affective work relationships, stronger group cohesiveness, trust, respect and belonging, satisfaction and a stronger sense of community. Groups characterized with sound 'social space' should perform better than groups that do not.

3.3 The Main Research Questions

The ALN Cognitive Discourse Model predicts that when discourse is scaffolded along the two dimensions of a) content and b) process, then learning effectiveness (as measured by the cognitive, affective and motivation constructs) is higher. Hence, the research question is *to what extent do content and process scaffolds increase learning effectiveness in ALN discourse?* The underlying hypotheses are:

a) learning effectiveness is higher with the content scaffold, and

b) learning effectiveness is higher with the process scaffold.

In addition, a general research question has been added to each set of hypotheses. One could theoretically argue for either a positive synergistic or negative synergistic relationship. Perhaps having the process scaffold is necessary to help participants follow the content scaffold; or perhaps having both scaffolds creates cognitive overload and a tendency not to read and follow both consistently. As there is no basis in prior research for predicting what it might be, the thesis will not predict exactly what it will be either. Hence, the general research question is: is there an interaction effect between process and content scaffolding? Stated as a hypothesis, it is:

c) there is an interaction effect between content and process scaffolding.

Specifically, this translates into the following sets of research questions and hypotheses.

Q1. To what extent do content and process scaffolds improve test grade?

H1.a Increases in individual and group test grades are higher with content scaffold than without content scaffold.

H1.b Increases in individual and group test grades are higher with process scaffold than without process scaffold.

H1.c There is an interaction effect between content and process scaffolding affecting increases in individual and group test grades.

Q2. To what extent do content and process scaffolds improve the quantity of evidence in group report*?*

As learning effectiveness increases, students' ability to cite evidence in their group report should increase. This is measured by the quantity of evidence in their group report.

H2.a Quantity of (quality) evidence in group report is higher with content scaffold than without content scaffold.

H2.b Quantity of (quality) evidence in group report is higher with process scaffold than without process scaffold.

H2.c There is an interaction effect between content and process scaffolding affecting quantity of (quality) evidence in group report.

Q3. To what extent do content and process scaffolds increase the quantity of interactive indicators?

Interactive indicators measure behavior that supports interactivity and negotiated meaning (Swan 2002). As learning effectiveness increases, the students' ability to discourse based on evidence should increase. This should lead to heightened 'grounding' in communications which in turn leads to more interactivity (see Section 1.2).

H3.a Quantity of interactive indicators is higher with content scaffold than without content scaffold.

H3.b Quantity of interactive indicators is higher with process scaffold than without process scaffold.

H3.c There is an interaction effect between content and process scaffolding affecting quantity of interactive indicators.

Q4. To what extent do content and process scaffolds increase satisfaction with group report?

As learning effectiveness increases, the student's ability to reach shared meaning should also increase. This should lead to consensus and therefore satisfaction with the group report.

H4.a Satisfaction with group report is higher with content scaffold than without content scaffold.

H4.b Satisfaction with group report is higher with process scaffold than without process scaffold.

H4.c There is an interaction effect between content and process scaffolding affecting satisfaction with group report.

Q5. To what extent do content and process scaffolds increase satisfaction with discourse?

As learning effectiveness increases, students' ability to reach shared meaning should also increase. This should lead to improved communications due to 'grounding' and hence higher satisfaction with the quality of discourse.

H5.a Satisfaction with discourse is higher with content scaffold than without content scaffold.

H5.b Satisfaction with discourse is higher with process scaffold than without process scaffold.

H5.c There is an interaction effect between content and process scaffolding affecting satisfaction with discourse.

Q6. To what extent do content and process scaffolds increase satisfaction with learning artifact?

While structured activities is an indirect cause for improved learning effectiveness (due to social learning theories), the instructor-provided learning artifact is a direct cause for increased learning effectiveness, presumably because it provides elaboration and aids comprehension. Hence students should attribute their increase in learning to the matrix learning artifact.

H6 Satisfaction with learning artifact is higher with matrix concept structure than without matrix concept structure.

Q7. To what extent do content and process scaffolds increase self-efficacy?

As learning effectiveness increases, students' self-perception of their ability to learn in the future should also increase. This is measured by the self-efficacy construct.

H7.a Increases in self-efficacy is higher with content scaffold than without content scaffold.

H7.b Increases in self-efficacy is higher with process scaffold than without process scaffold.

H7.c There is an interaction effect between content and process scaffolding affecting increases in self-efficacy.

3.4 Other Research Questions

In addition to the above main research questions, there are several side research questions of a correlational nature. These questions are due to the potential effects of the mediating and moderating variables.

Q1. To what extent does learning approach (i.e., Synthesis-Analysis), correlate to test grade? Do students with a disposition towards Synthesis-Analysis perform better in cognitive processing assignments (i.e., the cognitive aspect of "learning effectiveness" (see Section 2))?

Q2. To what extent does group involvement correlate to learning effectiveness? One of the most perplexing issues with collaborative learning is the extent to which the groups get along. One measure of group synergy is the extent to which members are involved with the group (as measured by the Group Development construct.) Do groups that get along show more effective learning?

Q3. To what extent does mental effort vary in each of the treatment conditions? Mental effort refers to the cognitive capacity allocated to meet problem requirements. The amount of mental effort is considered the essence of cognitive load (Paas 1992). Central to the Cognitive Load Theory (Sweller, van Merrienboer and Paas 1998), or CLT, is the notion that working memory and its limitations are a major consideration during instruction. Learning tasks requiring less mental effort, according to CLT, are more 'efficient' and result in same or better learning. The reason is learners can compensate for an increase in mental load (e.g., increasing task complexity) by investing more mental effort, thereby maintaining performance at a constant level. Presumably, if two learners exhibit the same degree of learning performance under different treatment conditions, but

one has to invest more mental effort than the other to achieve the same performance, then '(instructional) efficiency' is higher in the condition that requires less mental effort. Consequently, performance-based measures combined with mental effort measures provide a more comprehensive view of learning effectiveness. This is the issue that is well-worth exploring should study results be insignificant. Furthermore, instructional efficiency (E) can be calculated as (Paas, Tuovinen, Tabbers and van Gerven 2003):

$$E= (^{Z}\text{Performance} - {}^{Z}\text{Mental Effort}) / (\text{Square root of } 2)$$[22]

As part of a meta-analysis study on mobile technology:

Q4. How does the use of mobile technology affect the learning experience? What is the effect of mobile technology on learning? Does it make the learning experience more accessible? Or does the mobile device limit the learning experience? And why?

[22] Z denotes the normalized variable.

CHAPTER 4

RESEARCH METHODS

4.1 Field Experiment Design

To investigate the research model (Figure 3.2) and test hypotheses discussed in chapter 3, a field experiment with pre and posttest design was employed. The field experiment included undergraduate and graduate Computer Information Systems (CIS) and graduate Management Information Systems (MIS) students from both face-to-face and distance learning sections (see Section 6.1.1.1). Although students were not randomly "assigned" to courses, they were randomly assigned to the experiment conditions, unless pre-existing study groups existed. If pre-existing groups were present, they were preserved so that students might leverage established interpersonal relationships and preserve the ethnographic conditions of the ALN. (However, the pre-existing groups were randomly assigned to experiment conditions.)

The field experiment was a four cell (2X2) design (Table 4.1). The experiment was a between group design (each participant in the research was in one and only one condition). Each cell had twelve groups and each group had two to three undergraduate/graduate students. Hence, the experiment was designed for a total of 48 groups with approximately 96 – 144 students.

Table 4.1 Field Experiment with Pre and Posttest Design

	CS= No	CS= Yes
PS= No	Discussion board	Discussion board + Content scaffold
PS= Yes	Discussion board + Process scaffold	Discussion board + Content scaffold + Process scaffold

Key:

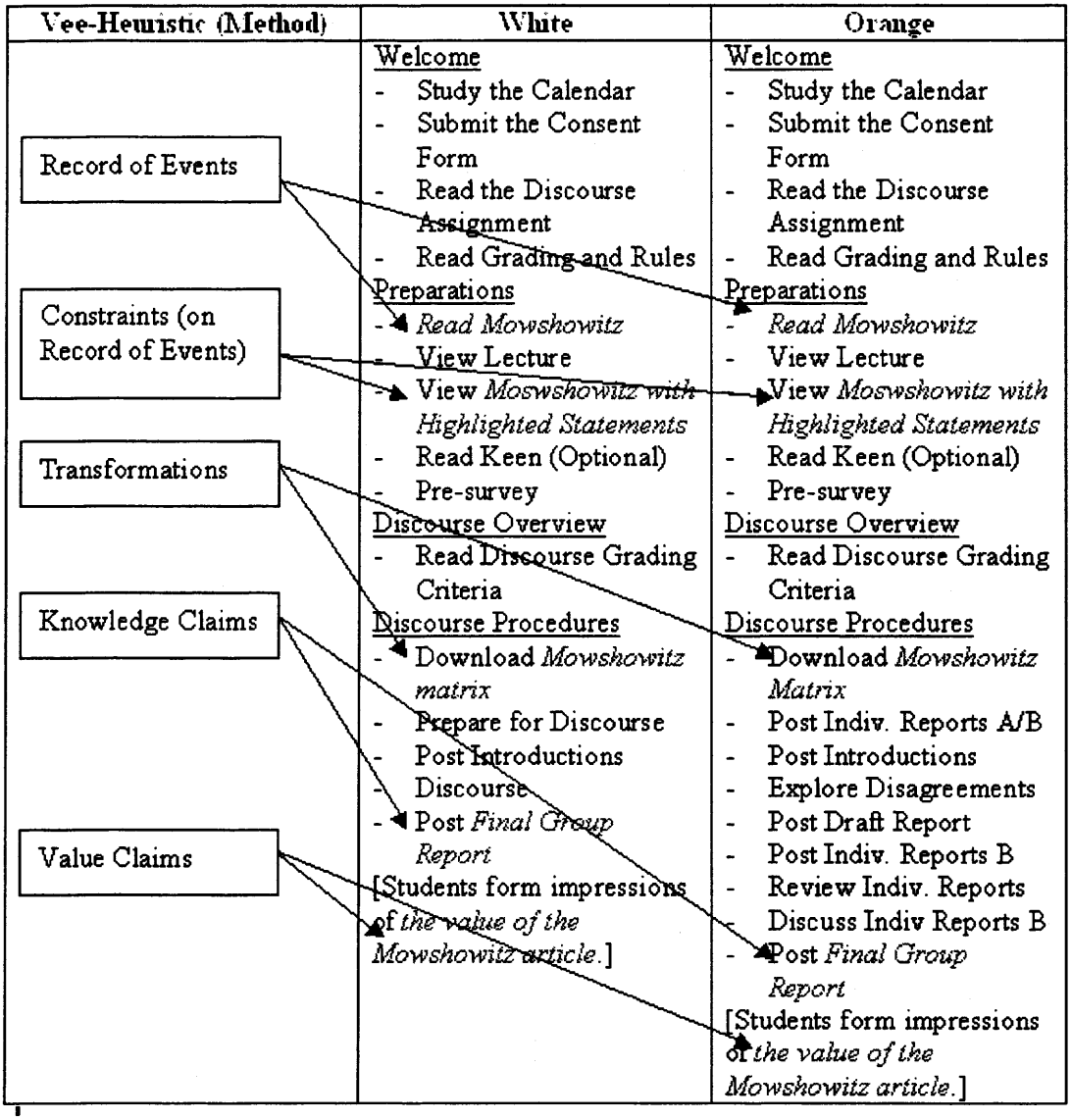
CS: Absence or presence of Content Scaffold
PS: Absence or presence of Process Scaffold

The four cells were:

a) **CS=No, SA=No** (i.e., control)**:** This was the control condition used for baseline comparison. The students in this condition were provided with the Mowshowitz article, a set of PowerPoint lecture slides (included Mowshowitz Framework and six Keen statements, see Appendix I), and a second version of the Mowshowitz article with highlighted source statements. The purpose of providing the students with the second version of the Mowshowitz article was to ensure all subjects in the field experiment had access to the same information (no information bias). There were no content scaffold and process scaffold. However, the discourse texture (the backdrop for discourse) was present: the students were graded on evidence-based discourse, and there were three assigned student roles: Facilitator, Report Writer and Weaver.

b) **CS=Yes, PS=No**: The students in this condition were provided with all the information available to the baseline condition, plus the content scaffold in the form of a technology-mediated matrix concept structure (see Appendix J). This content scaffold was unfolded via the Vee-heuristic sequence as depicted in Figure 4.1. The discourse process remained unscaffolded. Although the discourse process was unscaffolded, the students were provided with two optional occasions to record their votes on the matrix

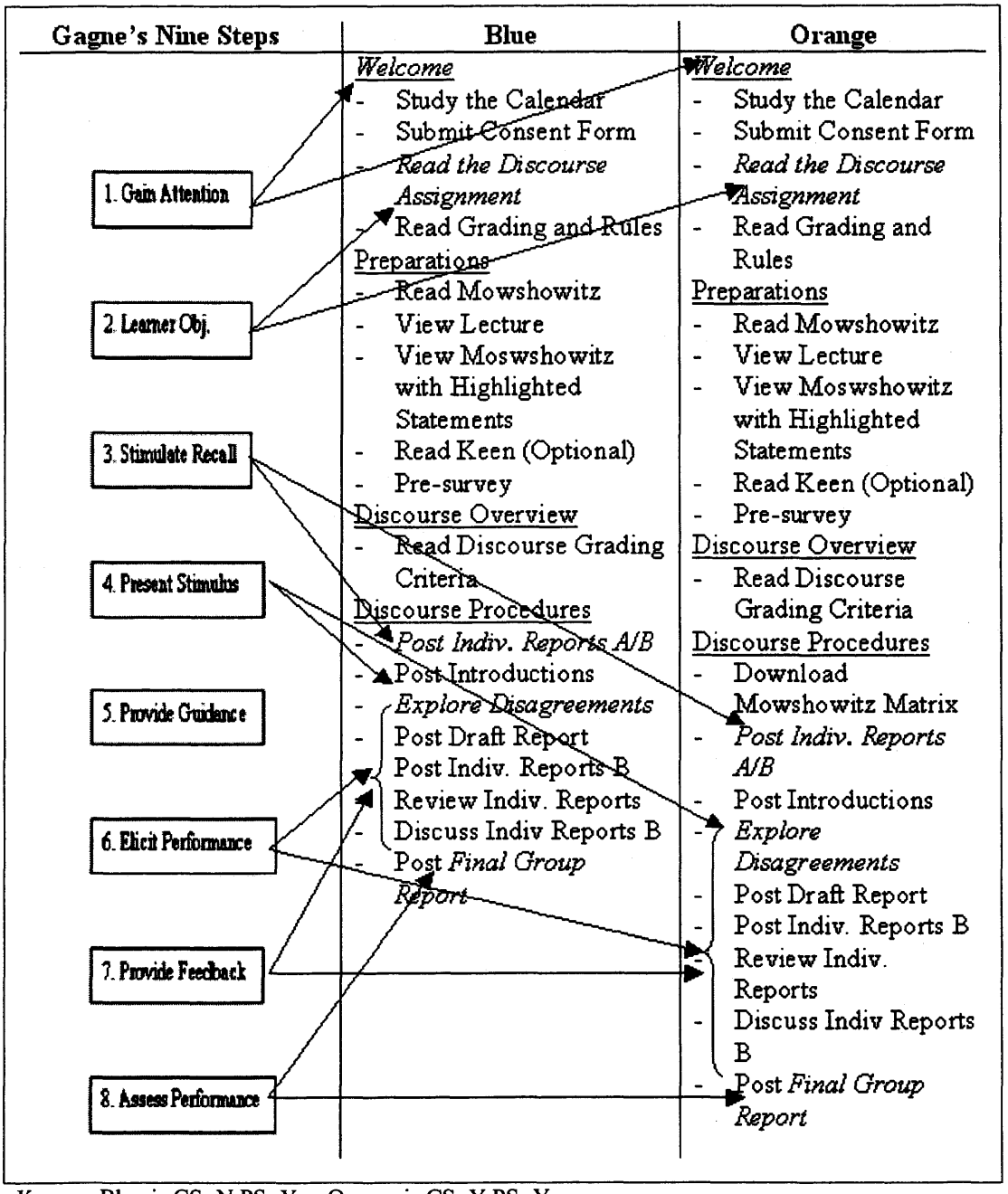
artifact (i.e., content scaffold)- to provide opportunities for the discourse process to interact with the content of discourse (an important component of Clark and Brennan's Grounding in Communications theory). The discourse texture was present (as in the control condition). (Note: Figure 4.1 refers to detailed study procedures that were introduced later in 4.4. They should be viewed in this figure, as well as Figures 4.2 and 4.3, from a high level perspective for validating the treatment conditions and their theoretical underpinnings.)



Key: White is CS=Y PS=N Orange is CS=Y PS=Y

Figure 4.1 The Vee-heuristic sequence (CS=Y PS=N/CS=Y PS=Y).

c) **CS=No, PS=Yes**: The students in this condition were provided with all the information available to the baseline condition, plus a group discourse process scaffold based on Gagne's Nine Events of Instruction (Figure 4.2), except for enhancing recall and transfer, and Gunawardena's Critical Thinking Model (Figure 4.3). They did not have content scaffold. The discourse texture was present (as in the control condition).

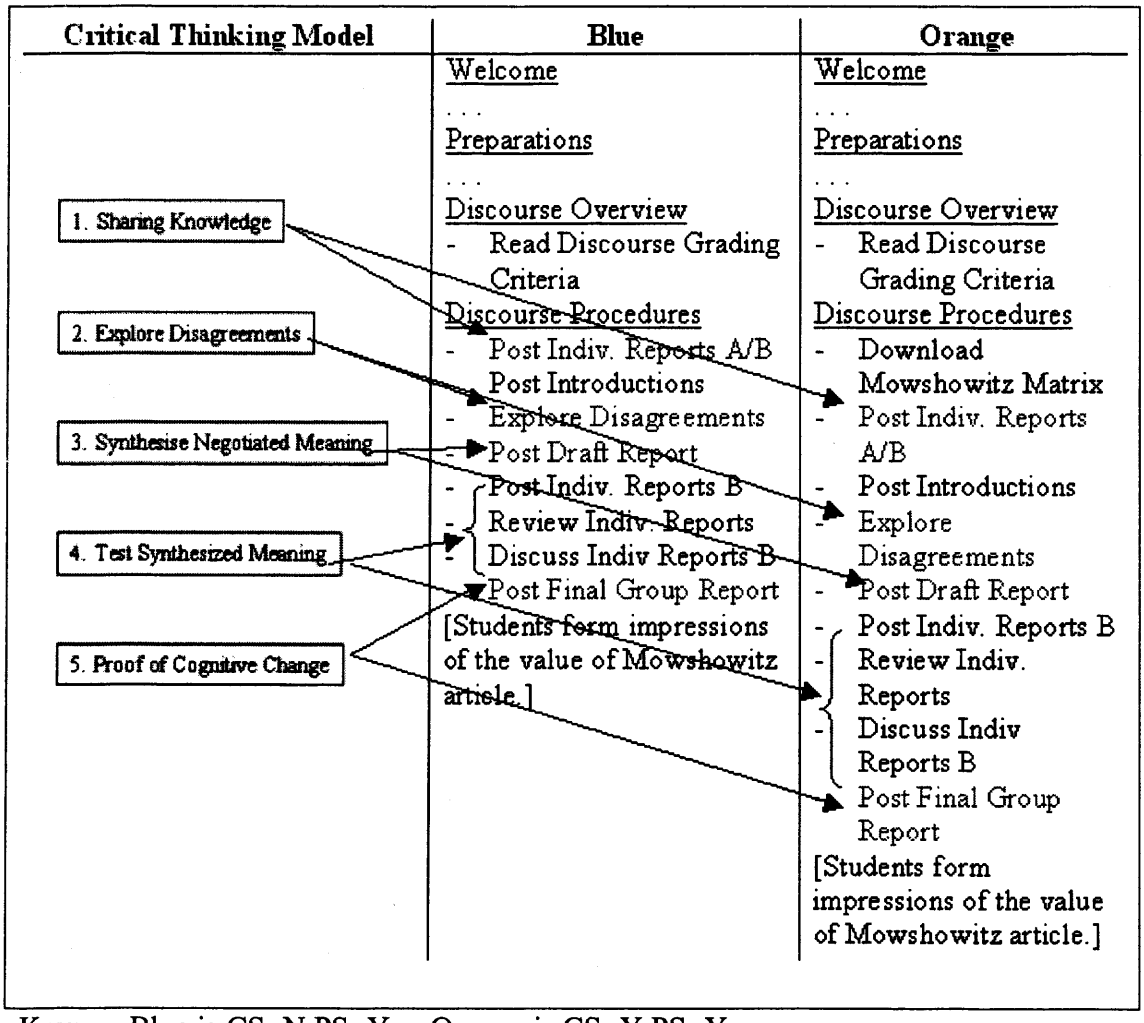


Key: Blue is CS=N PS=Y Orange is CS=Y PS=Y

Figure 4.2 Gagne's Nine Events of Instruction (CS=N PS=Y/CS=Y PS=Y).

Figure 4.2 illustrates the steps in the study that translate to Gagne's Nine Steps of Instruction with the exception of step nine (enhancing recall and transfer). While not explicitly carried out, step 5 (provide guidance) was accomplished by the use of

evidence-based discourse as a 'discourse texture'. Evidence-based discourse forced students to refer back to the Mowshowitz Framework which represented a form of non-prescriptive guidance (Cates and Bruce 2002). The assumption was as students frequently referred to the Mowshowitz Framework to look up the evidence to support their positions, they were reviewing the material and progressively assimilating information which they overlooked earlier. Step 6 (elicit performance) was embedded in the discourse process as students stated their points of view and explained to each other. The use of *in situ* leadership roles provided peer feedback (step 7) throughout the discourse.



Key: Blue is CS=N PS=Y Orange is CS=Y PS=Y

Figure 4.3 Gunawardena's Critical Thinking Model (CS=N PS=Y/CS=Y PS=Y).

Figure 4.3 illustrates each phase of the Critical Thinking Model as it was implemented in the study procedures. As these were the same set of procedures in Figure 4.2, Gagne's Nine Steps of Instruction (with the exception of enhancing recall and transfer) were subsumed/integrated within the Critical Thinking Model group process.

d) **CS=Yes, PS=Yes**: The students in this condition were provided with all the information available to the baseline condition, plus the content scaffold (see Appendix J) AND the discourse process scaffold based on Gagne's Nine Events of Instruction (see Figure 4.2) and Gunawardena's Critical Thinking Model (see Figure 4.3). Students

recorded their positions on the matrix artifact at two points in the structured group discourse process- to provide for interaction between the discourse process and discourse content (an important component of Clark and Brennan's Grounding in Communications theory). The discourse texture was present (as in the control condition).

4.2 Subjects

The subjects were volunteers from graduate and undergraduate Computer Information System (CIS675 and CIS455) and graduate Management Information System (MIS645) classes. They were randomly assigned into one of the four treatment conditions after the Consent Form was received. Later on, when their pre-surveys were received (CS=Y PS=N and CS=N PS=Y conditions) or when they completed Task 1b (CS=N PS=N and CS=Y PS=Y conditions), they were then randomly assigned into groups of twos or threes *within the condition.* (They were randomly assigned into groups unless there were pre-formed groups as was the case with CIS455.)

4.3 The Task

The participants began by reading the Mowshowitz (1981) article and corresponding lecture slides individually prior to discourse. Moshowitz was an abstract and complex article which discussed five social computing philosophies (aka Mowshowitz Framework): Technicism, Progressive Individualism, Elitism, Pluralism and Radical Criticism. It was selected for the study because it was a concept piece that students (undergraduates and graduates) had found challenging and therefore in need of a supplemental learning activity (such as discourse) as well as (content and process)

scaffolding. Afterwards in small discourse groups, they were asked to discuss and apply the Mowshowitz Framework against a comparative article (Keen 1981) by classifying it as an example of one of the Mowshowitz philosophies. While Keen discussed several aspects of IT implementation issues (some of which were outside of the Mowshowitz Framework), the students were directed to six source statements at the end of Keen, which described an IT implementation strategy. These six source statements exemplified one Mowshowitz philosophy: Elitism. A final group report was compiled to summarize the discourse. A detailed description of the task can be found in Appendix A.3.

4.4 Experimental Procedures

The field experiment was conducted in five phases:

a) **Welcome**: Participants were provided with a description of the task, grading criteria and rules. After reviewing this material, they submitted a Consent Form granting consent for the study. Instructions for this phase were found under the Discourse Study conference/ Welcome thread.

   Note: An Alternate Assignment (See Appendix K.) was included with this study.

b) **Preparations**: Participants were provided with the Mowshowitz article and lecture slides (included Mowshowitz Framework and the six Keen statements) prior to discourse. They were asked to review the material individually and take a pre-survey, which included a pre-test. Instructions for this phase were found under the Discourse Study conference/ Preparations thread.

c) **Discourse**: Afterwards in small discourse groups, they discussed and applied the Mowshowitz Framework against a comparative article (Keen) by classifying it as an example of one of the Mowshowitz philosophies. A final group report was compiled to summarize the discourse. Instructions for this phase were found under Discourse Study conference/ Discourse thread initially.

At this time, the participants were randomly assigned into one of four conditions. They were directed to one of the four conferences to continue with the study: Discourse Red Procedures, Discourse White Procedures, Discourse Blue Procedures and Discourse Orange Procedures.

d) **Wrap Up**: At the conclusion of discourse, the participants were asked to take a post-survey, which included a posttest. Instructions for this phase were found under the Discourse Study conference/ Wrap Up thread.

e) **Debriefing**: After the post-survey had been received, a Debriefing document was provided explaining the purpose of the research and conditions of the study. Instructions for this phase were found under the Discourse Study conference/ Debriefing thread.

Table 4.2 contains a list of procedures and their Appendix references used in the five phases of the field experiment.

Table 4.2 Integrated Experimental Schedule and Procedures

#	Phase	Days	Appendices
1	Welcome	1	[Discourse Study Conference] A. Welcome A.1 Study the Calendar A.2 Submit the Consent Form (Instructions and Form) A.3 Read the Discourse Assignment A.4 Read Grading and Rules
2	Preparations	3	[Discourse Study Conference] B. Preparations B.1 Read Mowshowitz B.2 View Lecture (Instructions and Slides) B.2.1 View Moswshowitz with Highlighted Statements B.3 Read Keen (Optional) B.4 Pre-survey (Instructions and Form)
3	Group Discourse	10	[Discourse Study Conference] C. Group Discourse C.1 Read Discourse Grading Criteria
			[Discourse Red Procedures Conference] Same as Discourse White Procedures but without D.1 Download Mowshowitz matrix.
			[Discourse White Procedures Conference] D. Discourse Procedures Overview D.1 Download Mowshowitz matrix D.1.1 Discourse MowArtifact D.2 Prepare for Discourse (Day 1) D.3 Post Introductions (Day 2) D.4 Discourse (Days 3-10) D.5 Post Final Group Report (Day 10)
			[DiscourseBlue Procedures Conference] Same as Discourse Orange Procedures but without E.1 Download Mowshowitz matrix.
			[Discourse Orange Procedures Conference] E. Discourse Procedures Overview E.1 Download Mowshowitz Matrix E.2 Post Individual Reports A/B (Day1) E.3 Post Introductions (Day 2) E.4 Review Individual Reports (Day 3) E.5 Explore Disagreements (Days 4-7) E.6 Post Draft Report (Day 7) E.7 Post Individual Reports B (Day 8) E.8 Review Individual Reports B (Day 8) E.9 Discuss Individual Reports B (Days 9, 10) E.10 Post Final Group Report (Day 10)
			[Group Assignment Conference] F.1 Student roles F.2 Group Assignments here
4	Wrap Up	2	[Discourse Study Conference] G. Wrap Up (Instructions and Post-survey form)
5	Debriefing		[Discourse Study Conference] H.1 Debriefing

The next table, Table 4.3, shows another view of the experimental procedures, by each of the four treatment conditions.

Table 4.3 Experimental Procedures by Condition

CS=N PS=N	CS=Y PS=N	CS=N PS=Y	CS=Y PS=Y
Welcome - Study the Calendar - Submit Consent Form - Read the Discourse Assignment - Read Grading and Rules Preparations - Read Mowshowitz - View Lecture - View Moswshowitz with Highlighted Statements - Read Keen (Optional) - Pre-survey Discourse Overview - Read Discourse Grading Criteria Discourse Procedures - Prepare for Discourse - Post Introductions - Discourse - Post Final Group Report [Students form impressions of the value of Mowshowitz article.]	Welcome - Study the Calendar - Submit Consent Form - Read the Discourse Assignment - Read Grading and Rules Preparations - Read Mowshowitz - View Lecture - View Moswshowitz with Highlighted Statements - Read Keen (Optional) - Pre-survey Discourse Overview - Read Discourse Grading Criteria Discourse Procedures - Download Mowshowitz matrix - Prepare for Discourse - Post Introductions - Discourse - Post Final Group Report [Students form impressions of the value of Mowshowitz article.]	Welcome - Study the Calendar - Submit Consent Form - Read the Discourse Assignment - Read Grading and Rules Preparations - Read Mowshowitz - View Lecture - View Moswshowitz with Highlighted Statements - Read Keen (Optional) - Pre-survey Discourse Overview - Read Discourse Grading Criteria Discourse Procedures - Post Indiv. Reports A/B - Post Introductions - Explore Disagreements - Post Draft Report - Post Indiv. Reports B - Review Indiv. Reports - Discuss Indiv Reports B - Post Final Group Report [Students form impressions of the value of Mowshowitz article.]	Welcome - Study the Calendar - Submit Consent Form - Read the Discourse Assignment - Read Grading and Rules Preparations - Read Mowshowitz - View Lecture - View Moswshowitz with Highlighted Statements - Read Keen (Optional) - Pre-survey Discourse Overview - Read Discourse Grading Criteria Discourse Procedures - Download Mowshowitz Matrix - Post Indiv. Reports A/B - Post Introductions - Explore Disagreements - Post Draft Report - Post Indiv. Reports B - Review Indiv. Reports - Discuss Indiv Reports B - Post Final Group Report [Students form impressions of the value of Mowshowitz article.]

4.5 Data Collection

Two surveys were administered to collect data: a pre-survey before the discourse and a post-survey after the discourse. Both surveys were web-based forms. Data were stored automatically (from the online survey) into an Access database, which was exported into Excel and then imported into SAS for analysis. Table 4.4 describes the constructs contained in the surveys.

Table 4.4 Data Collection Scales

Construct	Reference	Survey Item
Learner Characteristics[23]	[Basic demographics: race, gender, age etc.]	Pre-survey: 1 – 9
Self-Efficacy	MSLQ (Pintrich, Smith,Garcia and McKeachie 1991). Adapted from Self Efficacy construct (pp. 13)	Pre-survey: 12 – 17 Post-survey: 1 – 6
Learning Approach	Inventory of Learning Process (Schmeck, Ribich & Ramanaiah 1977)	Pre-survey: 18 - 32
Test Grade[24]	[Validated through student interviews.]	Pre-survey: 33 – 40 Post-survey: 48 - 55
Satisfaction with Learning Artifact	MSLQ (Pintrich, Smith, Garcia and McKeachie 1991). Adapted from Cognitive and Metacognitive Strategies-Elaboration and Organization construct. (pp. 20,21)	Post-survey: 8 - 13
Mental Effort	Mental Effort scale (Paas, van Merrienboer and Adam 1994)	Post-survey: 14 - 16
Group Involvement	Sociability, Social Space and Social Presence scale (Kreijns, Kirschner, and Jochems (in press). Adapted from Social Space construct.	Post-survey: 17 - 36
Satisfaction with Group Solution	Unpublished thesis. (Han 2003). Adapted from Group Outcome [Group Decision Satisfaction] scale.	Post-survey: 37 - 41
Satisfaction with Group Discourse	Unpublished thesis. (Han 2003). Adapted from Process Satisfaction [Decision quality, Quality of discussion] scale.	Post-survey: 42 - 47
Mobile Computing	[Open-ended question]	Post-survey: 59, 60

In addition to the pre and post-surveys, the study used content analysis to supplement the survey data. Content analysis data was obtained by analyzing the discourse threads of *three groups in each cell.* In order to safeguard the validity and

[23] Included for background statistics.
[24] Test questions contain both recall and transfer which are weighted 50% recall and 50% transfer.

reliability of content analysis, only manifest content (content that resided on the surface and was easily observable) was used. Two types of data were collected:

- Evidence in Group Report: The Group Report was analyzed thematically for complete MF Ids. This number was weighted by a factor of 2 if the solution was correct (i.e., Keen is Managerial Elitism); 1 if the solution were not correct. The number was then normalized over the maximum attained for the study multiplied by 100.
- Interactive Indicators (Swan 2002): Each occurrence of *acknowledgement and agreement/disagreement/approval, invitation and personal advice* was counted. The sum of the occurrences was tallied for each discourse group. This number was normalized over the maximum attained for the study multiplied by 100.

4.6 Data Analysis

Pre exam and post survey data were consolidated into a master file before analysis. Table 4.5 describes the Master data analysis file.

Table 4.5 Master Data Analysis File

Student ID	Group ID	Concept Scaffold [Y/N]	Process Scaffold [Y/N]	Learning Approach Sum_Const.	Group Involvement Sum_Const.
Test Grade Construct	Quantity of evidence in Group Report Construct	Quantity of Interactive indicators Construct	Satisfaction with Group Solution Sum_Const	Satisfaction with Group Discourse Sum_Const.	Satisfaction with Learning Artifact Sum_Const.
Self-efficacy Sum_Const.	Mental Effort[25] Sum_Const				

where:

Sum_Const was the sum of the survey questions for that construct (after coding the questions in the same direction)

Construct was the measure obtained for that construct per operational definition of the construct. (Note: This construct was a group construct and repeated for each member of the group.)

Scale Validation

The scales (Learning Approach, Group Involvement, Satisfaction with Group Report, Satisfaction with Group Discourse, Satisfaction with Learning Artifact, Mental Effort and Self-Efficacy) mainly used five-point semantic differential scales, and data were coded on a scale from 1 to 5, where 1 denoted the least favorable attitude and 5 the most favorable attitude. Confirmatory factor analysis and reliability tests (Cronbach's alpha) were used to check the underlying factors and test the reliability of scales.

Test of Hypotheses

[25] Note: Mental Effort Sum_Const is used for secondary research question analysis (see p. 48)

Hypotheses comparing the four treatment conditions were tested using One-way ANOVA (one independent variable with four levels). The dependent variables subjected to One-way ANOVA were:

- Test grade: the difference between post and pre-survey grades (ratio statistic).
- Quantity of evidence in Group Report: This was calculated as [no. of thematic MF IDs in group report * weighting_factor] / max. attained in the study * 100 (ratio statistic) where weighting_factor was 2 if the solution was correct, 1 if the solution were not correct.
- Quantity of interactive indicators: [no. of interactive indicators/ max. attained in the study] * 100 (ratio statistic).
- Satisfaction with group report: sum of the survey items in the construct (interval statistic)
- Satisfaction with group discourse: sum of the survey items in the construct (interval statistic)
- Satisfaction with learning artifact: sum of the survey items in the construct (interval statistic).
- Self-efficacy: sum of the survey items in the construct (interval statistic).

Correlational Statistics

Correlations between variables (e.g., Group Development and Satisfaction with Discourse) were tested using Pearson's correlation for interval/ratio statistic. When the normal distribution assumption was markedly violated, nonparametric methods (e.g., Chi-square, Kruskal-Wallis) were used.

Covariate Analysis

Several covariate analyses were performed to reveal contextual influences. These included: pretest test grade, online versus mixed mode class, graduate versus undergraduate population, and type of course (CIS versus MIS).

Summary

In summary, the following steps summarize the data analysis in this study:

- Preparation of raw data
- Importing data into SAS and consolidate data into a master file
    - Consolidate pre and post-survey data
- Data encoding (see Table 4.5)
- Factor analysis and scale validation
- Adding new variables by summarizing mean of each construct (see Table 4.6)
- Descriptive data analysis and test of normality (see Table 4.6)
    - Descriptive data analysis of central tendency and variability
    - Normality test and data transformation
- Test of hypotheses using Table 4.6.
    - Comparing mean (ANOVA)
- Testing association (Pearson's R for Group Development; and Point Biserial for Self-regulated learning) using Table 4.6.

Table 4.6 Normality Data Analysis File

Gp ID	CS [0/1]	SA [0/1]	Learning Approach Gp_Avg	Group Involvement Gp_Avg.	Test Grade Gp_Avg
Quantity of evidence in Group Report Gp_Avg	Quantity of Interactive Indicators Gp_Avg	Satisfaction with Group Solution Gp_Avg	Satisfaction with Group Discourse Gp_Avg.	Satisfaction with Learning Artifact Gp_Avg	Self-efficacy Gp_Avg
Mental Effort[26] Gp_Avg					

[26] Mental Effort Gp_Avg is used for secondary research question analysis (see p. 48)

where Gp_Avg was the average of the students' Sum_Const or Construct in the same group from Table 4.5.

CHAPTER 5

PILOTS

Six pilot studies were conducted between Summer 2003 and Spring 2004. After the first *three* pilots, a major redesign of the pilot occurred, based on pilot results and findings from the State of the Art paper. Two major changes were made: a) Compendium was replaced by Microsoft Word as the study moved to a matrix versus map concept structure; and b) the experiment progressed from a 2 (concept structure, no concept structure) X 1 to 2 (with or without content scaffold) X 2 (with or without process scaffold) design.

5.1 CIS455 Summer 2003

46 undergraduate CIS students participated in the pilot between 6/04 – 6/18/03. The purpose of the pilot was to assess the robustness and ease of use of the software tool, Compendium, for an undergraduate population. Issues related to robustness included the stability of the tool on multiple PC platforms, ranging from Windows 95, 98, 2000 to Windows NT. Results indicated that the software was stable in two of the four platforms: Windows 98 and 2000. Approximately one-third of the students were unable to download the software due to either platform issues or lack of computer resources (e.g., memory). The students were given a three-hour training session in the PC Mall laboratory, after which they were assigned an article for which they were to construct a map using Compendium. All students who participated in the training were able to complete the task.

Since Compendium was proven to be reliable, and students who were given training were able to use it, the next pilot deployed Compendium in one treatment condition. Although one-third of the students did not download Compendium, it was felt that this population lacked incentive as they met face-to-face weekly and found it easier to work in the PC Mall. This issue was re-examined in the following pilot.

5.2 CIS675 Fall 2003

24 graduate students participated in the pilot between 8/30 – 9/24/03. The pilot included several objectives:

- to assess whether the map version of the Mowshowitz learning artifact was helpful to the students as a learning aid;
- to assess whether students were able to download Compendium on their home computers; and
- to assess whether the self-study Compendium tutorial was adequate.

Pilot results indicated:

- students found the Mowshowitz learning artifact neither too confusing nor very helpful. While some students would use it again, others see no compelling reason to do so;
- except for one student in England, all students who chose to participate in the study were able to download Compendium on their home computers; and
- most of the students were able to follow the Compendium self-study unit, with the exception of a few students, two to three, who were low in PC literacy.

Encouraged by these results with the graduate population, with the exception of the insignificant effect of the learning artifact, the same pilot was conducted with an undergraduate population in the next pilot. Prior to the next pilot, the learning artifact was reworded in areas that caused confusion during discourse.

At the conclusion of the study, seven phone interviews were conducted at one month after the study. The purpose of the phone interviews was to validate the article assessment multiple-choice questions. The students were given a third assessment question over the phone, and asked to categorize the scenario as one of the Mowshowitz philosophies. Results indicated that students test score did not correspond with their knowledge. Specifically, some students were able to make guesses and scored higher on the test than they should have[27]. This issue was addressed using the multiple choices with justification format in the next pilot.

5.3 CIS 455 Fall 2003

21 undergraduate students participated in the pilot between 10/20 – 11/15/03. In order to improve the effectiveness of the learning artifact, the following changes were made:

a) a few phrases causing confusion were reworded:

- "The philosophy has tempered faith in technology by allowing for adjustments" was reworded as "The philosophy has faith in technology in the long term".
- "The computer specialist as apostles of computer literacy" was reworded as "the computer specialist as teachers of social computer literacy".

b) a question was added to the training review to focus students' attention on an essential concept that they were glossing over:

- Regulatory/Formal controls mean the same thing. [T] True [F] False.

The assessment instrument was expanded to include the use of multiple-choice and *one multiple-choice question with justification.* The use of justification (an open-ended response) is one way to validate whether the student had integrated knowledge of

[27] Since the interviews were conducted one month after the study, students were prompted with the list of Mowshowitz philosophies. Some also required prompting of the 'frames' that differentiate the philosophies. However, students with 'deep' learning were able to zone in on the correct answer quickly whereas students with 'surface' learning were not able to (despite prompting).

the subject, or gave a correct response on the multiple-choice by chance. (Note: Multiple-choice questions assessed declarative or propositional knowledge. Structural or expert or strategic knowledge was not assessed, as this study was at the 'application' level in the Bloom's taxonomy of conceptual knowledge.)

Otherwise, the purpose of this pilot was similar to the last pilot with one additional goal: to assess whether the text version of the Mowshowitz learning artifact (i.e., list format of the learning artifact) was helpful to the students as a learning aid.

Of the population (approximately one third) who participated in the pilot, results indicated:

- three out of four groups in the map condition gave a correct solution; versus one out of two groups in the text condition;
- while most students did not show a change in their post-test scores, two out of thirteen students in the map condition increased their post-test scores while two lowered their scores; and
- similarly, two out of five students in the text condition increased their post-test scores while two lowered their scores.

These results indicated that while the map version of the learning artifact resulted in better group solutions, it did not increase individual learning. Students might be giving in to group pressure to go along with the group solution.

Of more interest was the fact that two thirds of the population did not elect to participate in the study. However, out of forty students who should have turned in an alternate assignment, only four students turned in their assignment. This could be interpreted one of two ways: a) the students found the Mowshowitz article difficult and refused to perform the assignment, or b) the students lacked general motivation

regardless of the assignment[28]. It is difficult to assess which accounted for the lack of participation.

In summary, this pilot raised several questions about the study which were addressed in future pilots:

- in light of the mixed results between the text and map conditions, was Compendium, which required installation and training overhead, worth the overhead as a learning tool?
- was Mowshowitz appropriate as a study task for both the undergraduate and graduate populations? Was the lack of undergraduate participation linked to the Mowshowitz article, which might be too abstract for the undergraduates?
- could overall procedures be streamlined further so as to increase the appeal of the study?

5.4 MIS645 Spring 2004

Prior to this pilot, the State of the Art paper was completed. The literature review revealed that the matrix is preferred to the map for comparative analysis tasks. Due to this finding, the map learning artifact was replaced with the matrix, thereby eliminating Compendium from the study. This change also resulted in a significant streamlining of the overall procedures, as Compendium installation and training procedures were eliminated. The net reduction is about one third of the study procedures.

Fourteen graduate students participated in the pilot between 2/23 – 3/12/04. Changes incorporated in this pilot included:

- use of the matrix format for the Mowshowitz learning artifact;

[28] As the students did not complete either the discourse or alternate assignment, general student motivation was inferred.

- change from a single manipulated variable (text versus map) experiment design, which did not result in significant differences in the previous pilot, to two manipulated variables: [with or without content scaffold] X [with or without process scaffold];

- inclusion of a set of lecture PowerPoint slides, introducing the Mowshowitz Framework in outline form for all conditions;

- inclusion of a scanned Mowshowitz article with highlighted statements, providing all conditions with the same information going into the study;

- a pre-survey instrument with four (much) streamlined constructs was used: background information, self-efficacy, learning approach (synthesis/analysis versus lack of synthesis/analysis), and learning style (visual versus verbal);

- a post-survey with six (much) streamlined constructs was used: satisfaction with learning artifact, satisfaction with group discourse process, satisfaction with group discourse product (group report), self-efficacy at discourse, and group involvement; and

- revised discourse procedures (see below).

    - Gunawardena's five phases of critical thinking model was applied.

    - Only asynchronous discussions were allowed. No chats were allowed. (Analysis of transcripts was exceedingly difficult with mixed formats from prior pilots.)

    - In the process scaffold condition, groups were assigned after individual solutions were submitted (as incentive for students to commit to the study). This should lower the drop out rate after the groups are formed.

With a major change in the learning artifact format (which was re-validated by Mowshowitz prior to the pilot), as well as fundamental changes in discourse procedures, the purpose of this pilot was:

- to re-validate the learning artifact from the students' perspective. Specifically, they should find it helpful as a learning aid;

- to re-test the procedures, clarify wording of procedures and continue to simplify as much as possible;

- to begin to collect data for factor analysis of the following constructs: learning approach, learning style, self-efficacy, satisfaction with learning artifact, satisfaction

with discourse procedures, satisfaction with group report and group development; and

- to continue to validate the test questions through post interview.

After the pilot, five phone interviews were conducted to obtain feedback on the revised procedures. The students' responses included:

- while students might refer to both the lecture slides and the matrix, if they could only use one, they would choose the matrix;
- groups that developed a good rapport had better perceived results from the discourse vs. groups that did not;
- the Mowshowitz assignment was not too difficult with the help of the matrix;
- many suggestions were made to consolidate procedures, which were incorporated in the next pilot; and
- the students thought the assignment was unique and one of the more challenging assignments at NJIT.

5.5 CIS455 Spring 2004

Thirty undergraduate students participated in the pilot between 4/1 – 4/22/04. Changes incorporated in this pilot included are described below.

- Procedures were consolidated under four threads: Welcome, Preparation, Discourse Study, and Wrap up. The wording for the Topic, especially for detailed discourse procedures, now include 'Day X'- to help the students organize the information by timeline.
- Some of the students noted that the transfer question- "The export of IT overseas endangers major American corporations whose systems are now in the hands of potential terrorists"- was subject to interpretation as it did not explicitly state the reason for resistance to export of IT overseas. As a result, a different transfer question- "The Sarbanes-Oxley Act is a regulatory act that mandates internal financial audits in US Corporations. Your local civil rights organization opposes this on the basis that individual financial data becomes too easily accessible by the federal government. Potentially, bureaucratic officials who are not aware of the local context may misuse the information. Your civil rights organization wants this

data kept at the local government. The federal government needs to request this data on a case by case basis."- was used, which explicitly stated the reason for the resistance to technology.

Aside from minor fine-tuning changes to the procedures, the major objectives of the pilot were:

- to continue to collect data for factor analysis of the following constructs: learning approach, learning style, self-efficacy, satisfaction with learning artifact, satisfaction with discourse procedures, satisfaction with group report and group development;
- to continue to validate the test questions through post interview; and
- to observe whether the undergraduates drop out rate has decreased from CIS455 fall 2003 with the removal of Compendium.

Results of the pilot showed:

- thirty students out of 39 students completed the study, showing a decrease in undergraduate drop out rate;
- undergraduates continued to show a lack of motivation in reading the study procedures and adhering to schedule; and
- students appeared to be getting tired on the post-survey and were answering questions inconsistently.

Consequently, to control for (undergraduate) student fatigue during the main study, the final survey was reviewed to reduce any unnecessary questions so as to keep the length of the survey down.

CHAPTER 6

DATA ANALYSIS

The purpose of this chapter is to prepare (or scrub) the data for analyses in later chapters. This chapter includes an analysis of the participants' demographics (see Section 6.1), an analysis of the pre- and post-survey instruments (see Section 6.2), and a content analysis of group reports and discussion boards (see Section 6.3). While it is desirable to summarize the implications of the data as they are prepared, in the interest of reducing duplication of information, a reference is made to the main data analysis which appears later.

6.1 Descriptive Analysis

6.1.1 Demographics

The purpose of this section is to describe the demographic features of the participants. The demographics in Table 6.1 include Delivery Modality (Distance Learning DL or Face-to-face FTF), Graduate/Undergraduate, Degree Program (Management Information Systems or Computer Science/Information Systems), Ethnic Background (African American, Hispanic, White or Asian American), Gender, Age, English as a first language, GPA, WebBoard experience, Daily Participation (acknowledgement of the need to participate daily- Yes or No), and Availability (before or after 5pm).

Among the participants, the split was roughly the same between Distance Learning (47.67%) versus FTF Learning (52.33%), and Graduate (43.6%) versus Undergraduate (44.77%). However, most of the participants did not have English as a

first language (56.4%), and were predominantly in Computer Science/Information Systems (63.37%). The ethnic background, in rank order, was mostly AsianAmericans (48.26%), followed by White (27.91%), Hispanic (9.88%), Black/AfricanAmerican (6.40%) and Omitted (7.56%). Regarding Gender, most participants were Male (64.53%) versus Female (33.72%) with a few Omitted (1.74%). Regarding age groups, most of the participants were between 22 - 30 (55.81%) with approximately the same number of participants in the "under 21" (19.19%) and "31 – 40" (18.02%) age groups. There were a few participants "over 40" (5.81%) and a few "Omitted" (1.16%). In rank order, most students' GPAs were between "3.5 – under 4.0" (41.28%) followed by "3.0 – under 3.5" (28.49%), "under 3.0" (19.19%), "4.0" (8.72%) and "Omitted" (2.33%). About half the students had no previous WebBoard experience (45.35%). Almost all the students indicated they understood daily participation in the study was recommended (97.67%). Interestingly, the majority of the students were available for discourse after 5pm (70.93%). The implication of the demographics is the extent to which results of the study are generalizable to a larger population. This issue is discussed in Limitations in the Conclusion of the thesis (see Section 8.3).

Table 6.1 Demographic Characteristics

Characteristics		N (%)	
Delivery Modality	Distance Learning	82	(47.67%)
	FTF Learning	90	(52.33%)
Graduate/ Undergraduate	Graduate	70	(43.60%)
	Undergraduate	77	(44.77%)
	Other	20	(11.63%)
Degree Program	MIS	27	(15.70)
	CS/IS	109	(63.37%)
	Other	36	(20.93%)
Ethnic Background	Black/AfroAm	11	(6.40%)
	Hispanic	17	(9.88%)
	White	48	(27.91%)
	AsianAm	83	(48.26%)
	Other	13	(20.93%)
Gender	Female	58	(33.72%)
	Male	111	(64.53%)
	Omit	3	(1.74%)
Age	21 or younger	33	(19.19%)
	22 – 30	96	(55.81%)
	31 – 40	31	(18.02%)
	40 or older	10	(5.81%)
	Omit	2	(1.16%)
English as 1st language	Yes	72	(41.86%)
	No	97	(56.40%)
	Omit	3	(1.74%)
GPA	4.0	15	(8.72%)
	3.5 – under 4.0	71	(41.28%)
	3.0 – under 3.5	49	(28.49%)
	under 3.0	33	(19.19%)
WebBoard Experience	0 class	78	(45.35%)
	1 – 2 classes	60	(34.88%)
	3 – 4 classes	22	(12.79%)
	5+ classes	12	(6.98%)
Daily Participation	Yes	168	(97.67%)
	No	4	(2.33%)
Availability	Before 5pm	50	(29.07%)
	After 5pm	122	(70.93%)

Table 6.2 shows the Chi-Square analysis of the demographics cross tabulation by condition. As can be seen, there were no demographic differences among the conditions except for Delivery Modality. Regarding Delivery Modality, [CS=N PS=N] and [CS=N PS=Y] conditions were predominantly Distance Learning versus [CS=Y PS=N] and

[CS=Y PS=Y] conditions which were predominantly FTF. One possible effect this had on the study was participants in [CS=Y PS=N] and [CS=Y PS=Y] conditions might have contact outside of WebBoard. In addition, students in totally online classes might have very different experiences as well as different learning styles. However, since discourse was graded, and facilitators were instructed to record all discussions, these side-effects had been controlled to the extent possible for a field experiment.

Table 6.2 Demographic Characteristics by Condition

Characteristics		CS=N PS=N	CS=Y PS=N	CS=N PS=Y	CS=Y PS=Y	Chi-Square (Value, dF), p
Delivery Modality	Distance Learning	26	29	13	14	Chi-square(31.309, 3) < .0001**
	FTF Learning	17	7	29	37	
Graduate/ Undergraduate	Graduate	20	15	19	21	Chi-square(1.013, 3) = .798
	Undergraduate	17	17	20	23	
	Other	6	4	3	7	
Degree Program	MIS	6	7	7	7	Chi-square(5.012, 3) = .171
	CS/IS	27	18	27	37	
	Other	10	11	8	7	
Ethnic Background	Black/AfroAm	3	3	1	4	Chi-square(2.541, 3) = .468
	Hispanic	4	5	3	5	
	White	10	12	9	17	
	AsianAm	21	14	25	23	
	Other	5	2	4	2	
Gender	Female	14	15	14	15	Chi-square(2.179, 3) = .536
	Male	26	21	28	36	
	Omit	3	0	0	0	
Age	21 or younger	10	3	11	9	Chi-square(1.10, 3) = .777
	22 – 30	20	23	22	31	
	31 – 40	9	8	6	8	
	40 or older	3	1	3	3	
	Omit	0	1	0	0	
English as 1st language	Yes	18	15	15	24	Chi-square(2.404, 3) = .493
	No	22	21	27	27	
	Omit	3	0	0	0	
GPA	4.0	3	4	5	3	Chi-square(.151, 3) = .985
	3.5 – under 4.0	18	16	14	23	
	3.0 – under 3.5	13	7	15	14	
	under 3.0	7	9	7	10	
WebBoard Experience	0 class	20	18	20	20	Chi-square(1.032, 3) = .793
	1 – 2 classes	14	12	15	19	
	3 – 4 classes	5	4	2	11	
	5+ classes	4	2	5	1	
Daily Participation	Yes	41	34	42	51	Chi-square(4.863, 3) = .182
	No	2	2	0	0	
Availability	Before 5pm	14	10	9	17	Chi-square(1.911, 3) = .591
	After 5pm	29	26	33	34	

**indicates Anova result is significant with p<= .05.

6.1.2 Participation Rate

This section analyses the participation rate by condition. A major concern of the study was whether the drop out rate for conditions with process scaffolding was higher than conditions without process scaffolding. If this were the case, then the sample would be biased towards students who were high-achievers in two of the four conditions, which would be considered an internal validity threat. Table 6.3 shows the number of participants who dropped out of the study at the mid-point and end-point. Students were considered a participant after they submitted the consent form and pre-survey. Subsequently, participants who missed any milestones, whether mid-point or end-point, were also removed from the sample. The milestone that marked the mid-point was either *group introduction* (i.e., #GroupIntro) for conditions with no process scaffold, or *individual report* (i.e., #Task1a) for conditions with process scaffold. The milestones that marked the end-point were *post survey* (i.e., #PostSurvey), and *final group report* (i.e., #GpReport). Thus, final sample size (i.e., #EndParticipants) was the difference between the initial sample size (i.e., #StartParticipants) and total number of drops (i.e., the sum of mid-point and end-point drop outs, #TotalDrops).

It should be noted that the drop out rate for the Graduate conditions with process scaffold was 7 % - 9%; and the drop out rate for the Graduate conditions with no process scaffold was 10% - 13%. Chi-Square test for differences in means indicated the difference between the Graduate conditions with process scaffold and conditions with no process scaffold drop out rates was not significant ($p = .937$). Also, the drop out rate for Undergraduate conditions with process scaffold was 40% – 45%; and the drop out rate for the Undergraduate conditions with no process scaffold was 48%. Chi-Square test for

differences in means indicated the difference between the Undergraduate conditions with process scaffold and conditions with no process scaffold drop out rates was not significant (p= .888). These results indicated that the concern over an internal validity threat caused by a higher drop out rate in conditions with process scaffold did not occur.

On the other hand, the overall Undergraduate drop out rate across all conditions at 40% - 48% was much higher than the overall Graduate drop out rate at 7% - 13%. Statistically, the Chi-Square test for differences in means indicated the difference between Graduate versus Undergraduate drop out rates was significant at p= .0001. This does raise a concern whether the sample was biased towards undergraduate high-achievers (i.e., undergraduates who did not drop out). On the other hand, considerable angst went into the decision to include Undergraduates for the study because of the need for a larger sample size. (Note: Further analyses of a higher drop out rate for Undergraduates can be found in Sections 7.6 and 8.3.)

Finally, it should be noted that only undergraduate students in conditions with no process scaffold dropped out because they did not turn in a final report (i.e., #GpRpt >0). This is evidence that process scaffold provided support for undergraduate students to persist to the end. This is a noteworthy point as study results were not as positive for process scaffold in the rest of the findings.

Table 6.3 Participation Rate by Condition

Characteristics		CS=N PS=N	CS=Y PS=N	CS=N PS=Y	CS=Y PS=Y	Chi-Square
Graduate	#StartParticipants	29	24	23	27	
	#TotalDrops	3 (10%)	3 (13%)	2 (9%)	2 (7%)	Chi-
	#GroupIntro	3	3	0	0	Square= .413
	#Task1a	0	0	2	2	df=3
	#PostSurvey	0	0	0	0	p=.937
	#GpReport	0	0	0	0	
	#EndParticipants	26	21	21	25	
Under-graduate	#StartParticipants	33	29	35	47	
	#TotalDrops	16 (48%)	14 (48%)	14 (40%)	21 (45%)	Chi-
	#GroupIntro	14	9	0	0	Square=.637
	#Task1a	0	0	14	21	df=3
	#PostSurvey	0	0	0	0	p= .888
	#GpReport	2	5	0	0	
	#EndParticipants	17	15	21	26	

6.1.3 GPA Validation/Correction

GPA was a self-report score on the pre-survey (item #8). Since it is a self-report score, students might inflate the score. To address this issue, a note was added to the consent form to gain permission to access student records. As a result, validation of student survey responses against registrar records for 114 students showed that 18 students (15.8%) inflated their GPAs while 7 students (6.1%) under reported their scores. The data had been corrected to reflect the registrar's records.

6.1.4 Mobile Technology Usage

Analysis of mobile technology usage revealed that 35 out of 180 students (i.e., 24.2%) used mobile laptops. Of this population, the majority (i.e., 68.5%) of the students had a positive experience, finding it convenient to get connected anywhere. But a small population (i.e., 5.7%) had problems with the technology claiming bad connection or high connection costs. The rest of the population (i.e., 25.7%) was neutral to the technology.

6.2 Factor Analysis

This section assesses the discriminant validity and internal consistency of factors used in the thesis. A factor represents manifestations of an abstract underlying dimension derived by clustering related items. The benefit of grouping related items into factors is to simplify analysis. That is, instead of analyzing, say, sixty-six items, one needs to consider only the groupings of items. In choosing factors, it is good practice to choose factors that are distinct from each other (i.e., the factors satisfy discriminant validity) and which are composed of items that cluster around the same score (i.e., the factor has internal consistency). In SAS, by default, only factors with Eigenvalues greater than one are listed. Similarly, only items with loading factors greater than 0.3 are shown in SAS. Eigenvalues of greater than one assures that the factor accounts for a variance in the data equivalent to one variable; while loading factors greater than 0.3 assures that the correlation of the item to the factor is at least 0.3. Additionally, for the thesis, only items that load without splits were kept. Items that load without splits assure clean factors with no overlapping dimensions (i.e., discriminant). For internal consistency, a Cronbach's Alpha of higher than 0.7 was applied (Nunnaly 1978) to all factors. If a factor does not satisfy the Cronbach's Alpha target, it was discarded.

The factors used in the thesis were derived from sixty-six items drawn from the pre- and post-surveys. After data were collected, all questions were coded in the same direction so that high scores represent one of the following: high Self-Expectation before the study (SE), high Self-Expectation after the study (SEE), high synthesis-analysis Learning Approach (LA), high degree of Satisfaction with the Learning Artifact (SLA), high Mental Effort (ME), high degree of Satisfaction with Group Development (SGD),

high degree of Satisfaction with Group Solution (SGS), or high degree of Satisfaction with Group Discourse (SGI). Items in all the instruments were submitted together for factor analysis using Principal Component Analysis extraction method with Promax rotation. Tables 6.4 through 6.8 show five iterations resulting in the convergence of seven factors. Items were identified by the abbreviated name of the instrument followed by the question number on the survey. For example, SGD1(PO-17) referred to Satisfaction with Group Development instrument item 1 which can be found on the Post-survey in question 17. (Refer to Appendices B.4 and G for the Pre- and Post-survey items respectively.)

In the first iteration (see Table 6.4), the items for Satisfaction with Group Development (SGD), Satisfaction with Group Solution (SGS) and Satisfaction with Group Discourse(SGI) were loaded onto one factor. Subsequent factor analysis with 8, 9 and 10 factors failed to extract these items into separate factors. A decision was made to discard the Satisfaction with Group Development instrument (which represents a moderating variable) to retain the dependent variable instruments, Satisfaction with Group Solution and Satisfaction with Group Discourse, for hypothesis testing. A closer examination of the items in the Satisfaction with Group Development instrument revealed that questions were closely related to group discussion and group solution. For example, Satisfaction with Group Development item1, SGD1, stated "Group members felt free to criticize ideas, statements and/or opinions of each other". Another example, Satisfaction with Group Development item 13, SGD13, stated "The group conducted open and lively conversations and/or discussions." This validated the overlapping underlying constructs among Satisfaction with Group Development, Satisfaction with Group Solution, and Satisfaction with Group Discourse. Hence, Satisfaction with Group

Development was safe to discard. (The overlapping constructs Satisfaction with Group Solution and Satisfaction with Group Discourse are further discussed in the final factor structure below.)

Table 6.4 Principal Component Factor Analysis With Promax Rotation-1

Items	F1	F2	F3	F4	F5	F6	F7
...	...	...	...	...	...	...	...
SGD1(PO-17)	.403						
SGD2(PO-18)						.524	
SGD3(PO-19)	.694						
SGD4(PO-20)	.354					.377	
SGD5(PO-21)	.715						
SGD6(PO-22)	.556					.316	
SGD7(PO-23)	.667						
SGD8(PO-24)						.335	
SGD9(PO-25)	.372				.389		
SGD10(PO-26)	.478						
SGD11(PO-27)	.406						
SGD12(PO-28)	.595						
SGD13(PO-29)	.624						
SGD14(PO-30)							
SGD15(PO-31)	.664						
SGD16(PO-32)						.659	
SGD17(PO-33)	.660					.307	
SGD18(PO-34)						.563	
SGD19(PO-35)	.532						
SGD20(PO-36)	.409					.404	
SGS1(PO-37)	.598						
SGS2(PO-38)							
SGS3(PO-39)	.603						
SGS4(PO-40)	.460						
SGS5(PO-41)	.387						
SGI1(PO-42)	.859						
SGI2(PO-43)	.774						
SGI3(PO-44)	.758						
SGI4(PO-45)	.810						
SGI5(PO-46)	.822						
SGI6(PO-47)	.735						

Key:
SGD= Satisfaction with Group Development SGS= Satisfaction with Group Solution
SGI= Satisfaction with Group Discourse PR= Pre-survey PO= Post-survey

Table 6.5 shows the second iteration of factor analysis, after discarding the Satisfaction with Group Development instrument. With the exception of Learning Approach (LA), most items within an instrument were loading onto the same factor with no splits: SLA1 through SLA6 (Factor2), SEE1 through SEE6 (Factor3), SE1 through

SE6 (Factor 4), LA1+ LA2+ LA6+ LA7+ LA9+ LA11+ LA14+ LA15(Factor5), LA3+ LA4+ LA5+ LA8+ LA10+ LA12+ LA13(Factor6), and ME1 through ME3(Factor7). This meant that the original instruments had strong discriminatory validity among each other. However, the items within the instrument Learning Approach loaded onto two sub-factors which are labeled LA_SUB1 and LA_SUB2 for the time being. Items within the instruments Satisfaction with Group Solution and Satisfaction with Group Discourse were still loading onto the same factor (Factor1). As items LA4 and LA5 were split across Factor4 and Factor6, these items were eliminated one at a time in the next two iterations.

Table 6.5 Principal Component Factor Analysis With Promax Rotation-2

	F1	F2	F3	F4	F5	F6	F7
SE1(PR-12)				.811			
SE2(PR-13)				.547			
SE3(PR-14)				.792			
SE4(PR-15)				.939			
SE5(PR-16)				.802			
SE6(PR-17)				.835			
LA1(PR-18)					.697		
LA2(PR-19)					.521		
LA3(PR-20)						.540	
LA4(PR-21)				.323		.555	
LA5(PR-22)				.334		.481	
LA6(PR-23)					.614		
LA7(PR-24)					.798		
LA8(PR-25)						.689	
LA9(PR-26)					.651		
LA10(PR-27)						.629	
LA11(PR-28)					.809		
LA12(PR-29)						.583	
LA13(PR-30)						.661	
LA14(PR-31)					.696		
LA15(PR-32)					.669		
SEE1(PO-1)			.863				
SEE2(PO-2)			.709				
SEE3(PO-3)			.784				
SEE4(PO-4)			.869				
SEE5(PO-5)			.852				
SEE6(PO-6)			.853				
SLA1(PO-8)		.858					
SLA2(PO-9)		.896					
SLA3(PO-10)		.905					
SLA4(PO-11)		.823					
SLA5(PO-12)		.861					
SLA6(PO-13)		.824					
ME1(PO-14)							.893
ME2(PO-15)							.778
ME3(PO-16)							.843
SGS1(PO-37)	.765						
SGS2(PO-38)	.367						
SGS3(PO-39)	.655						
SGS4(PO-40)	.673						
SGS5(PO-41)	.511						
SGI1(PO-42)	.927						
SGI2(PO-43)	.872						
SGI3(PO-44)	.809						
SGI4(PO-45)	.872						
SGI5(PO-46)	.882						
SGI6(PO-47)	.855						

Key:
SE= Self-efficacy before LA= Learning Approach SEE= Self-efficacy after
SLA= Satisfaction with Learning Artifact ME= Mental Effort SGS= Satisfaction with Group Sol.
SGI= Satisfaction with Group Discourse PR= Pre-survey PO= Post-survey

Table 6.6 shows the third iteration of factor analysis after LA4 was discarded. The items within the instruments continued to load onto the same rotated factor structure as in iteration 2 (i.e., SLA, SEE, SE, LA_SUB1, LA_SUB2, and ME). As LA5 continued to be split without strong loading onto a single factor, it was eliminated in the next iteration.

Table 6.6 Principal Component Factor Analysis With Promax Rotation-3

	F1	F2	F3	F4	F5	F6	F7
SE1(PR-12)			.819				
SE2(PR-13)			.559				
SE3(PR-14)			.780				
SE4(PR-15)			.947				
SE5(PR-16)			.820				
SE6(PR-17)			.853				
LA1(PR-18)					.692		
LA2(PR-19)					.527		
LA3(PR-20)						.530	
LA5(PR-22)			.363			.359	
LA6(PR-23)					.646		
LA7(PR-24)					.806		
LA8(PR-25)						.698	
LA9(PR-26)					.626		
LA10(PR-27)						.626	
LA11(PR-28)					.811		
LA12(PR-29)						.588	
LA13(PR-30)						.671	
LA14(PR-31)					.688		
LA15(PR-32)					.670		
SEE1(PO-1)				.874			
SEE2(PO-2)				.710			
SEE3(PO-3)				.790			
SEE4(PO-4)				.877			
SEE5(PO-5)				.856			
SEE6(PO-6)				.860			
SLA1(PO-8)		.859					
SLA2(PO-9)		.896					
SLA3(PO-10)		.913					
SLA4(PO-11)		.824					
SLA5(PO-12)		.865					
SLA6(PO-13)		.836					
ME1(PO-14)							.894
ME2(PO-15)							.787
ME3(PO-16)							.845
SGS1(PO-37)	.765						
SGS2(PO-38)	.366						
SGS3(PO-39)	.657						
SGS4(PO-40)	.672						
SGS5(PO-41)	.510						
SGI1(PO-42)	.927						
SGI2(PO-43)	.872						
SGI3(PO-44)	.810						
SGI4(PO-45)	.872						
SGI5(PO-46)	.883						
SGI6(PO-47)	.855						

Key:

SE= Self-efficacy before LA= Learning Approach SEE= Self-efficacy after

SLA= Satisfaction with Learning Artifact ME= Mental Effort SGS= Satisfaction with Group Sol.

SGI= Satisfaction with Group Discourse PR= Pre-survey PO= Post-survey

Table 6.7 showed the fourth iteration of factor analysis, after eliminating LA5. While most of the items within the instruments continued to load onto the same rotated factor structure as in iterations 2 and 3 (i.e., SLA, SEE, SE, LA_SUB1, LA_SUB2, and ME), LA3 was now split across two factors. Since the loading was not strong on either factor, LA3 was eliminated in the next iteration. [It should be noted that replacing LA4 after removing LA5 did not alter results.]

Table 6.7 Principal Component Factor Analysis With Promax Rotation-4

	F1	F2	F3	F4	F5	F6	F7
SE1(PR-12)				.817			
SE2(PR-13)				.563			
SE3(PR-14)				.803			
SE4(PR-15)				.945			
SE5(PR-16)				.822			
SE6(PR-17)				.850			
LA1(PR-18)					.693		
LA2(PR-19)					.540		
LA3(PR-20)				.301		.533	
LA6(PR-23)					.651		
LA7(PR-24)					.800		
LA8(PR-25)						.684	
LA9(PR-26)					.618		
LA10(PR-27)						.619	
LA11(PR-28)					.809		
LA12(PR-29)						.600	
LA13(PR-30)						.665	
LA14(PR-31)					.681		
LA15(PR-32)					.670		
SEE1(PO-1)			.875				
SEE2(PO-2)			.718				
SEE3(PO-3)			.799				
SEE4(PO-4)			.876				
SEE5(PO-5)			.855				
SEE6(PO-6)			.859				
SLA1(PO-8)		.858					
SLA2(PO-9)		.898					
SLA3(PO-10)		.916					
SLA4(PO-11)		.828					
SLA5(PO-12)		.865					
SLA6(PO-13)		.849					
ME1(PO-14)							.894
ME2(PO-15)							.792
ME3(PO-16)							.846
SGS1(PO-37)	.765						
SGS2(PO-38)	.368						
SGS3(PO-39)	.657						
SGS4(PO-40)	.674						
SGS5(PO-41)	.510						
SGI1(PO-42)	.926						
SGI2(PO-43)	.871						
SGI3(PO-44)	.810						
SGI4(PO-45)	.870						
SGI5(PO-46)	.882						
SGI6(PO-47)	.854						

Key:
SE= Self-efficacy before LA= Learning Approach SEE= Self-efficacy after
SLA= Satisfaction with Learning Artifact ME= Mental Effort SGS= Satisfaction with Group Sol.
SGI= Satisfaction with Group Discourse PR= Pre-survey PO= Post-survey

Table 6.8 showed the fifth iteration of factor analysis. The items had loaded onto a rotated factor pattern without splits. Since most of the factors consisted of items from the same instrument, the factors were named after the instrument with the exception of the first factor (which was composed of two instruments, Satisfaction with Group Solution and Satisfaction with Group Discourse), and the two factors associated with Learning Approach.

The composite Satisfaction with Group Solution and Satisfaction with Group Discourse factor was labeled Satisfaction with Group Solution and Discourse (SGSD). Since the group solution was a summary of the group discourse, it stands to reason that Satisfaction with Group Solution was strongly correlated to Satisfaction with Group Discourse since they measured the same underlying abstract construct- satisfaction with a group process culminating in a group report. Hence, they have been consolidated as one factor.

The Learning Approach factors were labeled LA- and LA+ indicating the counterbalancing quality of the items in LA- relative to LA+. (LA- contained rote-memorization statements, whereas LA+ contained synthesis-analysis statements.) For example, one of the items in LA- read " I have trouble making inferences."; whereas one of the items in LA+ read "I can usually state the underlying message of films and readings." Since the items were re-coded in the same direction, LA+ and LA- should represent the same underlying construct- the pre-disposition to synthesis versus rote-memorization as a learning style. The fact that these items loaded onto different factors suggested that students were having problems reading the questions. Subsequently, it was found that Cronbach's Alpha for LA+ was low (=.68, below the target .70) and, hence, it

was discarded in the final factor structure. This left only LA- which was renamed LA. [Note: A final factor analysis was run to confirm the final six-factor structure.] Before proceeding, it should be noted that the minimum loading factor was 0.37 which satisfied the target 0.3. Furthermore, as all items loaded wholly onto one factor, the factors had clear discriminant validity.

Table 6.8 Principal Component Factor Analysis With Promax Rotation-5

	Satisfaction with Group Solution and Discourse	Satisfaction with Learning Artifact	Self-efficacy after	Self-efficacy before	Learning Approach Minus	Mental Effort	Learning Approach Plus
SE1(PR-12)				.819			
SE2(PR-13)				.572			
SE3(PR-14)				.804			
SE4(PR-15)				.945			
SE5(PR-16)				.830			
SE6(PR-17)				.859			
LA1(PR-18)					.698		
LA2(PR-19)					.524		
LA6(PR-23)					.658		
LA7(PR-24)					.812		
LA8(PR-25)							.668
LA9(PR-26)					.629		
LA10(PR-27)							.595
LA11(PR-28)					.807		
LA12(PR-29)							.614
LA13(PR-30)							.645
LA14(PR-31)					.675		
LA15(PR-32)					.660		
SEE1(PO-1)			.876				
SEE2(PO-2)			.718				
SEE3(PO-3)			.800				
SEE4(PO-4)			.876				
SEE5(PO-5)			.855				
SEE6(PO-6)			.859				
SLA1(PO-8)		.858					
SLA2(PO-9)		.898					
SLA3(PO-10)		.916					
SLA4(PO-11)		.828					
SLA5(PO-12)		.865					
SLA6(PO-13)		.846					
ME1(PO-14)						.891	
ME2(PO-15)						.800	
ME3(PO-16)						.844	
SGS1(PO-37)	.769						
SGS2(PO-38)	.370						
SGS3(PO-39)	.655						
SGS4(PO-40)	.677						
SGS5(PO-41)	.514						
SGI1(PO-42)	.924						
SGI2(PO-43)	.868						
SGI3(PO-44)	.810						
SGI4(PO-45)	.868						
SGI5(PO-46)	.880						
SGI6(PO-47)	.855						

Key:
SE= Self-efficacy before LA= Learning Approach SEE= Self-efficacy after
SLA= Satisfaction with Learning Artifact ME= Mental Effort SGS= Satisfaction with Group Sol.
SGI= Satisfaction with Group Discourse PR= Pre-survey PO= Post-survey

Table 6.9 show the eigenvalues for the final six factors on the first line. It should be noted that the minimum eigenvalue was 2.23 (i.e., Mental Effort) which satisfied the target of 1.0. The second line of the table showed Cronbach's Alpha for each factor indicating their degree of internal consistency. It should be noted that all remaining factors had extremely strong internal consistency with Cronbach's Alphas much higher than the target 0.7.

Table 6.9 Eigenvalues and Cronbach's Alpha of Final Factors

	Satisfaction with Group Solution and Discourse (SGSD)	Satisfaction with Learning Artifact (SLA)	Self-efficacy after (SEE)	Self-efficacy before (SE)	Learning Approach (LA)	Mental Effort (ME)
Eigenvalues	5.35	3.78	3.46	3.45	3.43	2.23
Cronbach's Alpha	.92	.94	.94	.92	.86	.82

6.3 Content Analysis

6.3.1 Group Report

As noted in Section 4.6, Group Reports were scored using content analysis based on Quantity of Evidence. This was calculated as

> [no. of thematic IDs in group report * weighting_factor]
> divided by [maximum attained in the study]
> multiplied by 100

where weighting_factor was 2 if the solution was correct, or 1 if the solution was incorrect.

The following additional rules were applied during data analysis to increase the quality of the indicator:

a) While a maximum of 3 supported evidences was applied, one additional evidence was added for group reports that had ONE supported philosophy versus those that had more than one supported philosophy. This was to prevent a report that had two philosophies from scoring higher than a report that had only one. Hence, the maximum Quantity of Evidence on a report was now 4 (instead of 3) .

b) Thirteen supporting evidences[1] were disallowed for reasons of logic. For example T.2, which stated "The philosophy considers obstacles in terms of technical issues, with a lack of critical analysis regarding social/political obstacles", was NOT supported by Keen. Specifically, T.2 was contradicted by Keen #5 which stated "Hybrid skills must be developed in systems staff; they cannot dismiss organizational and political issues as irrelevant or not their responsibility...". By disallowing these supporting evidences, reports were scored only on evidences that were logical (or quality evidences only).

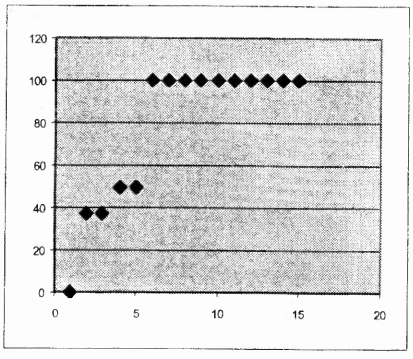
c) In reviewing the students' reports, students presented convincing arguments for Progressive Individualism and Pluralism. These should have received a higher weighting_factor than Radical Criticism or Technicism. Hence, final scoring was done using three weighting_factors: 3 points for Elitism, 2 points for Progressive Individualism or Pluralism and 1 point for Radical Criticism or Technicism. A finer-grained weighting system should improve the quality of results as the range was increased from [0 – 8] to [0 – 12], providing finer differentiation.

The results of the group report scores were depicted graphically with descriptive statistics (average, mode, median, minimum and maximum) in Figure 6.1. It should be noted that in all conditions there were a few groups that did very poorly, scoring under 40%. However the condition with both content and process scaffolds had the largest proportion of groups with perfect scores. Also note that the data distribution was not normal; and that a ceiling effect can be discerned occurring across the conditions.

[1] The thirteen evidences disallowed were: T.2, PI.4, PI.4.1, PI.4.2, E.4.1, P.4, R.1, R.2, R.2.1, R.2.2, R.3.1, R.4, R.4.1 (see Appendix J).

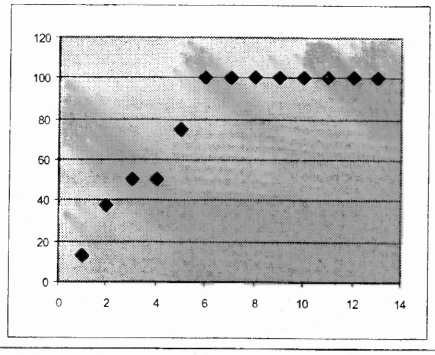
CS=N PS=N

Average= 81.11
Mode= 100
Median= 100
Minimum= 0
Maximum= 100



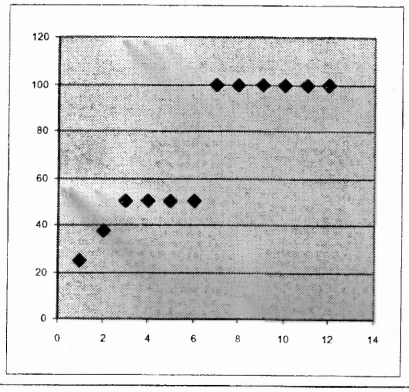
CS=Y PS=N

Average= 80.13
Mode= 100
Median= 100
Minimum= 16.67
Maximum= 100



CS=N PS=Y

Average= 74.36
Mode= 100
Median= 66.67
Minimum= 16.67
Maximum= 100



CS=Y PS=Y

Average= 89.22
Mode= 100
Median= 100
Minimum= 25
Maximum= 100

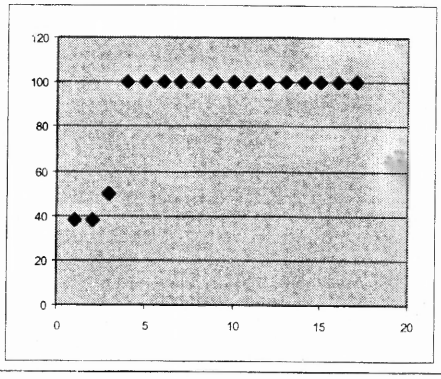
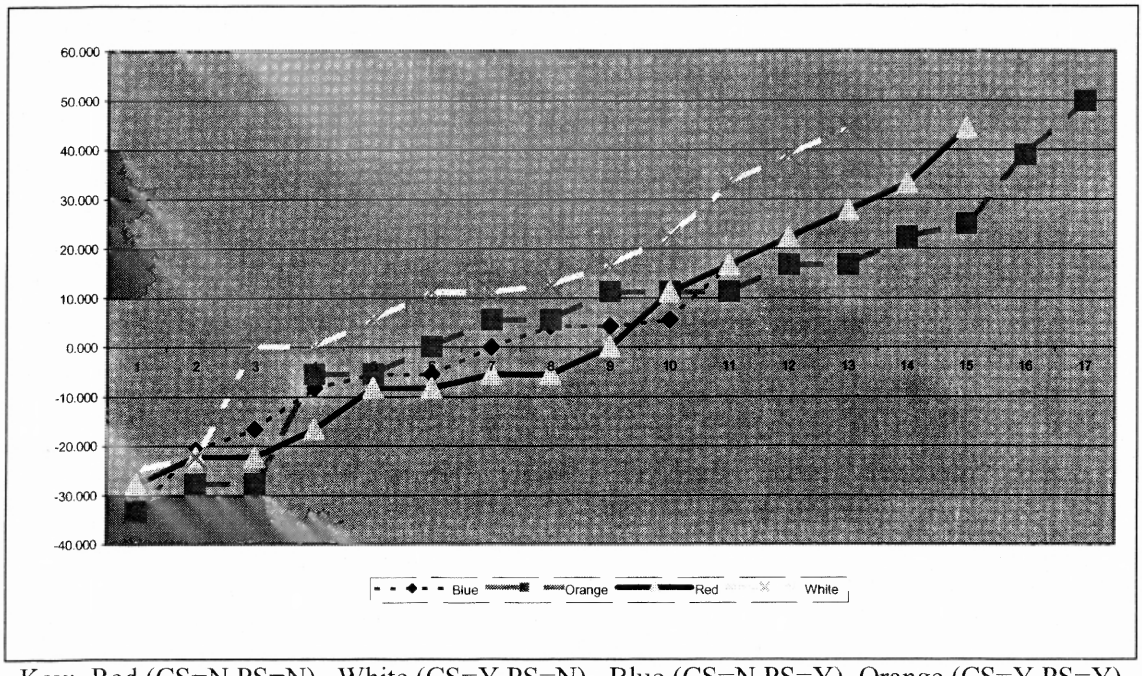


Figure 6.1 Group report score by condition.

6.3.2 Discourse

Twelve WebBoard conferences from the Group Discourse phase (see Table 4.2) were coded to obtain the Quantity of Interactive Indicators for hypothesis 3[2]. The twelve groups were drawn from each condition by selecting groups with the lowest, middle and highest group test scores[3]. This yielded a sample size of 12 which was used for testing hypothesis 3. Figure 6.2 shows the distribution of group test scores by condition. The data show an even distribution of group test scores within each condition between the lowest and highest scores. Hence the 'middle' scores (i.e., mean and average) were close to each other. More importantly, there was no ceiling effect.



Key: Red (CS=N PS=N) White (CS=Y PS=N) Blue (CS=N PS=Y) Orange (CS=Y PS=Y)

Figure 6.2 Discourse content analysis- average group test scores by condition.

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[2] Hypothesis 3 answers the research question: to what extent do content and process scaffolds increase the quantity of interactive indicators?

[3] The group test score is defined as the average of normalized individual test scores. Normalized individual test score is the individual's test score divided by the maximum attained by any individual in the study multiplied by 100. Note: Individual test score is the difference between post- and pre- test score as measured in the post- and pre-surveys.

Table 6.10 shows the twelve groups that were selected from the four conditions. For each condition, three groups were chosen representing groups that attained the lowest, highest and median[4] group test score. For example, in the [CS=N PS=Y] condition, the group with the minimum group test score was 'CIS455 Fa04 (B1)' (i.e., group B1 from class CIS455 during Fall 2004). This group achieved the minimum group test score of –33.333. It should be noted that hypothesis 3 was tested using non-parametric statistics because of the small sample size (i.e., twelve).

Table 6.10 Discourse Content Analysis- Twelve Groups

Conditions	Minimum	Maximum	Middle
CS=N PS=N	-27.778 MIS645 Sp05 (R2)	44.444 MIS645 Sp05 (R5)	2.593 MIS645 Sp05 (R1)
CS=Y PS=N	-25.000 MIS345 Fa04 (W2)	44.444 MIS345 Fa04 (W1)	11.432 CIS675 Su04 (W1)
CS=N PS=Y	-33.333 CIS455 Fa04 (B1)	27.778 CIS675 Sp05 (B1)	0.000 MIS345 Fa04 (B2)
CS=Y PS=Y	-33.333 CIS455 Fa04 (O1)	50.000 MIS345 Fa04 (O3)	6.699 CIS675 Sp05 (O4)

Two coders separately coded the WebBoard conferences. Prior to coding, each coder received a half-day training using one of the pilot studies. For the main study, the coders separately coded the twelve groups and subsequently met and discussed their codings, reaching 100% consensus. The experimenter met with the coders as tiebreaker. By the second session (out of two sessions that the coders met), disagreement between the coders was observed by the experimenter to be less than 10%. This indicated that coding instructions were highly reliable, rather than interpretive. Interpretive content analysis is one of the biggest causes for lack of reliability of content analysis as a research method.

[4] In reality, average score which was one away from the median was used for CS=N PS=N, CS=Y PS=N and CS=Y PS=Y conditions. (Median score was used for CS=N PS=Y condition.)

According to the instructions in Table 6.11, messages were categorized using six message categories. Occurrences of *acknowledgement* (ACK), *agreement/ disagreement* (Ag/Dis), *approval* (APP), *invitation* (INV) *and personal advice* (PA) were tallied to give an overall construct called *Interactive indicators*. With the exception of *administration* (see Grounded Discourse Content Analysis below), the coding scheme was developed based on Swan's (2002) Interactive Indicators categories (see Table 2.2) restricted to task-related messages. Again, the rationale for restricting the messages to task-related messages was to apply the indicator as a manifestation of (on-task) cognitive interaction. The count of *Interactive Indicators* (i.e., the sum of ACK, Ag/Dis, APP, PA and INV) was normalized over the maximum attained for the study multiplied by 100 (see Section 4.6). The normalized count was referred to as the *Interactive Indicators Across All Groups* construct (IntIndConst) to distinguish it from the raw count *Interactive Indicators* (IntInd).

Table 6.11 Discourse Content Analysis- Coding Instructions

General Instructions to Coders: 1. Unit of analysis is a message. 2. Categories of messages (see table below) are: Acknowledgement (Ack), Agree/Disagree (Ag/Dis), Approval (App), InviteResponse (Inv), Personal Advice (PA), Administration (Adm) 3. Count only task-related messages for Ack, Ag/Dis, App and Inv. 4. These categories are mutually exclusive: Ack, Ag/Dis, App. 5. Count only explicit content. Do not interpret latent content.	
ACK	Task-related messages referring directly to previous messages. Note: Included in previous messages are messages that clarify/refine others' and own messages. E.g., After reading both your argument … E.g., Alex picked [P4.1] … E.g., …(Quoting previous message verbatim.) E.g., I choose T.4 because …
Ag/Dis	Task-related messages expressing agreement/disagreement with others' messages. E.g., Dorothy and I agree. E.g., Common thoughts among us are… E.g., I think your statements are valid. E.g., I think you are right.
APP	Task-related messages expressing approval, praise or encouragement. E.g., Michael, job well done. E.g., Report looks good. E.g., Your summary is nice.
PA	Task-related advice to group members. E.g., Task 2 says pick one philosophy. I hope this answers your question. E.g, Tejas, you can base your answer on the above info. E.g., Please read my post on "Summary". E.g., We do not have evidence for…
INV	Task-related questions that further the discourse/report. E.g., Can you explain why you chose … E.g., What do you think about this point? E.g., Can we rephrase …
ADM	Non-task related messages related to scheduling, task assignment, and assignment clarification. E.g., Tomorrow we have to come up with an agreement on this. E.g., Can you put your vote under this thread? E.g., According to the instructions, we do not have to negate all the statements … E.g., I have cut and paste the instructions for the Group Report format below so we can refer to it better.

Grounded Discourse Content Analysis

Two refinements were added during grounded content analysis using training data. The first refinement was the addition of Administration as a coding category; and the second was the addition of two statistical constructs, specifically *Interactive Indicators Within A Group* (IntInd%), and *Administration Within A Group* (Adm%).

Addition of Administration as a coding category: Variations in the number of messages related to administrative tasks (i.e., scheduling, task assignment, and clarifications on instructions) were noted to vary across conditions during training. As process scaffold was expected to reduce time spent on administration tasks, because it provided instructions for day-to-day activities, Administration was added as a coding category to capture the variance showing across conditions.

Addition of *Interactive Indicators Within A Group* (IntInd%), and *Administration Within A Group* (Adm%): The experimenter noted a wide range of number of messages across groups without loss of discourse quality, which led the experimenter to question whether normalization across groups was valid (as *Interactive Indicators Across All Groups* (IntIndConst) was an index of the amount of interactive messages relative to the maximum number attained across the study). For example, a group using many more messages might have a larger number of INV messages (i.e., INVITE or questions) than a group with fewer number of INV messages. In some groups, INV messages did not move the discourse forward, but rather they were used by students to establish presence in the conference for grading purposes. Hence, with *Interactive Indicators Across All Groups* which was normalized over all groups, groups with high INV messages were showing a higher construct even though the discourse was not advancing or progressing. To account for this situation, *Interactive Indicators Within A Group (IntInd%)*, representing

the percent of *Interactive Indicators* type messages relative to the total number of messages within a group, was used as an additional indicator to manifest cognitive interaction. Because this index was calculated on the number of messages within a group, it should not be biased against groups who had fewer INV messages (because they knew what they were doing). Similarly, *Administration Within A Group* (Adm%) represented the number of messages spent on administering the group discourse relative to the total number of messages within the group conference.

Table 6.12 summarizes the raw data from content analysis of group discourse. This raw data was analyzed and interpreted in the next section (see Section 7.1.3.). It should be noted, while hypothesis 3 (see Section 7.1.3) referred to *Interactive Indicators Across All* Groups (IntIndConst), *Interactive Indicators Within A Group* (IntInd%) was analyzed additionally as part of hypothesis 3. The new indicator *Administration Indicator Within A Group* (Adm%) has also been added and its significance is discussed as Other Implications under hypothesis 3.

Table 6.12 Discourse Content Analysis- Final Group Data

	Interactive Indicator Across All Groups (IntIndConst)	Interactive Indicators Within A Group (IntInd%)	Administration Within A Group (Adm%)
Red			
Minimum Gp	38.028	51.923	36.538
Middle Gp	40.845	55.769	38.462
Maximum Gp	38.028	39.706	42.647
White			
Minimum Gp	21.127	51.724	41.379
Middle Gp	30.986	40.741	37.037
Maximum Gp	16.901	54.545	22.727
Blue			
Minimum Gp	14.085	62.500	37.500
Middle Gp	21.127	53.571	35.714
Maximum Gp	80.282	57.000	32.000
Orange			
Minimum Gp	21.127	68.182	22.727
Middle Gp	100.000	82.558	12.791
Maximum Gp	21.127	83.333	16.667

Notes:
1. IntIndConst is an index of the amount of Interactive Indicators type messages relative to the maximum number attained in any group in the study.
2. IntInd% is the percent of Interactive Indicators type messages relative to the total number of messages in the group conference.
3. Adm% is the percent of administrative type messages relative to the total number of messages in the group conference.

CHAPTER 7

RESULTS

7.1 Hypothesis Testing

In this section of the thesis, the data were subjected to a statistical technique known as "analysis of variance" (ANOVA). The purpose of ANOVA is to determine whether the variation (or differences) among the data is significant enough to accept the hypotheses. All ANOVA statistics result in a measure called the "significance" or p-value. The p-value gives the probability of Type 1 error which is an error from inferring a relationship when there is none. In other words, Type 1 error is associated with inferring a relationship when the null hypothesis H_0 is true (i.e., there is no relationship between the variables). Type 1 error usually occurs because of sampling errors when the sampling is not at random (or biased). It is common practice to consider a hypothesis as TRUE when the probability of the ANOVA statistic (p) is less than or equal to .05, meaning that the "chance" of inferring a relationship when there is none is less than or equal to 5 in 100. Assuming 'small' to 'medium' size effects[5], Cohen (1988) estimated that with a sample size of 58, as in this study, the statistical power (or likelihood) for detecting p= .05 when there really is a relationship is .15 - .20 (for 'small' effects) to .70 - .80 (for 'medium' effects) for the Student's T and the F-ANOVA statistics. Because of the sample size and low power (see Section 8.2.2), the discussion in this section refers to relationships that have a p-value between .05 and .10 as 'probable relationships', meaning these

[5] See section 8.2.1 for a discussion on the strength of manipulation of the content and process scaffolds in the study.

relationships are expected to be significant in the .05 range with larger sample sizes. (The term 'significant' relationships will be reserved for p-values less than or equal to .05.)

A key question in choosing an ANOVA statistic is whether the variable satisfies normality. When normality is satisfied, the most common statistic is either the F-test (for two or more groups of data) or the T-test (for two groups of data). When normality is not satisfied, the variable may be transformed (using log(x), exp(x), square(x), square root(x), reciprocal(x), etc.) and re-tested. After transformation, if the variable satisfies normality, the F-test or T-test may be used. If however the variable still does not satisfy normality, then it needs to be tested via nonparametric statistics (e.g., Chi-square, Whitney-Mann U, Kruskal-Wallis, etc.). For this thesis, the Kruskal-Wallis statistic, which is appropriate for independent and multi-groups, is used as the nonparametric statistic of choice. As parametric statistics have more power than nonparametric statistics, parametric statistics are preferred with nonparametric statistics as a second choice.

Table 7.1 summarizes the normality test results for variables used in the research approach. The normality test was done with the Anderson-Darling test with $p > .05$. The Anderson-Darling test is a modification of the traditional Kolmogorov-Smirnov (K-S) test and gives more weight to the tails of the distribution than does the K-S test. Whereas K-S is suited to large sample sizes ($N > 1000$), Anderson-Darling is suited to smaller sample sizes ($50 < N < 1000$). Since this study has 58 groups of data, Anderson-Darling is a better test than K-S. (Note: Before proceeding, it should be noted that since Satisfaction with Group Solution and Satisfaction with Group Discourse have been combined into one factor, namely Satisfaction with Group Solution and Discourse,

hypotheses 4 (i.e., Satisfaction with Group Solution) and 5 (i.e., Satisfaction with Group Discourse) were tested once.

Table 7.1 Normality Test Results

Research Approach	Variable	Normality Test	Notes
H1	Increase in Individual Test Grade (Itest) Increase in Group Test Grade (GrTest)	p<.005[6] no p > .250** yes	Kruskal-Wallis Analysis of Ranks
H2	Quantity of Evidence in Group Report (GpRptEv)	p < .005[7] no	Kruskal-Wallis Analysis of Ranks
H3	Interactive Indicators Across All Groups (IntIndConst)	N/A[8]	Kruskal-Wallis Analysis of Ranks
H4	Satisfaction with Group Solution and Discourse (SGSD)	p = .092** yes	Rank(x) transformation
H5	Satisfaction with Group Solution and Discourse (SGSD)	see H4	see H4
H6	Satisfaction with Learning Artifact (SLA)	p> .250** yes	Square(x) transformation
H7	Increase in Self-Efficacy (SE_Inc)	p= .084** yes	Rank(x) transformation
Mediating Variable	Learning Approach (LA)	p > .250** yes	
Intervening Variable	Mental Effort (ME)	p > .250** yes	

N/A indicates normality test does not apply for small sample size (N < 50).
** indicates Anderson-Darling normality test is significant with p> .05. That is, it satisfies normality test.

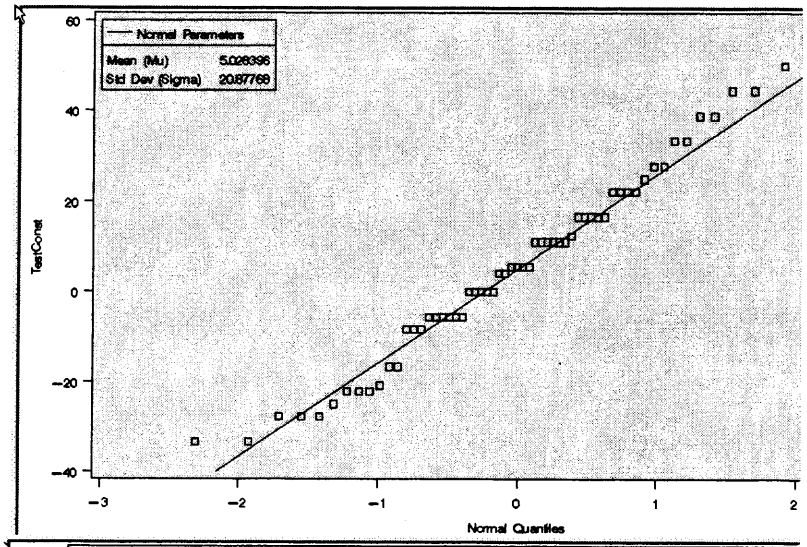
In Table 7.1 above, Interactive Indicators Across All Groups (i.e., H3) could not be tested for normality because of the small sample size of twelve[9]. Hence, the Kruskal-Wallis statistic was used for ANOVA. In addition, when a transformation was needed to satisfy normality, the transformation was listed in the Notes column. When transformation failed to satisfy normality, the Kruskal-Wallis statistic was used. This was also listed in the Notes column.

According to Chambers, Cleveland, Kleiner and Tukey (1983), there is no single statistical tool that is as powerful as a visual check for normality. Normal quantile-quantile (Q-Q plot) is the most commonly used diagnostic tool for checking normality of

[6] ITest represents individual (versus group) data and is not normal, even with SAS transformations.
[7] GpRptEv has ceiling effect and is not normal.
[8] Interactive Indicator Across All Groups has twelve data points, corresponding to the twelve discourse groups. For small samples, nonparametric tests are used as a rule.
[9] Anderson-Darling test for normality recommends at least 50 sample points.

data. It is constructed by plotting the quantiles of the data against corresponding quantiles of the normal distribution. If the distribution of the data is normal, the quantiles of the data will match the normal quantiles and the plot will fall near the line y=x. Figures 7.1 and 7.2 show the Q-Q plots for Increases in Group Test Grade(TestConst), Satisfaction with Group Solution and Discourse(SGSD), Increases in Self-Efficacy(SE_Inc), Learning Approach(LA) and Mental Effort(ME). As can be seen, the data was approximately normal with no major shifts or tilts away from the line.

Increases in Group Test Grade (TestConst)



Satisfaction with Group Solution and Discourse (SGSD)

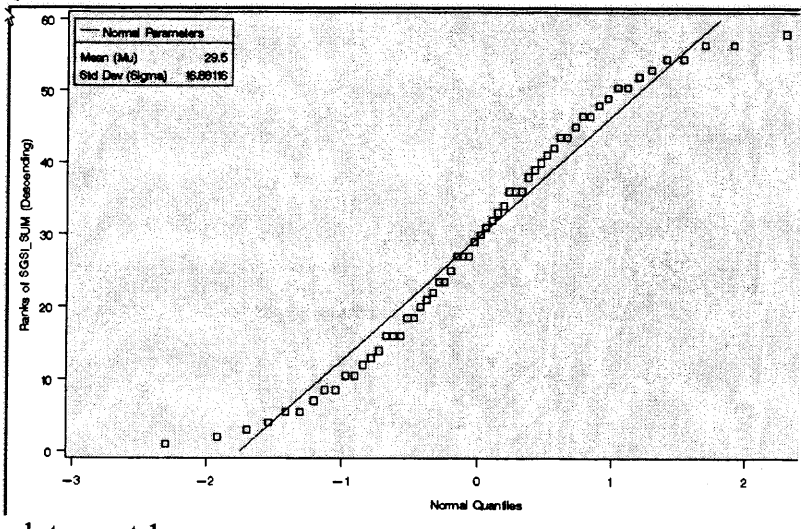
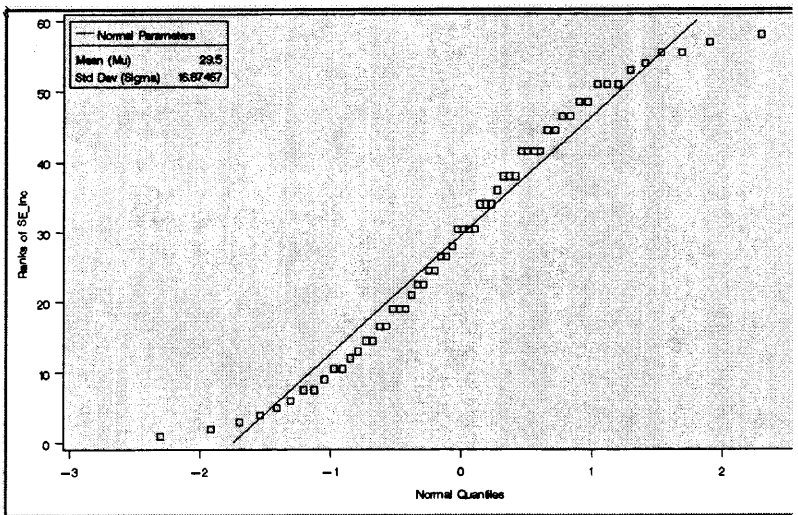
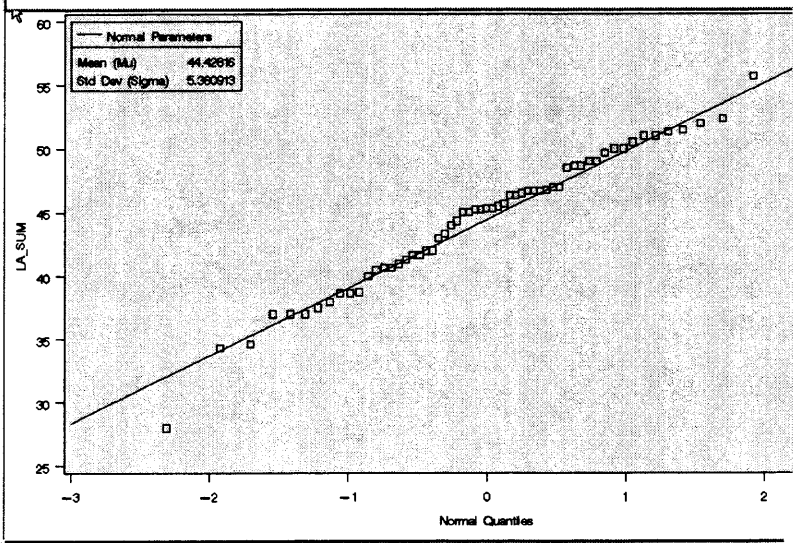


Figure 7.1 Normal Q-Q plots- part 1.

Increases in Self-Efficacy (SE_Inc)



Learning Approach (LA)



Mental Effort (ME)

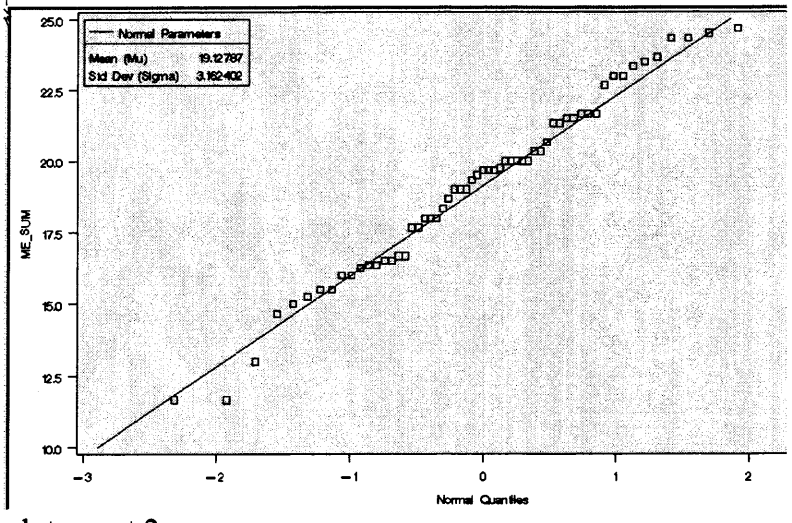


Figure 7.2 Normal Q-Q plots- part 2.

7.1.1 (Hypothesis 1) To what extent do content and process scaffolds improve test grade?

For this set of hypotheses, two types of ANOVA statistics were used. For Increases in Individual Test Grades (i.e., ITest), the Kruskal-Wallis Analysis of Ranks is used, since the data distribution was not normal. For Increases in Group Test Grades (i.e., GrTest), the Student's T was used to test the differences for main effects; while the F-test, Type I Sums Of Squares, was used to test the differences for interaction effects. In SAS, Type I Sums Of Squares is the preferred effects model for unbalanced designs (versus Type III Sums Of Squares). This is because, for unbalanced designs, Type III Sums Of Squares does not equal the model sum of squares. The hypothesis is accepted when the p-value is less than or equal to 0.05.

H1.a Increases in individual(Itest) and group test grades (GrTest) are higher with content scaffold than without content scaffold. ***Not supported.***

Table 7.2 shows that while Itest Mean Score for conditions with content scaffold (i.e., 93.029) is higher than conditions without content scaffold (i.e., 79.818), the difference in the group mean scores is not significant (i.e., p= 0.074 is greater than 0.05).

Table7.2 Kruskal-Wallis Statistic on Increases in Individual Test Grade for (CS)

	N	Sum of Scores	Expetced Under H_0	Std. Dev. Under H_0	Mean Score
CS= N	85	6784.50	7352.50	318.238	79.818
CS=Y	87	8093.50	7525.50	318.238	93.029
Chi-Square Approximation= 3.186 **DF**= 1 **Significance p**= 0.074					

** indicates Anova result is significant with p <= .05.

Table 7.3 shows that while GrTest Mean Score for conditions with content scaffold (i.e., 8.750) is higher than conditions without content scaffold (i.e., 1.041), the difference in the group mean scores is not significant (i.e., p= 0.162 is greater than 0.05).

Table 7.3 Students' T Statistic on Increases in Group Test Grade for (CS)

	Mean (N)	Std. Dev.	Variance
CS=N	1.041 (N= 28)	19.742	389.752
CS=Y	8.750 (N= 30)	21.545	464.181
Sum of Squares= 860.562 Mean Square= 860.562 F(2.010, 1)= .162			

** indicates Anova result is significant with p <= .05.

H1.b Increases in individual(Itest) and group test grades (GrTest) are higher with process scaffold than without process scaffold. ***Not supported.***

Table 7.4 shows that while Itest Mean Score for conditions with process scaffold (i.e., 85.570) is lower (i.e., opposite to hypothesis) than conditions without process scaffold (i.e., 87.595), the difference in the group mean scores is not significant (i.e., p= 0.785 is greater than 0.05).

Table 7.4 Kruskal-Wallis Statistic on Increases in Individual Test Grade (PS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
PS=N	79	6920.0	6833.50	317.204	87.595
PS=Y	93	7958.0	8044.50	317.204	85.570
Chi-Square Approximation= .0744 **DF**= 1 **Significance p**= 0.785					

** indicates Anova result is significant with p <= .05.

Table 7.5 shows that while GrTest Mean Score for conditions with process scaffold (i.e., 3.472) is lower (i.e., opposite to hypothesis) than conditions without process scaffold (i.e., 6.696), the difference in the group mean scores is not significant (i.e., p= 0.561 is greater than 0.05).

Table 7.5 Students' T Statistic on Increases in Group Test Grade (PS)

	Mean (N)	Std. Dev.	Variance
PS=N	6.696 (N= 28)	21.652	468.814
PS=Y	3.472 (N= 30)	20.373	415.052
Sum of Squares= 150.547 Mean Square= 150.547 F(.340, 1)= .561			

** indicates Anova result is significant with p <= .05.

H1.c There is an interaction effect between content and process scaffolds affecting increases in individual(Itest) and group test grades (GrTest). ***Not supported.***

Table 7.6 shows that Itest Mean Score for conditions with content and process scaffolds (i.e., 91.559) is second highest relative to other conditions (i.e., 81.302, 95.111, 78.298). Since Itest is not normal, two-way ANOVA for difference in the means is not available.

Table 7.6 Kruskal-Wallis Statistic on Increases in Individual Test Grade (CS*PS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
CS= N PS=N	43	3496.0	3719.5	275.621	81.302
CS=Y PS=N	36	3424.0	3114.0	258.943	95.111
CS=N PS=Y	42	3288.5	3633.0	273.451	78.298
CS=Y PS=Y	51	4669.5	4411.5	290.711	91.559
N/A					

** indicates Anova result is significant with p <= .05.

Table 7.7 shows that GrTest Mean Score for conditions with content and process scaffolds (i.e., 6.700) is second highest (i.e., opposite of H1.c) compared to conditions without both content and process scaffolds (i.e., 2.592, 11.431, -.748). The difference in the group mean scores is not significant for interaction effects (i.e., p= 0.901 is greater than 0.05).

Table 7.7 F-Test Statistic on Increases in Group Test Grade (CS*PS)

	Mean (N)	Std. Dev.	Variance
CS=N PS=N	2.592 (N= 15)	22.184	492.115
CS=Y PS=N	11.431 (N= 13)	20.865	435.355
CS=N PS=Y	-0.748 (N= 13)	17.214	296.322
CS=Y PS=Y	6.700 (N= 17)	22.461	504.503
CS*PS	Sum of Squares= 6.930 Mean Square= 6.930		F(.020, 1)= .901

** indicates Anova result is significant with p <= .05.

Summary Of Findings

It should be noted that between group differences in Increases in Individual Test Grade for CS main effect (p=.074) is a 'probable relationship' (i.e., p <= .10). That is, the test scores have a tendency to be higher with content scaffold than without. As this is a 'probable relationship', it is reasonable to expect that with larger sample sizes the finding may achieve statistical significance.

From Table 7.7, although Increases in Group Test Grade for conditions with both content and process scaffolds are not significant (p= .901), it is the second highest (6.70) after the condition for content scaffold (11.431). This suggests that process scaffold aids assimilation of the content scaffold, by drawing attention to it. (This pattern, where higher Mean Score is observed for conditions with both content and process scaffold, is especially evident in Section 7.2).

7.1.2 (Hypothesis 2) To what extent do content and process scaffolds improve the quantity of evidence in group report?

For this set of hypotheses, the Kruskal-Wallis Analysis of Ranks (see Table 7.1) was used to test the differences in Quantity of Evidence in Group Report (GpRptEv) average between groups. The hypothesis is accepted when the p-value is less than or equal to 0.05.

H2.a Quantity of (quality) evidence in group report (GpRptEv) is higher with content scaffold than without content scaffold. ***Not supported.***

Table 7.8 shows that while GpRptEv Mean Score for conditions with content scaffold (i.e., 31.567) is higher than conditions without content scaffold (i.e., 27.285), the difference in the group mean scores is not significant (i.e., p= 0.255 is greater than 0.05).

Table 7.8 Kruskal-Wallis Statistic on Quantity of Evidence in Group Report (CS=Y)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
CS=N	28	764.0	826.0	54.421	27.285
CS=Y	30	947.0	885.0	54.421	31.567
Chi-Square Approximation= 1.298 **DF**= 1 **Significance p**= 0.255					

** indicates Anova result is significant with p <= .05.

H2.b Quantity of (quality) evidence in group report (GpRptEv) is higher with process scaffold than without process scaffold. ***Not supported.***

Table 7.9 shows that while GpRptEv Mean Score for conditions with process scaffold (i.e., 30.000) is higher than conditions without content scaffold (i.e., 28.964), the difference in the group mean scores is not significant (i.e., p= 0.783 is greater than 0.05).

Table 7.9 Kruskal-Wallis Statistic on Quantity of Evidence in Group Report (PS=Y)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
PS=N	28	811.0	826.0	54.422	28.964
PS=Y	30	900.0	885.0	54.422	30.000
Chi-Square Approximation= 0.076 **DF**= 1 **Significance p**= 0.783					

** indicates Anova result is significant with p <= .05.

H2.c There is an interaction effect between content and process scaffolds affecting quantity of (quality) evidence in group report (GpRptEv). N/A

Table 7.10 shows that GpRptEv Mean Score for conditions with content and process scaffolds (i.e., 34.029) is highest relative to conditions without both content and process scaffolds (i.e., 29.500, 28.346, 24.730). However, results cannot be tested for significance as GpRptEv is not normal.

Table 7.10 Kruskal-Wallis Statistic on Quantity of Evidence in Group Report (CS*PS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
CS= N PS=N	15	442.5	442.5	47.688	29.500
CS=Y PS=N	13	368.5	383.5	45.416	28.346
CS=N PS=Y	13	321.5	383.5	45.416	24.730
CS=Y PS=Y	17	578.5	501.5	49.573	34.029
Chi-Square Approximation= N/A **Significance p**= N/A					

** indicates Anova result is significant with p <= .05.

Summary Of Findings

One explanation for the lack of significance in hypotheses 2.a (i.e., conditions with content scaffold are predicted to have higher group mean scores), 2.b (i.e., conditions with process scaffold are predicted to have higher group mean scores), and 2.c (i.e., conditions with both content and process scaffolds are predicted to have the lowest group mean score) is the ceiling effect occurring in group report data. (Despite attempts to improve the group report scoring, which was limited by instructions to the students as to how they would be graded, the ceiling effect remained. (see Section 6.3.1).) The data

distributions for group report data are shown in Figure 6.1. Ceiling effect occurs when a large number of subjects attain the highest possible scale value because the scale only discriminates among individuals in the low to moderate range. In this situation, differences in the high range are obscured and are not detected in the scores.

Although the differences are not significant, it should be noted that the direction of the scores are as predicted for most hypotheses, (i.e., hypotheses 2.a and 2.b). For future studies, a better group report scoring scale that differentiates high group report scores should be constructed. If this is done, significant results are more probable.

7.1.3 (Hypothesis 3) To what extent do content and process scaffolds increase the quantity of interactive indicators?

For this set of hypotheses, the Kruskal-Wallis Analysis of Ranks (see Table 7.1) was used to test differences in Quantity of Interactive Indicators average between groups. The hypothesis is accepted when the p-value is less than or equal to 0.05. As discussed in Section 6.3.2.1, both Interactive Indicators Across All Groups IntIndConst (representing the normalized Interactive Indicators across all groups) and Interactive Indicators Within A Group IntInd% (representing the percent of Interactive Indicators within a group) are tested in this hypothesis.

H3.a Quantity of interactive indicators(IntIndConst) is higher with content scaffold than without content scaffold. ***Not supported.***

Table 7.11 shows that while IntIndConst Mean Score for conditions with content scaffold (i.e., 5.750) is lower (i.e., opposite to hypothesis) than conditions without content scaffold (i.e., 7.250), the difference in the group mean scores is not significant (i.e., p= 0.462 is greater than 0.05).

Table 7.11 Kruskal-Wallis Statistic on Interactive Indicators Across All Groups (CS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
CS=N	6	43.50	39.0	6.124	7.250
CS=Y	6	34.50	39.0	6.124	5.750
Chi-Square Approximation= 0.540 **DF**= 1 **Significance p**= 0.462					

** indicates Anova result is significant with p <= .05.

H3.a' Quantity of interactive indicators(IntInd%) is higher with content scaffold than without content scaffold. ***Not supported.***

Table 7.12 shows that while IntInd% Mean Score for conditions with content scaffold (i.e., 7.333) is higher than conditions without content scaffold (i.e., 5.667), the difference in the group mean scores is not significant (i.e., p= 0.423 is greater than 0.05).

Table 7.12 Kruskal-Wallis Statistic on Interactive Indicators Within A Group (CS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
CS=N	6	34.00	39.0	6.245	5.667
CS=Y	6	44.00	39.0	6.245	7.333
Chi-Square Approximation= 0.641 **DF**= 1 **Significance p**= 0.423					

** indicates Anova result is significant with p <= .05.

H3.b Quantity of interactive indicators(IntIndConst) is higher with process scaffold than without process scaffold. ***Not Supported.***

Table 7.13 shows that while IntIndConst Mean Score for conditions with process scaffold (i.e., 6.750) is higher than conditions without process scaffold (i.e., 6.250), the difference in the group mean scores is not significant (i.e., p= 0.807 is greater than 0.05).

Table 7.13 Kruskal-Wallis Statistic on Interactive Indicators Across All Groups (PS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
PS=N	6	37.50	39.0	6.124	6.250
PS=Y	6	40.50	39.0	6.124	6.750
Chi-Square Approximation= .060 **DF**= 1 **Significance p**= 0.807					

** indicates Anova result is significant with p <= .05.

H3.b' Quantity of interactive indicators(IntInd%) is higher with process scaffold than without process scaffold. ***Supported.***

Table 7.14 shows that IntInd% Mean Score for conditions with process scaffold (i.e., 9.167) is higher than conditions without process scaffold (i.e., 3.833). The difference in group mean scores is significant (i.e., p= .010 is less than 0.05).

Table 7.14 Kruskal-Wallis Statistic on Interactive Indicators Within A Group (PS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
PS=N	6	23.00	39.0	6.245	3.833
PS=Y	6	55.00	39.0	6.245	9.167
Chi-Square Approximation= 6.564 **DF**= 1 **Significance p**= 0.010**					

** indicates ANOVA result is significant with p< .05.

H3.c There is an interaction effect between content and process scaffolds affecting quantity of interactive indicators(IntIndConst). ***Not supported.***

Table 7.15 shows that the IntIndConst Mean Score for conditions with both content scaffold and process scaffolds (i.e., 7.000) is second highest relative to conditions without both content and process scaffolds (i.e., 9.000, 4.500 and 5.500). The difference in the group mean scores is not tested for significance since the twelve group sample is too small for parametric two-way ANOVA.

Table 7.15 Kruskal-Wallis Statistic on Interactive Indicators Across All Groups (CS*PS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
CS= N PS=N	3	27.00	19.5	5.303	9.000
CS=Y PS=N	3	13.50	19.5	5. 303	4.500
CS=N PS=Y	3	16.50	19.5	5. 303	5.500
CS=Y PS=Y	3	21.00	19.5	5. 303	7.000
Chi-Square Approximation= N/A **Significance p**= N/A					

** indicates ANOVA result is significant with p <= .05.

H3.c' There is an interaction effect between content and process scaffolds affecting quantity of interactive indicators(IntInd%). ***N/A***

Table 7.16 shows that IntInd% Mean Score for conditions with content scaffold and process scaffolds (i.e., 11.000) is highest relative to conditions without both content and process scaffolds (i.e., 3.667, 4.000 and 7.333). The difference in the group mean

scores is not tested for significance since the twelve group sample is too small for parametric two-way ANOVA.

Table 7.16 Kruskal-Wallis Statistic on Interactive Indicators Within A Group (CS*PS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
CS= N PS=N	3	12.00	19.5	5.408	4.000
CS=Y PS=N	3	11.00	19.5	5.408	3.667
CS=N PS=Y	3	22.00	19.5	5.408	7.333
CS=Y PS=Y	3	33.00	19.5	5.408	11.000
Chi-Square Approximation= N/A **Significance p**= N/A					

** indicates ANOVA result is significant with p <= .05.

Other Discourse Implications. As discussed in Section 6.3.2.1, Administration was added as a category after grounding on training discourse data. Tables 7.17- 7.19 show the Kruskal-Wallis test for Administration Within A Group (ADM%). While there is no significant difference in means with content scaffold as a main effect, there is a significant difference in means using process scaffold. Table 7.18 shows that ADM% Mean Score is higher without process scaffold (i.e., 8.583) than with process scaffold (i.e., 4.417). This difference is significant (i.e., p= .0450 which is less than or equal to .05) and shows that process scaffold is reducing the amount of planning/administration messages. This result is consistent with the ADM% Mean Score trend in Table 7.19 which shows that the two conditions without process scaffold have higher ADM (i.e., 9.667, 7.500) messages than the two conditions with process scaffold (i.e., 6.667 and 2.167). [Note: Two-way ANOVA is not available as the twelve group sample is too small for parametric tests.]

Table 7.17 Kruskal-Wallis Statistic on Administration Within A Group (CS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
CS= N	6	49.00	39.0	6.234	8.167
CS=Y	6	29.00	39.0	6.234	4.833
Chi-Square Approximation= 2.573 **DF**= 1 **Significance p**= 0.109					

** indicates ANOVA result is significant with p <= .05.

Table 7.18 Kruskal-Wallis Statistic on Administration Within A Group (PS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
PS=N	6	51.50	39.0	6.234	8.583
PS=Y	6	26.50	39.0	6.234	4.417
Chi-Square Approximation= 4.020 **DF**= 1 **Significance p**= 0.045**					

** indicates ANOVA result is significant with p <= .05.

Table 7.19 Kruskal-Wallis Statistic on Administration Within A Group (CS*PS)

	N	Sum of Scores	Expected Under H_0	Std. Dev. Under H_0	Mean Score
CS= N PS=N	3	29.0	19.50	5.398	9.667
CS=Y PS=N	3	22.5	19.50	5. 398	7.500
CS=N PS=Y	3	20.0	19.50	5. 398	6.667
CS=Y PS=Y	3	6.5	19.50	5. 398	2.167
Chi-Square Approximation= N/A **Significance p**= N/A					

** indicates ANOVA result is significant with p <= .05.

Summary Of Findings

While results on Interactive Indicators Across All Groups are not significant (i.e., hypotheses 3.a, 3.b and 3.c), the use of Interactive Indicators Within A Group, which compares quantity of quality interaction relative to all interactions within one group, shows that process scaffold is a significant main effect (H3.b'). One explanation for Interactive Indicators Within A Group being a more sensitive indicator is students who are better prepared or who are high achievers will need fewer interactions to accomplish the learning objective. That is, they will be able to reach consensus in less time and in fewer messages. Conversely, students who are less prepared or low achievers will need

more time and more messages (especially INV or question messages) to accomplish the same goal. Hence, normalizing the number of on-task interactive messages across groups to derive an indicator that means cognitive depth may not make sense under all conditions . Rather, comparing the relative amount of on-task messages to all messages within a group provides an alternate measure should the group indulge in INV messages without moving the discourse forward.

In addition, H3.b' yields a significant result suggesting that process scaffold enables students to achieve more interaction (as measured by Interactive Indicator Within A Group). One explanation is the process scaffold forces the students to begin discourse earlier and to participate on a regular basis (Massey, Montoya-Weiss and Hung, 2003). Earlier and more regular participation may increase student focus and stimulate interaction. Moreover, Table 7.18 shows that there are significantly fewer Administration type messages for conditions with process scaffold[10]. Putting both results together, H3.b' and Table 7.18 suggest that process scaffold reduces the amount of planning/administration messages which then enables students to focus proportionately more on-task which then enables them to achieve more interaction (as measured by Interactive Indicator Within A Group).

[10] It should be noted that Interactive Indicator messages and Administration messages may overlap. For example, a message may be coded with both Ack and ADM, with only Ack, or only ADM. Being so, it is meaningful to test Interactive Indicator Within A Group separately from Administration Within A Group. In other words, high Interactive Indicator Within A Group does not imply low Administration Within A Group as the two are independent categories.

7.1.4 (Hypothesis 4)To what extent do content and process scaffolds increase satisfaction with group report?

For this set of hypotheses, the Student's T was used to test the differences in Satisfaction with Group Report and Group Discourse (SGSD) average between groups for main effects; while the F-test, Type I Sums of Squares, was used to test the differences for interaction effects. (Note: As discussed in Section 6.2, SGSD is the composite factor consisting of Satisfaction with Group Solution SGS and Satisfaction with Group Discourse SGI.) The hypothesis is accepted when the p-value is less than or equal to 0.05.

H4.a Satisfaction with group report (SGSD) is higher with content scaffold than without content scaffold. ***Not supported.***

Table 7.20 shows that while the SGSD Mean Score for conditions with content scaffold (i.e., 30.300) is higher than conditions without content scaffold (i.e., 28.643), the difference in the group mean scores is not significant (i.e., p= 0.712 is greater than 0.05).

Table 7.20 Student's T Statistic on Satisfaction With Group Solution and Discourse (CS)

	Mean (N)	Std. Dev.	Variance
CS=N	28.643 (N= 28)	17.810	317.201
CS=Y	30.3(N= 30)	16.230	263.424
Sum of Squares= 39.771 Mean Square= 39.771 F(.14, 1)= .712			

** indicates ANOVA result is significant with p <= .05.

H4.b Satisfaction with group report (SGSD) is higher with process scaffold than without process scaffold. ***Not supported.***

Table 7.21 shows that while SGSD Mean Score for conditions with process scaffold (i.e., 30.600) is higher than conditions without process scaffold (i.e., 28.321), the difference in the group mean scores is not significant (i.e., p= 0.612 is greater than 0.05).

Table 7.21 Students' T Statistic on Satisfaction With Group Solution and Discourse (PS)

	Mean (N)	Std. Dev.	Variance
PS=N	28.321 (N= 28)	18.064	326.300
PS=Y	30.6 (N= 30)	15.929	253.731
Sum of Squares= 75.193 Mean Square= 75.193 F(.26, 1)= .612			

** indicates ANOVA result is significant with p <= .05.

H4.c There is an interaction effect between content and process scaffolds affecting satisfaction with group report (SGSD). ***Not supported.***

Table 7.22 shows that while SGSD Mean Score for conditions with content and process scaffolds (i.e., 33.500) is higher than conditions without both content and process scaffolds (i.e., 30.233, 26.115, 26.808). The difference in the group mean scores is not significant (i.e., p= 0.236 is greater than 0.05).

Table 7.22 F-Test Statistic on Satisfaction With Group Solution and Discourse (CS*PS)

	Mean (N)	Std. Dev.	Variance
CS=N PS=N	30.233 (N= 15)	20.256	410.317
CS=Y PS=N	26.115 (N= 13)	15.673	245.631
CS=N PS=Y	26.808 (N= 13)	15.106	228.189
CS=Y PS=Y	33.5 (N= 17)	16.375	268.125
CS*PS	Sum of Squares= 418.355 Mean Square= 418.355		F(1.44, 1)= .236

** indicates ANOVA result is significant with p <= .05.

Summary Of Findings

While the finding is not significant for this group of hypotheses, it should be noted that a pattern is emerging with consistency across hypotheses 2, 3 and 4. The pattern is the mean scores Quantity of Evidence in Group Report (GpRptEv), Interactive Indicators Within A Group (IndInd%) and Satisfaction with Group Solution and Discourse (SGSD) are higher with content scaffold than without, with process scaffold than without, and highest with both content and process scaffolds. This suggests a positive correlation between the three dependent variables and the manipulated variables content and process scaffolds, as well as a synergistic effect between content and process

scaffolds. (The correlation between all variables is discussed in detail in Section 7.4). In future research, Satisfaction With Group Solution and Discourse should be explored again, after removing ceiling effects from group report scores.

7.1.5 (Hypothesis 5)To what extent do content and process scaffolds increase satisfaction with discourse?

Since SGSD consists of Satisfaction with Group Solution (hypothesis 4) and Satisfaction with Group Discourse (hypothesis 5), hypothesis 5 is the same as hypothesis 4.

7.1.6 (Hypothesis 6)To what extent do content and process scaffolds increase satisfaction with learning artifact?

For this hypothesis, the F-test (refer to Table 7.1) was used to test the differences in Satisfaction with Learning Artifact (SLA) average between groups. The hypothesis is accepted when the p-value is less than or equal to 0.05.

H6. Satisfaction with learning artifact (SLA) is higher with matrix concept structure than without. ***Not supported.***

Table 7.23 shows that while the SLA Score for conditions with matrix content structure (i.e., 567.093) is higher than conditions without (i.e., 558.419), the difference in the group mean scores is not significant (i.e., p= 0.839 is greater than 0.05).

Table 7.23 Student's T Statistic on Satisfaction with Learning Artifact (CS)

	Mean	Std. Dev.	Variance
CS=N	558.419	180.915	32730.19
CS=Y	567.093	142.260	20237.98
Sum of Squares= 1089.635 Mean Square= 1089.635 F(.040)= .839			

Summary Of Findings

Although Satisfaction with Learning Artifact is higher in conditions with matrix concept structure than without, the result is not statistically significant. One explanation for this is the confounding effect of the PowerPoint slide set which was given to all conditions. In reality, the slide set was sort of a concept scaffold in text form (versus matrix form). The reason the slide was given to all participants was because the final report and discourse were graded on the Mowshowitz Framework which could only be found in the slide set or the matrix. In future studies, the article may be highlighted/notated with the Mowshowitz Framework, thereby replacing the slide set. This should eliminate the confounding effect and provide a stronger manipulation of the

concept scaffold. That is, the treatment would test matrix versus no concept structure (as opposed to matrix versus text concept structure).

7.1.7 To what extent do content and process scaffolds increase self-efficacy?

For this set of hypotheses, the F-test (refer to Table 7.1) is used to test the differences in the Increase in Self-Efficacy (SE_Inc) average between groups. The hypothesis is accepted when the p-value is less than or equal to 0.05.

H7.a Increases in self-efficacy (SE_Inc) is higher with content scaffold than without content scaffold. ***Not supported.***

Table 7.24 shows that while SE_Inc Mean Score for conditions with content scaffold (i.e., 31.050) is higher than conditions without content scaffold (i.e., 27.839), the difference in the group mean scores is not significant (i.e., p= 0.474 is greater than 0.05).

Table 7.24 Students' T Statistic on Increase in Self-Efficacy (CS)

	Mean (N)	Std. Dev.	Variance
CS=N	27.839 (N= 28)	15.925	253.594
CS=Y	31.05 (N= 30)	17.845	318.437
Sum of Squares= 149.298 Mean Square= 149.298 F(.520, 1)= .474			

** indicates ANOVA result is significant with p <= .05.

H7.b Increases in self-efficacy (SE_Inc) is higher with process scaffold than without process scaffold. ***Not supported.***

Table 7.25 shows that while SE_Inc Mean Score for conditions with process scaffold (i.e., 28.683) is lower (i.e., opposite to hypothesis) than conditions without content scaffold (i.e., 30.375), the difference in the group mean scores is not significant (i.e., p= 0.706 is greater than 0.05).

Table 7.25 Students' T Statistic on Increases in Self-Efficacy (PS)

	Mean (N)	Std. Dev.	Variance
PS=N	30.375 (N= 28)	17.654	311.678
PS=Y	28.683 (N= 30)	16.373	268.077
Sum of Squares= 41.446 Mean Square= 41.446 F(.14, 1)= .706			

** indicates ANOVA result is significant with p <= .05.

H7.c There is an interaction effect between content and process scaffolds affecting increases in self-efficacy (SE_Inc). ***Not supported.***

Table 7.26 shows that while SE_Inc Mean Score for conditions with content and process scaffolds (i.e., 32.912) is highest than conditions without both content and

process scaffolds (i.e., 23.154, 31.900, 28.615), the difference in the group mean scores is not significant (i.e., p= 0.421 is greater than 0.05).

Table 7.26 F-Test Statistic on Increases in Self-Efficacy (CS*PS)

	Mean (N)	Std. Dev.	Variance
CS=N PS=N	31.9 (N= 15)	18.385	338.007
CS=Y PS=N	28.615 (N= 13)	17.340	300.673
CS=N PS=Y	23.154 (N= 13)	11.483	131.849
CS=Y PS=Y	32.912 (N= 17)	18.525	343.164
CS*PS	Sum of Squares= 818.013	Mean Square= 272.671	F(.96, 1)= .421
** indicates ANOVA result is significant with p <= .05.			

Summary Of Findings

Although the findings are not significant in this group of hypotheses, a similar trend is observed similar to previous hypotheses (i.e., Quantity of Evidence in Group Report, Interactive Indicators Within A Group, Satisfaction with Group Solution and Discourse, and Satisfaction with Learning Artifact) in that conditions with content scaffold have higher group mean scores than conditions without. The same pattern is observed in conditions with both content and process scaffolds (i.e., this condition has the highest group mean score). However, contrary to previous patterns observed, conditions with process scaffold do not have a higher Increases in Self-Efficacy group mean score.

Self-efficacy has been included in the study as a higher-level learning outcome because it influences future learning outcomes. To the extent the student is able to perform well in this assignment, the student will be able to transfer the skill to future assignments. The lack of significance for Increases in Self-Efficacy is not surprising given the lack of significance in Increases in Test Grade (i.e., hypothesis 1). Until the issue in hypothesis 1 is addressed (i.e., process scaffold confusion), students will not have concrete evidence of success in their test grades. When students have evidence of this success (i.e., improved test grade), their self-efficacy is expected to improve.

7.2 Contextual Analysis

In this section, covariate analysis is performed to determine contextual influences from several variables. (As this is a field experiment, it is not possible to control for all variables by random assignment to the four experimental conditions.) The contextual variables are re-coded to a value of 1 for values below the median; and a value of 2 for values above the median. Table 7.27 shows the re-coded value, range, and percent for each variable. It should be noted that the population is evenly split across the contextual variables with the exception of Class which is two-thirds Undergraduates. As in Section 7.1, the ANOVA statistics (i.e., Student's T, F-ANOVA, and Kruskal-Wallis) are considered significant at p less than or equal to .05.

Table 7.27 Contextual Variables Recoding Table

	Re-coded Value	Range	Percent
Pre-Test	1(Below median)	5.33 to <=10	44.83%
	2(Above median)	>10 to 16	55.17%
GPA	1(Below median)	1 to <=2.4	48.28%
	2(Above median)	>2.4 to 4	51.72%
Learning Approach	1(Below median)	28 to <=45.25	50%
	2(Above median)	>45.25 to 56	50%
Mode	1 (DL)	1 to <=1.5	43.1%
	2 (FTF)	>1.5 to 2	56.9%
Class	1 (Undergrad)	1 to 1	62.07%
	2 (Grad)	2 to 2	37.93%
Major	1 (CIS/IS)	1 to 1	48.28%
	2 (MIS)	2 to 2	51.72%

In the sections that follow, the first table shows the ANOVA results for the hypotheses (i.e., H1- Increases in Group Test Grade, H2- Quantity of Evidence in Group Report, H4- Satisfaction with Group Solution and Discourse, H6- Satisfaction with Learning Artifact, H7- Increases in Self-Efficacy.) by effects (i.e., CS effect, PS effect, and CS*PS interaction effect). It should be noted hypothesis 3 (i.e., Interactive Indicators

Across All Groups) was not tested because of the limited sample size (i.e., twelve groups). Also hypothesis 5 was not tested. The second table shows the means breakdown for each of the four experimental conditions.

7.2.1 Pre-Test

Pre-test scores indicate the potential for learning. If Pre-test score is high, the students have above average mastery of this assignment. Hence, testing for Pre-test score as a contextual variable reveals whether scaffolding needs for above average students are different from below average students on the current assignment. Tables 7.28 shows that results are not significant for Pre-test.

Table 7.28 ANOVA For Pre-Test Grade Contextual

	Effects	Pre-Test= 1	Pre-Test= 2
Group Test Grade	CS	F(1.85,1)= .187	F(.49, 1)= .489
	PS	F(.06, 1)= .802	F(2.20, 1)= .149
	CS*PS	F(1.86, 1)= .186	F(2.08, 1)= .160
Quantity of Evidence in Group Report	CS	K-W(.171, 1)= .680	K-W(1.230, 1)= .268
	PS	K-W(1.335, 1)= .248	K-W(.321, 1)= .571
	CS*PS	N/A	N/A
Satisfaction with Group Solution and Discourse	CS	F(.51, 1)= .481	F (0.21, 1)= .648
	PS	F (1.27, 1)= .272	F (.03, 1)= .866
	CS*PS	F (.58, 1)= .455	F (1.87, 1)= .182
Satisfaction with Learning Artifact	CS	F(.46, 1)= .503	F(.42, 1)= .522
	PS	F(.67, 1)= .423	F(.00, 1)= .967
	CS*PS	F(.85, 1)= .366	F(1.30, 1)= .265
Increase in Self-Efficacy	CS	F(1.12, 1)= .301	F (0.00, 1)= .996
	PS	F (.05, 1)= .830	F (.730, 1)= .402
	CS*PS	F (3.78, 1)= .065	F (.150, 1)= .700
** indicates Anova result is significant with p <= .05.			

Table 7.29 Means Breakdown For Pre-Test Grade Contextual

	Conditions	Pre-Test= 1	Pre-Test= 2
Group Test Grade	CS=N PS=N	4.167+	.793
	CS=Y PS=N	2.084	15.586++
	CS=N PS=Y	-3.30	3.334+
	CS=Y PS=Y	20.834++	-1.010
Quantity of Evidence in Group Report	CS=N PS=N	14.250+	16.643
	CS=Y PS=N	6.625	17.444++
	CS=N PS=Y	13.688	12.700
	CS=Y PS=Y	16.833++	17.364+
Satisfaction with Group Solution and Discourse	CS=N PS=N	24.563	36.714+
	CS=Y PS=N	13.5	31.722
	CS=N PS=Y	28.0++	24.90
	CS=Y PS=Y	27.0+	37.045++
Satisfaction with Learning Artifact	CS=N PS=N	552.003	595.988+
	CS=Y PS=N	420.424	573.192
	CS=N PS=Y	559.224+	514.8
	CS=Y PS=Y	563.389++	617.458++
Increase in Self-Efficacy	CS=N PS=N	31.188+	32.714++
	CS=Y PS=N	22.75	31.222+
	CS=N PS=Y	22.125	24.8
	CS=Y PS=Y	41.917++	28

++ indicates highest mean. + indicates second highest mean.

7.2.2 GPA

GPA indicates the historical achievement level of the student. If GPA is high, the students is most likely a high-achiever. Hence, testing for GPA as a contextual variable reveals whether scaffolding needs for high-achieving students are different from other students. While this is almost the same as the Pre-Test variable, GPA indicates historical achievement whereas Pre-Test indicates achievement in the current assignment.

Tables 7.30 and 7.31 show that:

-students with higher GPAs achieved significantly higher Quantity of Evidence in Group Report with no process scaffold (p= .025).

-students with lower GPAs achieved significantly higher a) Increases in Group Test Grade with concept scaffold (p=.010); and b) Satisfaction with Group Solution and Discourse with both scaffolds or no scaffold.

These results suggest that students with low GPAs were able to benefit from concept scaffold as evidenced by Increases in Group Test Grade and Satisfaction with

Group Solution and Discourse. However, for students with high GPAs, it appears no scaffolding was needed for Quantity of Evidence in Group Report. While the last sentence may seem perplexing, students with highGPAs are high achievers, so they will compensate with extra effort without scaffolding to achieve good results. Also, since Quantity of Evidence in Group Report has a ceiling effect, the latter result may be suspect.

Table 7.30 ANOVA For GPA Contextual

	Effects	GPA= 1	GPA= 2
Increase in Group Test Grade	CS	F(7.89,1)= .010**	F(.32, 1)= .576
	PS	F(0.00, 1)= .987	F(1.59, 1)= .219
	CS*PS	F(.30, 1)= .592	F(.15, 1)= .705
Quantity of Evidence in Group Report	CS	K-W(1.09, 1)= .296	K-W(.298, 1)= .585
	PS	K-W(1.985, 1)= .159	K-W(5.048, 1)= .025**
	CS*PS	N/A	N/A
Satisfaction with Group Solution and Discourse	CS	F(.73, 1)= .403	F (.09, 1)= .772
	PS	F (.06, 1)= .809	F (.11, 1)= .743
	CS*PS	F (10.52, 1)= .004**	F (.66, 1)= .423
Satisfaction with Learning Artifact	CS	F(.00, 1)= .955	F(.09, 1)= .766
	PS	F(.16, 1)= .697	F(.09, 1)= .765
	CS*PS	F(3.09, 1)= .091	F(.01, 1)= .939
Increase in Self-Efficacy	CS	F(.19, 1)= .694	F (.31, 1)= .583
	PS	F (.08, 1)= .783	F (.19, 1)= .669
	CS*PS	F (3.60, 1)= .070	F (.09, 1)= .766
** indicates Anova result is significant with p <= .05.			

Table 7.31 Means Breakdown For GPA Contextual

	Conditions	GPA= 1	GPA= 2
Increase in Group Test Grade	CS=N PS=N	-9.722	16.666++
	CS=Y PS=N	6.019+	16.071+
	CS=N PS=Y	-13.658	10.317
	CS=Y PS=Y	9.722++	4.012
Quantity of Evidence in Group Report	CS=N PS=N	13.437+	18.000++
	CS=Y PS=N	11.083	18.00++
	CS=N PS=Y	12.333	11.786
	CS=Y PS=Y	19.750++	14.500
Satisfaction with Group Solution and Discourse	CS=N PS=N	28.813+	31.857
	CS=Y PS=N	15.5	35.214+
	CS=N PS=Y	12.417	39.143++
	CS=Y PS=Y	34.563++	32.556
Satisfaction with Learning Artifact	CS=N PS=N	578.365+	565.861
	CS=Y PS=N	455.634	586.660
	CS=N PS=Y	488.834	587.826+
	CS=Y PS=Y	596.834++	599.744++
Increase in Self-Efficacy	CS=N PS=N	30.438++	33.571
	CS=Y PS=N	21.0	35.143+
	CS=N PS=Y	16.417	28.929
	CS=Y PS=Y	31.438++	34.222++

++ indicates highest mean. + indicates second highest mean.

7.2.3 Learning Approach (LA)

Learning Approach indicates the learner's preferred learning style on a scale from "surface" to "deep" learning. "Surface" learners are pre-disposed to memorization; whereas "deep" learners strive to synthesize/analyze. Hence, testing for Learning Approach as a contextual variable reveals whether scaffolding needs for students with various learning styles are different.

Tables 7.32 and 7.33 reveal that:

-students with synthesis/analysis learning style: a)achieved higher Increases in Group Test Grade with content scaffold (p= .035); and b) achieved higher Quantity of Evidence in Group Report with content scaffold (p= .045).

These results suggest the content scaffold was able to benefit students with synthesis/analysis learning style more than other students as evidenced by Increases in Group Test Grade and Quantity of Evidence in Group Report.

Table 7.32 ANOVA For Learning Approach Contextual

	Effects	LA= 1	LA= 2
Increase in Group Test Grade	CS	F(.03,1)= .870	F(4.99, 1)= .035**
	PS	F(1.19)= .286	F(.02, 1)= .893
	CS*PS	F(.84, 1)= .368	F(1.64, 1)= .213
Quantity of Evidence in Group Report	CS	K-W(.536, 1)= .816	K-W(4.015, 1)= .045**
	PS	K-W(.305, 1)= .581	K-W(.453, 1)= .501
	CS*PS	N/A	N/A
Satisfaction with Group Solution and Discourse	CS	F(.22, 1)= .641	F (.22, 1)= .643
	PS	F (.22, 1)= .642	F (.07, 1)= .800
	CS*PS	F (.46, 1)= .501	F (1.32, 1)= .262
Satisfaction with Learning Artifact	CS	F(1.75, 1)= .198	F(.89, 1)= .354
	PS	F (.51, 1)= .482	F(.03, 1)= .854
	CS*PS	F (.76, 1)= .391	F(1.06, 1)= .313
Increase in Self-Efficacy	CS	F (1.00, 1)= .328	F(.05, 1)= .834
	PS	F (.07, 1)= .799	F (.50, 1)= .488
	CS*PS	F (1.74, 1)= .198	F (.52, 1)= .479
** indicates Anova result is significant with p <= .05.			

Table 7.33 Means Breakdown For Learning Approach Contextual

	Conditions	LA= 1	LA= 2
Increase in Group Test Grade	CS=N PS=N	12.500++	-8.730
	CS=Y PS=N	6.077+	19.998++
	CS=N PS=Y	-4.166	1.388
	CS=Y PS=Y	3.703	10.070+
Quantity of Evidence in Group Report	CS=N PS=N	16.313+	13.571
	CS=Y PS=N	13.188	18.000++
	CS=N PS=Y	13.200	11.188
	CS=Y PS=Y	18.111++	16.438+
Satisfaction with Group Solution and Discourse	CS=N PS=N	22.938+	38.571+
	CS=Y PS=N	21.625	33.3
	CS=N PS=Y	20.9	30.5
	CS=Y PS=Y	28.111++	39.563++
Satisfaction with Learning Artifact	CS=N PS=N	509.826	644.190++
	CS=Y PS=N	535.317	511.578
	CS=N PS=Y	491.224	573.960+
	CS=Y PS=Y	622.695++	571.014
Increase in Self-Efficacy	CS=N PS=N	32.438+	31.286++
	CS=Y PS=N	31	24.8
	CS=N PS=Y	24.4	22.375
	CS=Y PS=Y	39.611++	25.375+
++ indicates highest mean. + indicates second highest mean.			

7.2.4 Mode

Mode indicates whether the student is Distance Learning (DL) or Face-to-face (FTF). For the purpose of the study, FTF is interpreted as blended learning since the study required students to be online. For students in FTF classes, the students might have met in class

and have had other opportunities to interact besides WebBoard. Hence, testing for mode as a contextual variable reveals whether scaffolding needs for students who are completely virtual are different from other students.

Tables 7.34 and 7.35 show that:

-FTF students achieved significantly higher Increases in Group Test Grade with concept scaffold (p=.013).

One explanation for the significantly higher Group Test Grade with concept scaffold for FTF students is the ability to communicate outside of WebBoard on other assignments. This might have enhanced the communication process and enabled better test results.

Table 7.34 ANOVA For Mode Contextual

	Effects	Mode= DL	Mode= FTF
Increase in Group Test Grade	CS	F(.41,1)= .527	F(7.00, 1)= .013**
	PS	F(.88, 1)= .359	F(.60, 1)= .444
	CS*PS	F(.85, 1)= .366	F(1.93, 1)= .176
Quantity of Evidence in Group Report	CS	K-W(.317, 1)= .574	K-W(3.237, 1)= .072
	PS	K-W(.479, 1)= .489	K-W(1.490, 1)= .222
	CS*PS	N/A	N/A
Satisfaction with Group Solution and Discourse	CS	F(.23, 1)= .635	F (.49, 1)= .492
	PS	F (.76, 1)= .395	F (1.78, 1)= .192
	CS*PS	F (2.52, 1)= .127	F (1.55, 1)= .223
Satisfaction with Learning Artifact	CS	F(.38, 1)= .545	F(1.02, 1)= .321
	PS	F (.60, 1)= .446	F(.01, 1)= .937
	CS*PS	F (.52, 3)= .480	F(.28, 1)= .560
Increase in Self-Efficacy	CS	F(.13, 1)= .725	F (1.28, 1)= .268
	PS	F (.02, 1)= .894	F (.01, 1)= .941
	CS*PS	F (1.79, 1)= .195	F (.77, 1)= .387
** indicates Anova result is significant with p <= .05.			

Table 7.35 Means Breakdown For Mode Contextual

	Conditions	Mode= DL	Mode= FTF
Increase in Group Test Grade	CS=N PS=N	9.027+	-4.762
	CS=Y PS=N	7.449	33.333++
	CS=N PS=Y	9.26++	-3.751
	CS=Y PS=Y	-11.111	10.516+
Quantity of Evidence in Group Report	CS=N PS=N	15.313++	13.571
	CS=Y PS=N	12.136	16.0+
	CS=N PS=Y	9.667	15.10
	CS=Y PS=Y	13.333+	20.214++
Satisfaction with Group Solution and Discourse	CS=N PS=N	37.75+	21.643
	CS=Y PS=N	29.364	8.25
	CS=N PS=Y	32.00	25.25+
	CS=Y PS=Y	47.00++	30.607++
Satisfaction with Learning Artifact	CS=N PS=N	602.194	538.627+
	CS=Y PS=N	524.836	533.611
	CS=N PS=Y	604.963+	523.290
	CS=Y PS=Y	660.852++	584.987++
Increase in Self-Efficacy	CS=N PS=N	37.688+	25.286+
	CS=Y PS=N	29.955	21.25
	CS=N PS=Y	27.5	21.85
	CS=Y PS=Y	41.5++	31.071++

++ indicates highest mean. + indicates second highest mean.

7.2.5 Year

Year indicates whether the student is an undergraduate or a graduate. Undergraduate students have been found to be lacking in motivation compared to graduate students. Hence, testing for Year as a contextual variable reveals whether the scaffolds are equally effective for populations with varying levels of motivation.

Tables 7.36 and 7.37 show that:

-graduate students achieved significantly higher Satisfaction with Group Solution and Discourse with process scaffold (p=.05**).

It should be noted that process scaffold appeared to be effective for graduate students and not for undergraduate students in improving Satisfaction with Group Solution and Discourse. One explanation process scaffold did not increase Satisfaction with Group Solution and Discourse for undergraduate students is its text-based format, which required much effort to read. Being undergraduates, the process scaffold was

probably not used or not used as intended. (The issue with undergraduates and, particularly undergraduate motivation, is addressed in more detail in Section 8.2.2.)

Table 7.36 ANOVA For Year Contextual

	Effects	Year= Undergrad	Year= Grad
Increase in Group Test Grade	CS	F(3.34,1)= .077	F(.14, 1)= .712
	PS	F(.19, 1)= .666	F(1.17, 1)= .293
	CS*PS	F(.12, 1)= .734	F(.36, 1)= .555
Quantity of Evidence in Group Report	CS	K-W(.302, 1)= .583	K-W(2.335, 1)= .127
	PS	K-W(.026, 1)= .873	K-W(.428, 1)= .513
	CS*PS	N/A	N/A
Satisfaction with Group Solution and Discourse	CS	F(.06, 1)= .802	F (.30, 1)= .588
	PS	F (1.38, 1)= .248	F (4.36, 1)= .05**
	CS*PS	F (1.53, 1)= .225	F (19, 3)= .669
Satisfaction with Learning Artifact	CS	F(.53, 1)= ..472	F(.60, 1)= .450
	PS	F (.00, 1)= .949	F(.02, 1)= .877
	CS*PS	F (.52, 1)= .476	F(2.12, 1)= .163
Increase in Self-Efficacy	CS	F(2.19, 1)= .148	F(.44, 1)= .513
	PS	F(.98, 1)= .330	F(.11, 1)= .747
	CS*PS	F(1.86, 1)= .182	F(1.34, 1)= .263
** indicates Anova result is significant with p <= .05.			

Table 7.37 Means Breakdown For Year Contextual

	Conditions	Year= Undergrad	Year= Grad
Increase in Group Test Grade	CS=N PS=N	-2.222	12.221+
	CS=Y PS=N	9.861++	16.666++
	CS=N PS=Y	-8.532	8.333
	CS=Y PS=Y	8.951+	4.166
Quantity of Evidence in Group Report	CS=N PS=N	18.950+	11.40
	CS=Y PS=N	17.600	14.00++
	CS=N PS=Y	15.643	8.75
	CS=Y PS=Y	21.222++	12.688+
Satisfaction with Group Solution and Discourse	CS=N PS=N	29.85++	31
	CS=Y PS=N	25.35+	28.667
	CS=N PS=Y	15.214	40.333+
	CS=Y PS=Y	25.222	42.812++
Satisfaction with Learning Artifact	CS=N PS=N	241.171++	112.115
	CS=Y PS=N	185.254+	166.801++
	CS=N PS=Y	115.946	116.482+
	CS=Y PS=Y	97.349	112.323
Increase in Self-Efficacy	CS=N PS=N	28.95	37.8++
	CS=Y PS=N	30.8+	21.333
	CS=N PS=Y	15.143	32.5
	CS=Y PS=Y	32.389++	33.5+
++ indicates highest mean. + indicates second highest mean.			

7.2.6 Major

Major indicates whether the student is from the College of Computing Sciences (i.e., Computer Science CS or Information Systems IS) or from the School of Business (i.e., Management of Information Systems MIS). The student's major as a contextual variable reveals whether scaffolding needs for technology versus management students are different.

Tables 7.38 and 7.39 reveal that there are no significant differences in results based on a student's major.

Table 7.38 ANOVA For Major Contextual

	Effects	Major= CIS/IS	Major= MIS
Increase in Group Test Grade	CS	F(.58,1)= .454	F(1.36, 1)= .253
	PS	F(.64, 1)= .430	F(.11, 1)= .741
	CS*PS	F(.36, 1)= .555	F(.08, 1)= .777
Quantity of Evidence in Group Report	CS	K-W(.179, 1)= .672	K-W(1.443, 1)= .230
	PS	K-W(.015, 1)= .902	K-W(.005, 1)= .944
	CS*PS	N/A	N/A
Satisfaction with Group Solution and Discourse	CS	F(.05, 1)= .818	F (.47, 1)= .500
	PS	F (.14, 1)= .708	F (.59, 1)= .449
	CS*PS	F (.07, 1)= .791	F (3.36, 1)= .078
Satisfaction with Learning Artifact	CS	F(0., 001)= .958	F(.09, 1)= .761
	PS	F (.69, 1)= .414	F(1.32, 1)= .261
	CS*PS	F (.45, 3)= .510	F(.75, 1)= .396
Increase in Self-Efficacy	CS	F(.23, 1)= .635	F (.26, 1)= .612
	PS	F (.31, 1)= .581	F (1.49, 1)= .233
	CS*PS	F (2.05, 1)= .165	F (.64, 1)= .433
** indicates Anova result is significant with p <= .05.			

Table 7.39 Means Breakdown For Major Contextual

	Conditions	Major= CIS/IS	Major= MIS
Increase in Group Test Grade	CS=N PS=N	4.364	1.402
	CS=Y PS=N	18.055++	8.487++
	CS=N PS=Y	2.182	-4.168
	CS=Y PS=Y	5.833+	7.936+
Quantity of Evidence in Group Report	CS=N PS=N	13.786	16.188+
	CS=Y PS=N	15.250++	14.722
	CS=N PS=Y	14.214	10.250
	CS=Y PS=Y	14.900+	20.214++
Satisfaction with Group Solution and Discourse	CS=N PS=N	26.429	33.563+
	CS=Y PS=N	22.125	27.889
	CS=N PS=Y	27.357++	26.167
	CS=Y PS=Y	26.7+	43.214++
Satisfaction with Learning Artifact	CS=N PS=N	615.464++	534.962
	CS=Y PS=N	576.167+	503.973
	CS=N PS=Y	535.199	550.233+
	CS=Y PS=Y	571.058	637.398++
Increase in Self-Efficacy	CS=N PS=N	29.643+	33.875++
	CS=Y PS=N	19.0	32.889+
	CS=N PS=Y	24.214	21.917
	CS=Y PS=Y	34.85++	30.142

++ indicates highest mean. + indicates second highest mean.

7.2.7 Contextual Analysis Summary

It should be noted that the Means Breakdown Tables 7.29 (Pre-Test), 7.31 (GPA), 7.33 (Learning Approach), 7.35 (Mode), 7.37 (Year) and 7.39 (Major) show a highly consistent pattern of highest means for the [CS=N PS=N] and [CS=Y PS=Y] conditions. This suggests that results are highest either without scaffolding or with both scaffolding. While the experimenter would have liked to see [CS=Y PS=N] condition in the top conditions list along with [CS=Y PS=Y], she realizes that the matrix concept scaffold manipulation had been confounded by the PowerPoint slides. On the other hand, it is encouraging that the [CS=Y PS=Y] condition appears to outperform the process scaffold only or content scaffold only conditions. This suggests that the process scaffold enabled assimilation of the content scaffold and is worth exploring in future research.

7.3 Learning Approach as an Intervening Variable

Learning approach (see Figure 1.1) indicates the ability of the students to glean organization from a unit of material as well as to organize it. The Learning Approach scale measures student's ability to adopt a "surface" versus a "deep" learning style. "Surface" learning is characterized by memorization, where as "deep" learning is characterized by synthesis/analysis and retention. If there is a significant difference in the Learning Approach among the conditions, the conditions with predominantly "deep" learners may be biased towards better learning outcomes as the study required synthesis/analysis. Table 7.40 indicates that an analysis of variance of Learning Approach means for the main effects (i.e., p= .465 for CS, p= .442 for PS) as well as the interaction effects (i.e., p= .641) is not significant (i.e., p is not less or equal to .05).

Table 7.40 F-Test Statistic on Learning Approach (CS, PS, CS*PS)

	Mean (N)	Std. Dev.	Variance
CS=N	29.884(28)	3.840	14.748
CS=Y	29.067(30)	4.465	19.933
PS=N	29.063(28)	4.738	22.447
PS=Y	29.834(30)	3.578	12.801
CS=N PS=N	29.306 (N= 15)	4.415	17.263
CS=Y PS=N	28.782 (N= 13)	5.496	30.206
CS=N PS=Y	30.552 (N= 13)	3.485	12.142
CS=Y PS=Y	29.285 (N= 17)	3.655	13.357
CS	Sum of Squares= 9.682 Mean Square= 9.682 F(.54, 1)= .465		
PS	Sum of Squares= 10.696 Mean Square= 10.696 F(.60, 1)= .442		
CS*PS	Sum of Squares= 1.973 Mean Square= 1.973 F(.11, 1)= .741		

7.4 Correlation Statistics

This section analyses the correlation among the variables. Specifically, the dependent, intervening and covariate variables are examined. Correlation is the measure of association between variables. The statistic varies between –1 (i.e., as X gets larger, Y gets smaller) and 1 (i.e., as X gets larger, Y gets larger). The analysis of correlation

between variables is an important analysis regardless whether study results achieved significance. Barring any issues of validity inherent in the study design, correlation between variables may provide general trends which might have escaped the experimenter in the design of the study. Hence, these results provide a higher perspective which may be leveraged to guide future research direction.

Table 7.41 shows Pearson's correlation statistic for the 'dependent' (i.e., Increases in Group Test Grade, Quantity of Evidence in Group Report, Satisfaction with Group Solution and Discourse, Satisfaction with Learning Approach, Increase with Self-Efficacy), 'intervening' (Learning Approach) and 'covariate' (Pre-test, GPA) and mental effort (Mental Effort) variables. The covariates Mode, Year and Major are excluded as they are dichotomous and hence can not be analysed with Pearson's R. Table 7.41 represents results from the 58 groups (i.e., full sample), while Table 7.42 represents results from the 12 discourse groups used for content analysis. The second analysis was done to analyze correlation between Interactive Indicators Across All Groups and the 'dependent' variables using Kendall's Tau-b which is more suited to discrete values as the sample size of twelve (groups) is limited. As in Sections 7.1 and 7.2, the discussion below draws attention to the Pearson's R statistic with $p <= .05$. Assuming 'small' to 'medium' size effects, Cohen (1988) estimated that with a sample size of 58, as in this study, the statistical power (or likelihood) of Pearson's R for $p = .05$ is less than .15 for 'small' effects and between .60 - .70 for 'medium' effects.

Table 7.41 Pearson's Correlations on Full Sample

	TestConst	GpRptEv	SGSD	SLA	SE_Inc	LA	PreTest	GPA	ME
TestConst	1.00	.399 .002**	.135 .311	.166 .213	.111 .409	-0.088 .509	-.168 .208	.301 .022**	.099 .460
GpRptEv		1.00	.401 .002**	.343 .009**	.166 .212	.207 .118	.409 .001**	.481 .0001**	-.012 .926
SGSD			1.00	.396 .002*	.332 .011**	.497 <.0001**	.294 .025**	.332 .011**	.109 .414
SLA				1.00	.445 .0005**	.025 .855	.213 .108	.265 .045**	.1601 .228
SE_Inc					1.00	-.180 .176	.030 .822	.241 .068	.058 .667
LA						1.00	.244 .065	.406 .001**	.693 .606
PreTest							1.00	.425 .001**	-.038 .778
GPA								1.00	.012 .928
ME									1.00
** indicates Correlation result is significant with p <= .05.									

Key:

TestConstruct= Group Test Grade GpRptEv= Quantity of Evidence in Group Report

SGSD= Satisfaction with Group Solution and DiscourseSLA= Satisfaction with Learning Artifact

SE_Inc= Increase in Self-Efficacy LA= Learning Approach

Pre-Test= Pre-test Grade GPA= Grade Point Average

ME= Mental Effort

Table 7.42 Kendall's Tau-b on Twelve Group Sample

	TestConst	GpRptEv	SGSD	SLA	SE_Inc	IntIndConst	IntInd%	Adm%
TestConst	1.00	.593 .018**	.388 .084	-.092 .679	.032 .889	.049 .833	.092 .679	-.326 .147
GpRptEv		1.00	.408 .101	.270 .275	.232 .358	.285 .265	.180 .467	-.408 .101
SGSD			1.00	.199 .372	.410 .071	.549 .017**	.137 .536	-.123 .581
SLA				1.00	.469 .038**	.529 .021**	.303 .172	-.229 .303
SE_Inc					1.00	.413 .076	.437 .052	-.362 .110
LA						-.272 .233	.030 .891	.168 .450
IntIndConst						1.00	.160 .944	-.032 .888
IntInd%							1.00	-.626 .005**
Adm%								1.00

** indicates Correlation result is significant with p <= .05.

Key:

TestConstruct= Group Test Grade GpRptEv= Quantity of Evidence in Group Report

SGSD= Satisfaction with Group Solution and DiscourseSLA= Satisfaction with Learning Artifact

SE_Inc= Increase in Self-Efficacy ME= Mental Effort

IntIndConst= Interactive Indicators Across All GroupsIntInd%= Interactive Indicators Within A Group

Adm%= Administration Within A Group

Figure 7.3 provides a visual perspective of the significant correlations achieved in Table 7.41 without GPA. Figure 7.4 provides a visual perspective of the significant correlations achieved with GPA (also from Table 7.41). The results with GPA are placed on a separate visual because it is positively correlated with almost all of the research variables and would hide the relationships in Figure 7.3 if placed on the same visual.

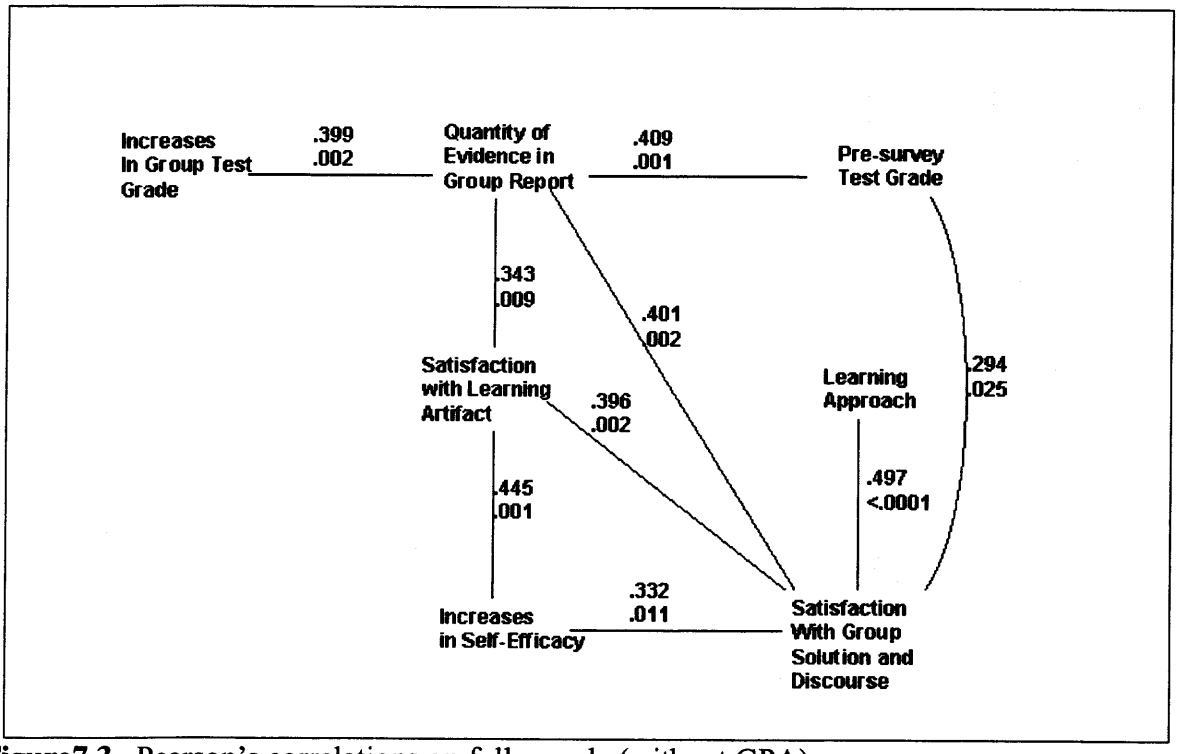


Figure7.3 Pearson's correlations on full sample (without GPA).

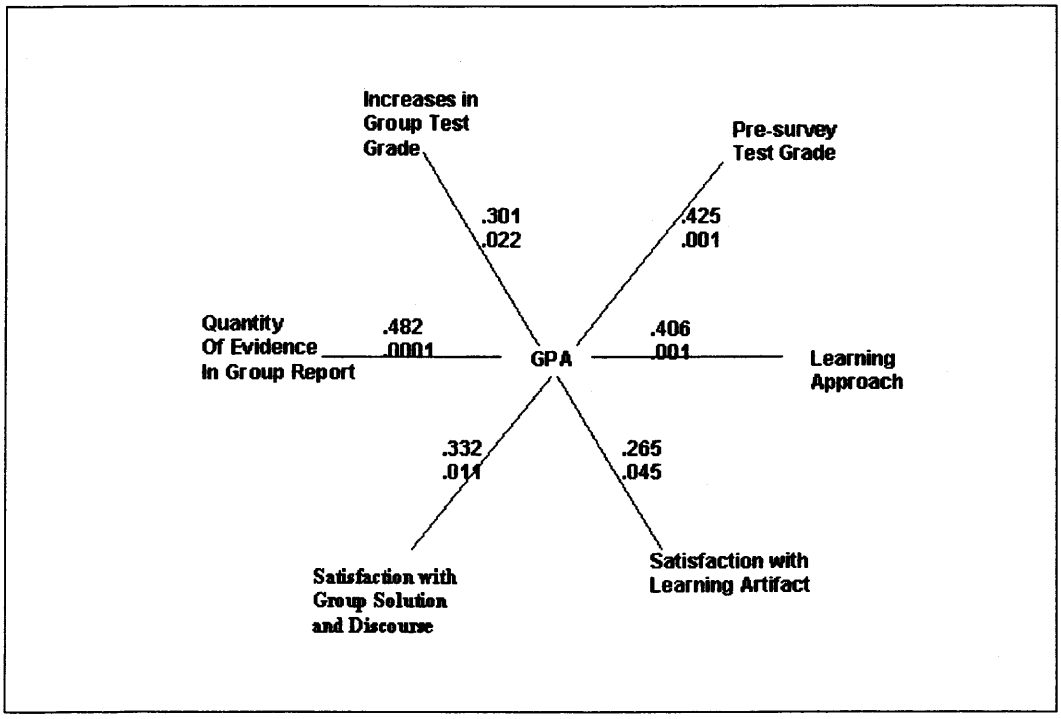


Figure 7.4 Pearson's correlations on full sample (GPA only).

Since GPA was correlated to most of the variables (see Figure 7.4), the possibility exists that the other variables were correlated to each other because of a common covariance with GPA. To remove the common effect of GPA, partial correlations among the variables were performed. Table 7.43 shows the results of the partial correlations. Correspondingly, Figure 7.5 shows a visual perspective of the significant partial correlations from Table 7.43.

Table 7.43 Partial (GPA) Correlations on Full Sample

	TestConst	GpRptEv	SGSD	SLA	SE_Inc	LA	PreTest	ME
TestConst	1.00	.305 .021**	.040 .769	.094 .485	.041 .761	-.241 .071	-.342 .009**	.100 .459
GpRptEv		1.00	.291 .028**	.255 .056	.059 .663	.015 .912	.257 .053	-.021 .878
SGSD			1.00	.339 .010**	.275 .038**	.420 .001**	.179 .183	.112 .409
SLA				1.00	.407 .002**	-.094 .488	.116 .391	.163 .225
SE_Inc					1.00	-.313 .018**	-.082 .544	.056 .677
LA						1.00	.087 .520	.070 .603
PreTest							1.00	-.048 .725
ME								1.00

** indicates Correlation result is significant with p <= .05.

Key:

TestConstruct= Group Test Grade GpRptEv= Quantity of Evidence in Group Report

SGSD= Satisfaction with Group Solution and DiscourseSLA= Satisfaction with Learning Artifact

SE_Inc= Increase in Self-Efficacy LA= Learning Approach

Pre-Test= Pre-test Grade

ME= Mental Effort

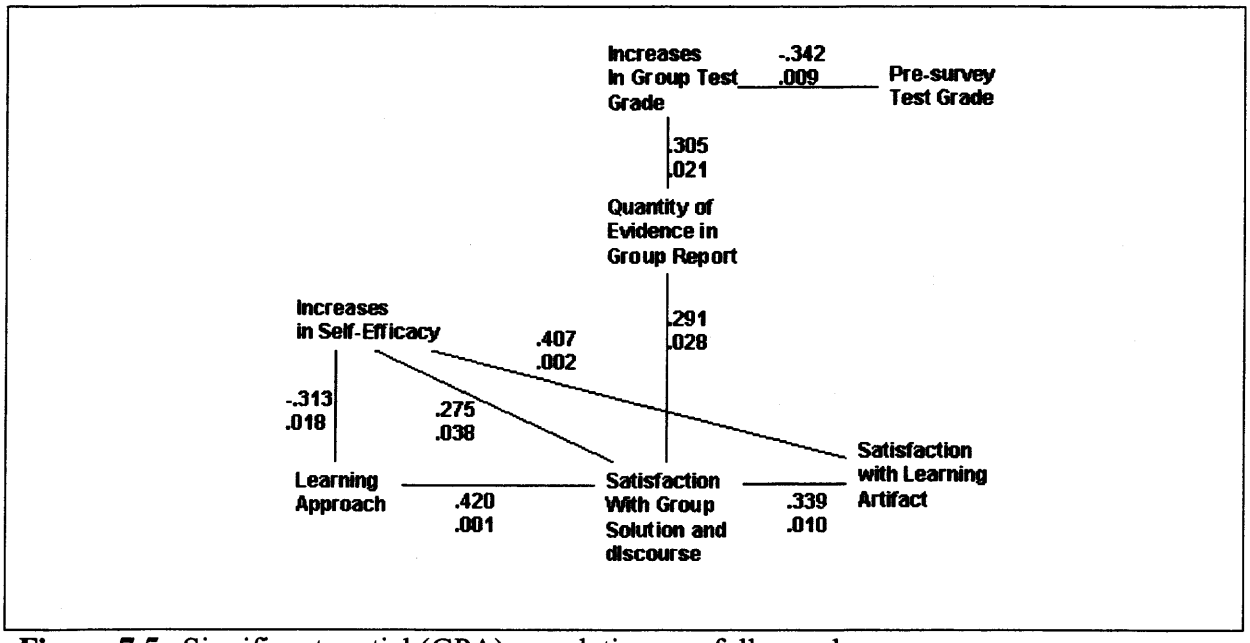


Figure 7.5 Significant partial (GPA) correlations on full sample.

Significant findings guiding the interpretation[11] of Tables 7.41, 7.42 and 7.43 are as follows:

a) a positive correlation (.549, p<= .05) exists between Interactive Indicators Across All Groups IntIndConst, and Satisfaction with Group Solution and Discourse SGSD. (See Table 7.42.)

b) significant positive correlations, albeit to varying degrees from .275 to .407, exist among the variables Increases in Group Test Grade, Quantity of Evidence in Group Report, Satisfaction with Group Solution and Discourse, Satisfaction with Learning Artifact and Increases in Self-Efficacy (p <= .05). (See Table 7.43.)

c) a positive correlation (.420, p <= .05) exists between Satisfaction with Group Solution and Discourse SGSD, and Learning Approach LA. (See Table 7.43.)

d) significant positive correlations, ranging from .265 to .482, exist between GPA and these variables: Increases in group Test Grade, Quantity of Evidence in Group Report, Satisfaction with Group Solution and Discourse, Satisfaction with Learning Artifact, Learning Approach and Pre-survey Test Grade (p <= .05). (See Table 7.41.)

Returning to the research model in Figure 3.2, the correlations suggest general trends that support parts of the research model. Assuming an effective operationalisation

[11] The interpretation makes use of inductive logic from mathematics which states if A increases as B increases, and B increases as C increases, then A increases as C increases.

of a content scaffold manipulation that increases Satisfaction with Learning Artifact, and an effective operationalisation of a process scaffold manipulation that increases Interactive Indicators Across All Groups, results a) and b) predict a corresponding increase in Increases in Group Test Grade, Quantity of Evidence in Group Report, Satisfaction with Group Solution and Discourse and Increases in Self-Efficacy as both Satisfaction with Learning Artifact and Interactive Indicators Across All Groups are positively correlated with these variables (see last footnote). (Note: The full implication of this trend is discussed in detail in Section 8.1 of the conclusion of the thesis.)

In addition to the results mentioned above, it should be noted that a negative correlation (-.342, $p <= .05$) exists between Increases In Group Test Grade and Pre-survey Test Grade (See Table 7.43.). One explanation for this is students who did poorly on the Pre-survey Test Grade took this as a wake up call and increased their efforts which ultimately paid off in Increases in Individual Test Grade (and corresponding Increases in Group Test Grade).

However, the implications for Learning Approach (LA) appear perplexing. While result c) predicts a positive correlation between LA and Satisfaction With Group Solution and dIsCourse which is positively correlated to the rest of the research model's dependent variables (see result b)), a negative correlation (-.313, $p <= .05$) exists between Increases in Self-Efficacy and Learning Approach (See Table 7.4.3). One explanation for this dichotomy is while students with Synthesis-Analysis LA did well on the assignment, their self-perception of their ability to perform well on similar assignments in the future actually decreased. (The lack of correlation between actual and perceived student achievement is a known concern in education (personal conversation with Dr. Ruiz-

Primo, 2005).) One explanation for a lower self-perception is awareness of a new experience which required getting used to.

7.5 Mental Effort

In addition to Learning Approach, another potential intervening variable is mental effort. Mental effort refers to the cognitive capacity allocated to meet problem requirements. As working memory is limited (Sweller, van Merrienboer and Paas, 1992), learning tasks requiring less mental effort results in same or better learning. (Although results may be the same, less mental effort is more 'efficient' learning.)

In the study, if either concept scaffold or process scaffold required additional mental effort, then conditions with one/both scaffolds would have required more/less mental effort which would have biased learning outcomes. As can be seen from results of the F-Statistic on Mental Effort (Table 7.44), while conditions with PS main effect did not have significant differences in mental effort, conditions with CS main effect had differences that are significant (i.e., p= .049 is less than .05). Interestingly, the conditions without concept scaffold had a higher mental effort (i.e., 19.973) than conditions with concept scaffold (i.e., 18.339). This is evidence that the concept scaffold was reducing mental effort and functioning as a learning aid rather than increasing the cognitive load. In addition, no cognitive overload was found in conditions where both scaffolds were applied (i.e., p= .177 is not less than or equal .05). This wa a major concern of the study.

Table 7.44 F-Test Statistic on Mental Effort (CS, PS, CS*PS)

	Mean (N)	Std. Dev.	Variance
CS=N	19.973(28)	2.939	8.636
CS=Y	18.339(30)	3.207	10.283
PS=N	19.068(28)	3.675	13.504
PS=Y	19.183(30)	2.660	7.078
CS=N PS=N	20.372 (N= 15)	3.499	12.241
CS=Y PS=N	17.564 (N= 13)	3.395	11.526
CS=N PS=Y	19.513 (N= 13)	2.173	4.721
CS=Y PS=Y	18.931 (N= 17)	3.022	9.132
CS	Sum of Squares= 38.684 Mean Square= 38.684	F(4.08, 1)= .049**	
PS	Sum of Squares= 1.166 Mean Square= 1.166	F(.12, 1)= .727	
CS*PS	Sum of Squares= 17.749 Mean Square= 17.749	F(1.87, 1)= .177	

Drilling down, the next question is whether a lower Mental Effort showed any significant differences in means compared to higher Mental Effort for CS main effect. Tables 7.45 and 7.46 analyze Mental Effort as a covariate for CS main effect. (PS main effect, and CS*PS interaction effects were not analyzed as no significant differences were found for Mental Effort.) Following the algorithm used for covariates in Section 7.2, Mental Effort was coded into two values: a value of 1 indicates Mental Effort below the median while a value of 2 indicates Mental Effort above the median.

It should be noted that Mental Effort as a covariate did not achieve any significant differences in means among groups with/without concept scaffolds.

Table 7.45 ANOVA For Mental Effort Covariate (CS)

	Effects	ME= 1	ME= 2
Increases in Group Test Grade	CS	F(.04,1)= .842	F(3.38, 1)= .078
Quantity of Evidence in Group Report	CS	K-W(1.016, 1)= .314	K-W(.394, 1)= .530
Satisfaction with Group Solution and Discourse	CS	F(.03, 1)= .863	F (.10, 1)= .752
Satisfaction with Learning Artifact	CS	F(1.06, 1)= .312	F(.26, 1)= .616
Increases in Self-Efficacy	CS	F(.14, 1)= .715	F (.33, 1)= .573
** indicates Anova result is significant with p <= .05.			

Table 7.46 Means Breakdown For Mental Effort Covariate (CS)

	Conditions	ME= 1	ME= 2
Increases in Group Test Grade	CS=N	3.661+	-6.54+
	CS=Y	5.246++	14.005++
Quantity of Evidence in Group Report	CS=N	13.723+	14.294+
	CS=Y	16.056++	16.000++
Satisfaction with Group Solution and Discourse	CS=N	28.955+	28.441+
	CS=Y	30.139++	30.542++
Satisfaction with Learning Artifact	CS=N	509.475+	590.089++
	CS=Y	572.706++	558.674+
Increases in Self-Efficacy	CS=N	28.636+	27.324+
	CS=Y	31.389++	30.542++
++ indicates highest mean. + indicates second highest mean.			

A final set of analysis (see Table 7.47) was performed to determine if learning outcomes were significantly different for Mental Effort as an intervening variable. That is, did lower Mental Effort result in better learning outcomes compared to higher Mental Effort overall? While this analysis did not result in any significant findings it confirmed the fact that cognitive overload (which manifests as higher Mental Effort and lower learning outcomes) did not occur in the study. This is an important finding as cognitive overload was a major concern going into the study, especially for conditions with both scaffolds.

Table 7.47 ANOVA on Mental Effort as Intervening Variable

	Mean (ME= 1)	Mean (ME= 2)	Significance
Group Test Grade	4.645(29)+	5.412(29)++	F(.02, 1)= .890
Quantity of Evidence in Group Report	29.690(29)++	29.310(29)+	K-W(.010, 1)= .920
Satisfaction with Group Solution and Discourse	29.690(29)++	29.310(29)+	F(.01, 1)= .933
Satisfaction with Learning Artifact	548.722(29)+	577.090(29)++	F(.45, 1)= .506
Increase in Self-Efficacy	30.345(29)++	28.655(29)+	F(.14,1)= .707
++ indicates highest mean. + indicates second highest mean.			

7.6 Qualitative Analysis

In this section of the thesis, recurring comments from an open-ended question[12] in the post-survey are listed. The purpose of reviewing the comments is to obtain validation whether the content and process scaffolds were effective, and whether the students felt they learned during discourse. Tables 7.48, 7.49 and 7.50 list comments regarding the content scaffold, process scaffold and discourse respectively.

Regarding the concept scaffold, students found the learning aids helpful. These included the highlighted Mowshowitz article, the PowerPoint slide set and the Mowshowitz matrix. In most cases, students found multiple learning aids useful except one student who did not find the grid as useful as the lecture slides. Overall these comments validate the effectiveness of the matrix content scaffold, although it appears students found the lecture slides equally effective. This is a cause for concern because it suggests that the matrix content scaffold manipulation was not that much stronger than the control condition's PowerPoint slide set. This point will be re-visited in the next Section in 8.2.2 in the conclusion of the thesis.

[12] The open-ended question is "How did you like the study? For example, was the group discussion helpful in furthering your understanding of the Mowshowitz article? Were the learning aids (e.g., lecture slides, the matrix (if applicable) helpful?"

Table 7.48 Open-Ended Responses from the Post-Survey on Concept Scaffold

"The learning aids did help me a great deal, most especially the MF matrix. It was a lot easier to categorize Keen's statements and formulate my arguments. The matrix was set up nicely --I can refer to the footnotes and if I want more details, the footnotes list the specific page/s in the article."
"I believe that every study tool was instrumental in getting me to what I had to achieve. However, I feel that the slides helped most. "
"I did enjoy the study. The discussion was helpful, but even more so the lecture slides were helpful in understanding the Mowshowitz Framework. "
"Lecture Slides are helpful to understand the article and the members in our group are also great to share and explain the content of the material. "
"The matrix was very helpful as a constantly referred to it when I wanted to add more insight into our discussions. "
"I worked with matrix because it was clear and easy to use. "
"Article was very difficult but the learning aids like lecture slides, matrix and highlighted article made it much easier to understand it. "
"The PowerPoint lecture helped; and most importantly the Matrix MF concept structure was definitely a big help. "
"Lecture slides were helpful. The grid not really, amybe because this I am not used to the grid. "
"Also reading the article accompanied with the slides helped a lot. "

Regarding the process scaffold, there was a group of students, *mostly undergraduates*, who complained about the process scaffold. Their comments suggest that the text-based process scaffold was too much work. They had problems ranging from finding them to finding the time to read them. They also did not like WebBoard and found it difficult to flip back and forth between the instructions and the discourse. This is one explanation for the tie between [CS=Y PS=Y] and [CS=N PS=N] conditions for highest results in the contextual analysis (see Section 7.2). That is, students who struggled with the process scaffold did better without it (i.e., CS=N PS=N); while students who did not struggle with the process scaffold found it worked best with the concept scaffold (i.e., CS=Y PS=Y). The issue with the process scaffold is discussed further in Sections 8.2.1 and 8.4 in the conclusion of the thesis.

Table 7.49 Open-Ended Responses from the Post-Survey on Process Scaffold

"Finding the instructions and understanding what has to be done took longer than the actual readings."
"I found the instructions to be abstract. The sources of information were scattered and vaguely worded. Overall, I wasn't happy with the delivery of this project at all. "
"The actual tasks were not clear. Took awhile to find out what the actual assignments were. "
"Trying to find directions in webboard was hard (and yes i do know how to use webboard). It took me awhile to even find the link for this post-survey. "
"There was too much printing of instructions that did not conform to easy reading for the students"
"The format/directions were horrible. I spent 2 hours just figuring out what I was supposed to do. "
"Directions were complicated. Since you can only have one section of web board open at a time, it was difficult to flip back and forth. It was also difficult to remember when to find relevant information. "
"The webboard system is completely confusing. It would help for all materials to be in a central location. "
"I was lost most of the time. I had a difficult time looking for things on webboard. It took me a long time to get used to the format. "
"I didn't like the study since the directions were not given in the correct sections of the Webboard. It took me a long time to figure out what was being asked. The directions weren't clear at all. "
"The instruction is not clear. I need to look through every thread to find what I need. "

Regarding group discourse, most of the comments were positive which is most encouraging. Most students found discourse improved their understanding of the Mowshowitz article through sharing of ideas. However, there was a handful of groups, *mostly undergraduates*, who experienced difficulty with non-participating group members. Group participation seemed to be the biggest issue for unsatisfactory group discourse experience. This is a difficult issue to solve as it is related to student motivation (see Section 8.3).

Table 7.50 Open-Ended Responses from the Post-Survey on Group Discourse

"The topics choosen was interesting, not so sure about our group. Would have love for the others to be more responsive. "
"I also like the fact that you work in a group and see what others thought of. "
"Group discussion was helpful and the group was good in responding to issues. Lot of questions were answered due to lively discussions. "
"The study is challenging. The group discussions helped a lot in improving my way of thinking and analyzing"
"The group discussion was helpful in gaining a better understanding of the principles. "
"I thought the group discussion did allow to me see a different perspective on the different philosophies and also had me change my mind about Keen's statements"
"My group teammates were AWOL most of the time and an effective discourse was impossible. "
"The group discussions were helpful and it was better to work in a group. "
"I was stuck in a group where no other member posted anything so there wasn't much of a discussion"
"The group did not discuss very much and could barely be reached. "
"The discussion was really helpful in furthering my understanding of Mow's article. "
"The group discussions were the most beneficial part of the entire process. They enabled people to concatonate their ideas into logical thoughts. "
"The group was a mess. We could never began a discussion. We simply posted our report and that was all. "

CHAPTER 8

CONCLUSION

The purpose of this chapter is to conclude the thesis with a discussion of the implications of the findings in Chapter 7. This includes the validity of the Asynchronous Learning Network Cognitive Discourse Model ALNCDM (Figure 3.1) (see Section 8.1), generalizability of the study (see Section 8.2), the issue of undergraduate lack of motivation (see Section 8.3), and directions for future research (see Section 8.4). The thesis then highlights its contributions (see Section 8.5) and potential applications (see Section 8.6) at the end.

8.1 ALN Cognitive Discourse Model ALNCDM

Table 8.1 summarizes the results obtained from testing of the hypotheses for the study. Despite mostly insignificant findings, this thesis suggests further research to refine (see Section 8.2.1) the experiment design for the ALNCDM research approach based on a) general trends revealed in correlation/contextual analyses (see Sections 7.4 and 7.2) and b) empirical evidence in support of concept/process scaffolds. General trends and empirical evidence in support of the ALNCDM are the main topics in this section.

Table 8.1 Summary of Results- Main Hypotheses

H1.a Increases in individual (ITest) and group test grades (GrTest) are higher with content scaffold than without content scaffold. **Not supported.** H1.b Increases in individual (ITest) and group test grades (GrTest) are higher with process scaffold than without process scaffold. **Not supported.** H1.c There is an interaction effect between content and process scaffolds affecting increases in individual (ITest) and group test grades (GrTest). **Not supported.**
H2.a Quantity of (quality) evidence in group report (GpRptEv) is higher with content scaffold than without content scaffold. **Not supported.** H2.b Quantity of (quality) evidence in group report (GpRptEv) is higher with process scaffold than without process scaffold. **Not supported.**
H3.a Quantity of interactive indicator (IntIndConst) is higher with content scaffold than without content scaffold. **Not supported.** H3.a' Quantity of interactive indicator (IntInd%) is higher with content scaffold than without content scaffold. **Not supported.** H3.b Quantity of interactive indicator (IntIndConst) is higher with process scaffold than without process scaffold. **Not Supported.** H3.b' Quantity of interactive indicator (IntInd%) is higher with process scaffold than without process scaffold. **Supported.** H3.c There is an interaction effect between content and process scaffolds affecting quantity of interactive indicator (IntIndConst). **Not supported.**
H4.a Satisfaction with group report (SGSD) is higher with content scaffold than without content scaffold. **Not supported.** H4.b Satisfaction with group report (SGSD) is higher with process scaffold than without process scaffold. **Not supported.** H4.c There is an interaction effect between content and process scaffolds affecting satisfaction with group report (SGSD). **Not supported.**
H6. Satisfaction with learning artifact (SLA) is higher with matrix concept structure than without. **Not supported.**
H7.a Increases in self-efficacy (SE_Inc) is higher with content scaffold than without content scaffold. **Not supported.** H7.b Increases in self-efficacy (SE_Inc) is higher with process scaffold than without process scaffold. **Not supported.** H7.c There is an interaction effect between content and process scaffolds affecting increases in self-efficacy (SE_Inc). **Not supported.**

One general trend found in correlation analysis (see Section 7.4) is the positive association among Satisfaction with Learning Artifact, Interactive Indicators Across All Groups, Increases in Group Test Grade, Quantity of Evidence in Group Report, Satisfaction with Group Solution and Discourse, and Increases in Self-Efficacy (See results a), b) and c) in Section 7.4). While association does not infer causality, it does not rule out the possibility, for example, that a deliberate manipulation of a concept scaffold designed to increase Satisfaction with Learning Artifact and a deliberate manipulation of a process scaffold designed to increase Interactive Indicators Across All Groups may cause a corresponding increase in Increases in Group Test Grade, Quantity of Evidence in Group Report, Satisfaction with Group Solution and Discourse, and Increases in Self-Efficacy. This is part of the research approach depicted in Figure 3.2. *That is, through a manipulation of the independent variables content and process scaffolds, the dependent variables in the research approach may be increased as a result of the treatment.* In order to validate the research approach definitively, future research should refine the experiment design (see Section 8.2.1) and re-test the hypotheses of this study. In addition, future research should be designed to obtain a larger number of subjects and to use Path Analysis or Structural Equation Modeling to validate the ALNCDM.

Another trend observed in correlation analysis is the positive association between GPA and most of the dependent variables in the research approach, including Increases in Group Test Grade, Quantity of Evidence in Group Report, Satisfaction with Learning Artifact and Satisfaction with Group Solution and Discourse (see Figure 7.4). Another way of saying this is GPA, which is a pre-existing attribute, is a mediating variable for the dependent variables. Consequently, *the research approach has been updated with*

GPA as an intervening variable replacing Group Development which was discarded during factor analysis (see Section 6.2). The updated research approach is shown in Figure 8.1.

Yet another trend found in correlation analysis is the positive correlation between Learning Approach (LA) and Satisfaction with Group Solution and Discourse (see result c) in Section 7.4), which is correlated to several dependent variables (see result b) in Section 7.4). This is also supported by contextual analysis of LA (see Section 7.2.3) which showed that students with Synthesis-Analysis LA achieved significantly better results on two out of three cognitive measures. These findings suggest that LA is a mediating variable, although a rather complex one. It is a complex mediating variable in that, while it is positively correlated to most dependent variables (see result b) in Section 7.4), it is at the same time negatively correlated to Increases in Self-Efficacy (see Section 7.4). *Taken together, LA is nonetheless a mediating variable*, and is retained in the updated research approach in Figure 8.1. Specifically, LA predicts higher learning outcomes for students with Synthesis-Analysis LA, while it acts in an inversely proportional way on Self-Efficacy.

Figure 8.1 shows the updated ALNCDM research approach, summarising the discussions above. The revised research approach is similar to the previous one with the exception of the intervening variable Group Development which has been replaced with GPA.

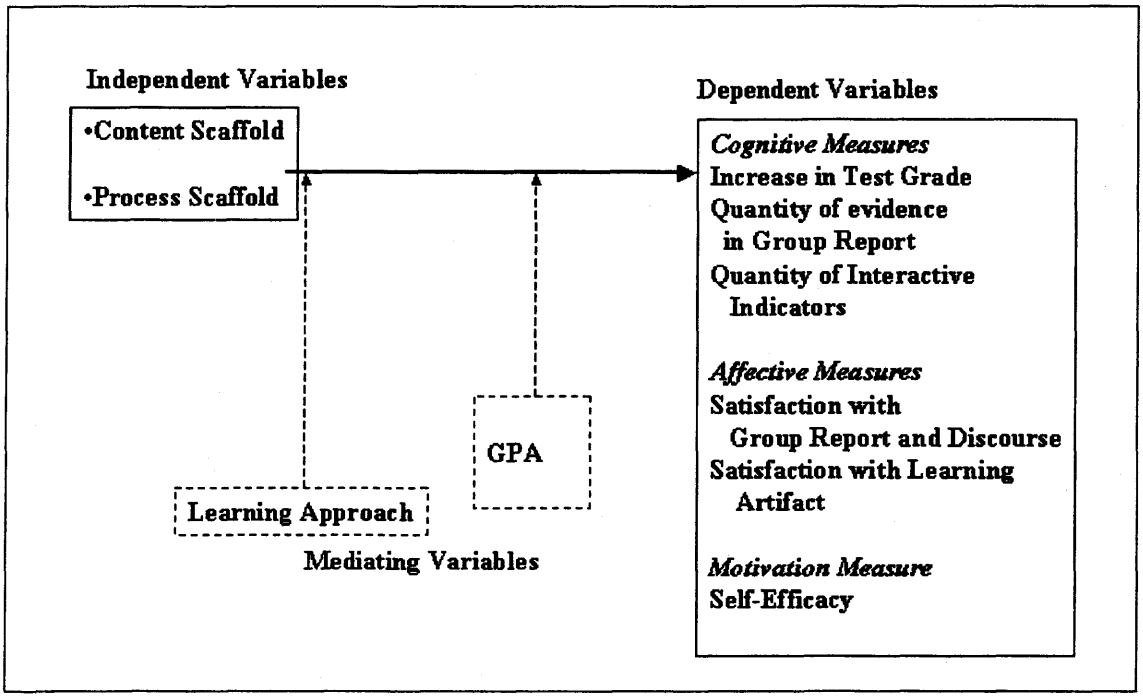


Figure 8.1 Asynchronous Learning Network Cognitive Discourse Model Research Approach V2.

Empirical Evidence in Support of the ALNCDM

In addition to general trends found in correlation analysis, there is evidence from the study's empirical data supporting the ALNCDM as well. Specifically in support of the use of content scaffold, study results showed that: a) students with below average GPAs achieved higher Increases in Group Test Grade (p=.010**) with concept scaffold (see Section 7.2.2), and b) students with Synthesis-Analysis Learning Approach achieved higher Increases in Group Test Grade (p= .035**) and Quantity of Evidence in Group Report (p=.045**) with concept scaffold (see Section 7.2.3). Building the case for process scaffold, study results showed that a) all conditions with process scaffold completed the final group report as opposed to other conditions that had groups that did not finish (see Section 6.1.2), b) graduate students achieved higher Satisfaction with Group Solution and Discourse (p= .05**) with process scaffold (see Section 7.2.5), and

c) process scaffold reduced Administration (p= .045**) and increased Interactive Indicators Within A Group (p= .010**) (see Section 7.1.3). The latter translates to increases in time on task (i.e., learning) by reducing time on administration.

Contextual Analysis in Support of the ALNCDM

Finally, in addition to general trends found in correlation analysis and empirical evidence, results from the study's contextual analysis suggest the ALNCDM works especially well for students with specific traits (see Section 7.2). Table 8.2 summarizes the major results from contextual analysis. Specifically, students with higher GPAs achieved higher quantity of group report without process scaffold; while students with lower GPAs achieved higher group test grade with the concept fold. These results are encouraging because they suggest that students who are high-achievers achieve better cognitive results when left on their own device; while students who are low-achievers benefited from the concept scaffold. In addition, students with synthesis analysis results also benefited from the concept scaffold. Taken together, the results suggest the ALNCDM's concept scaffold works especially well for low-achievers and students with synthesis-analysis learning approach.

Last but not least, graduate students achieved higher satisfaction with group solution and discourse with the process scaffold. This is evidence that the process scaffold was effective, although for a section of the sample only (i.e., the graduate students).

Table 8.2 Summary of Results- Contextual Analysis

GPA
Students with higher GPA achieved significantly higher quantity of evidence in group report with no process scaffold. **Supported.**
Students with lower GPA achieved significantly higher increases in group test grade with concept scaffold. **Supported**
Learning Approach
Students with synthesis/analysis learning style achieved higher increases in group test grade and higher quantity of evidence in group report with content scaffold. **Supported.**
YEAR
Graduate students achieved significantly higher satisfaction with group solution and discourse with process scaffold. **Supported.**

8.2 Limitations

The purpose of this section is to discuss the limitations of the study from two perspectives: external validity and internal validity. External validity discusses aspects of the study that limits its validity when applied to other populations. Internal validity discusses aspects of the study that limits its validity due to experimental design.

8.2.1 External Validity

One limitation of the study is its field experiment research methodology. Because the field experiment was performed on pre-existing classes, a random sample from the whole population of NJIT students was not possible. Descriptive analysis of the participant population (see Table 6.1) showed students were predominantly male (64.53%), non-white (72%) and in Computer Science/ Information Systems (63.37%). An analysis of variance showed that delivery modality (i.e., face-to-face versus distance learning) had a wide range across the four conditions. In addition, students who participated in the study

were students from the New Jersey Institute of Technology which is a technology institution. Technical and liberal arts students are very likely to have different learning styles which may influence the results. As a result of the demographics, caution should be exercised when applying the results to other populations.

A second limitation of the study was the high drop out rate for undergraduate students. Due to the high dropout rate among initially recruited undergraduate subjects, the final N of subjects in this study was too small to obtain adequate statistical power to examine results for low to medium strength relationships. Additionally, while some degree of non-participation was expected, the undergraduate drop out rate ranged from 40% to 48% compared to the graduate drop out rate of 7% to 13% (See Table 6.3). Using a Chi-Square test, the difference was found to be statistically significant (p= .0001). Thus, caution should be exercised when applying these results to other populations.

A third limitation of the study is the use of a single discourse assignment for the study. Future research needs to explore embedded and longitudinal discourse assignments, as well as different types of content scaffolds (see Section 8.4).

8.2.2 Internal Validity

Instrumentation. There are two design issues with the field experiment that were discovered during data analysis. First, when Satisfaction with Learning Artifact did not achieve significant results with concept scaffold as a main effect, the experimenter suspected that the concept scaffold was not operationalized with enough strength. (This was validated by analysing the variance within groups which came out high[13].) Second, when undergraduate students were making comments in the post-survey about their

[13] Weak manipulations are evidenced by a wide range of dependent values within the condition.

confusion over the process scaffold (see Section 7.6), the experimenter saw that the process scaffold as it was operationalized was getting in the way of the undergraduates. While pilot studies were carried out before the main study, the concerns addressed during the pilots were that the content scaffold be valid (which Mowshowitz validated), that students found the concept scaffold helpful (which they did during post-study phone interviews), that the discussion board software be easy to use (which necessitated the WebBoard extra credit tutorial) and that the software for the concept scaffold be easy to use (which resulted in the replacement of Compendium with Microsoft Word).

After analyzing the data and upon reflection, the experimenter explains in the next paragraphs why the manipulations were weak and how they might be improved.

The first design issue is insufficient strength in manipulating the concept scaffold. This is because of the PowerPoint slides which were present in all the conditions. PowerPoint slides contained evidence for discourse which would be graded. Since all conditions needed to be graded the same way, it was considered necessary to handout the evidence to all students so as not to bias results in favor of conditions with concept scaffold (which contained the evidence). However, the PowerPoint slides acted as a text-based content scaffold so, in essence, the control conditions were receiving content scaffolding as well. So what the study ended up comparing was text-based scaffold versus text-based plus matrix scaffold, rather than what was intended, which was no scaffold versus matrix scaffold.

In order to strengthen the content scaffold manipulation, future studies need to remove the PowerPoint slides. Instead, in order for all the students to receive evidence prior to the study, evidence may be embedded in the Mowshowitz paper as handwritten

notes in the margin (e.g., as annotations in an Acrobat file format). The idea is to remove all traces of an organized text-based learning artifact which is one form of content scaffold.

The second issue with the study concerns the heaviness of the process scaffold for undergraduates. It became evident that the process scaffold was an issue when undergraduate students kept missing the individual report milestone (i.e., Task 1a[14]). Task1a was a required task where students had to post individual solutions prior to the study. The issue with the process scaffold did not go away after Task 1A but continued for the rest of the study. This was verified by conducting a qualitative analysis of the post-survey (see Section 7.6). The qualitative analysis showed that complaints about the process scaffold came mostly (if not exclusively) from undergraduates. One explanation why the undergraduates had problems with the process scaffold is it was text-based and too long. While the undergraduates did not have a problem with the PowerPoint slides (which was also text-based), they did not read the process instructions because it was much longer (or too heavy).

In future studies, an extra-credit tutorial might be included to motivate the students to read the process scaffold instructions. This would be similar to the extra credit WebBoard tutorial which all the students had access to so they might learn to use the discussion board software[15]. If the process scaffold tutorial were to be implemented, another extra credit assignment should be created for the control condition so students would be spending equal time on the study, and earning the same number of extra credits.

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[14] A comparable drop out rate was experienced in the Red and White conditions from students not showing up for discourse or not finishing the group report.

[15] The WebBoard tutorial worked well, as most students took advantage of the tutorial to earn extra credit. Consequently, problems with WebBoard had been minimal.

One possibility would be for the students in the control condition to propose a discussion board structure for the discussion thread Task 2. Task 2 is the thread where the main discourse occurred. It can potentially be organized better as the group wishes.

Miscellaneous. In addition to instrumentation (i.e., weak manipulations of the concept and process scaffolds), two other internal validity threats should be noted. First, the ceiling effect found in the group report scores meant that reports in the high range could not be differentiated. Second, the use of both Student's T, F and Kruskal-Wallis ANOVA statistics in Section 7 may result in increased Type I errors.

8.3 Undergraduate Students Participation and Motivation Issues

Analysis of participation rate (see Section 6.1.2) showed that while drop out rates among the four conditions were statistically no different, the Chi-Square test showed there was a significantly higher undergraduate (40 – 48%) versus graduate (7 – 13%) drop out rate ($p = .0001$). While the high-achieving undergraduate students stayed with the study, the rest of the undergraduate students dropped out. This result suggests that the use of process scaffold in its current format, designed to reduce task complexity, was not sufficient to engage all undergraduate students, particularly those that are not high-achievers. Rather, it appeared to act as a deterrent as these students were not willing to invest the time and effort to learn the process scaffold (see Section 7.6). How to level the learning curve associated with the process scaffold is further explored in Future Research below.

In the final analysis, student engagement is a personal choice. As Novak (1984) suggests, students have to choose to learn. It is the experimenter's observation that

undergraduates in the study lacked motivation to complete this research assignment. This is supported by the qualitative analysis in Section 7.6 (see Table 7.50) which revealed that undergraduate students complained about "AWOL" students from their groups whereas graduate students do not have this issue. While it may be argued that students might be lacking motivation to complete the study, and might have completed the alternate assignment, actual data revealed that undergraduates did not turn in the alternate assignment either. As the study was a requirement in the course syllabus, inability on the part of undergraduates to complete an assignment of this complexity is an issue for future studies of this type. In the experimenter's opinion, the lack of motivation in undergraduates for future studies of this type needs to be addressed from a different perspective (other than the use of technology to engage students). For example, one may solicit input from student surveys on how to improve their motivation to complete research studies. Another suggestion would be to fund this type of research by paying students for their participation.

8.4 Future Research

To improve generalizability. This includes replication of the study in various settings (including embedded studies and longitudinal studies), replicating the study in different types of courses with different types of content scaffolds (including text-based browser pages, etc.), and replicating the study in different types of academic institutions (including liberal art universities). In addition, prior to the next study, the concept/process manipulations need to be strengthened. This may be as simple as removing the

PowerPoint slides, and reducing the heaviness of the process scaffold by creating multi-media process tutorials.

To Improve Undergraduate Participation. To address the process scaffold manipulation limitation for undergraduates, the experimenter reviewed the literature in major journals for new ideas. A perusal of current literature focused on ALN discourse revealed a significant amount of research on discourse (content analysis). The article by Jonassen and Remediz (2005) on the use of discourse structures embedded within the User Interface (UI) to scaffold discussion appears particularly promising in light of process scaffold issues experienced with below average students in the study. This is because the application of discourse structures as a scaffold within the UI of discussion software represents a gentle way to embed process scaffolding without major student effort and may be the solution for below average students, as well as other students, to continue to engage in discourse.

According to Jonassen et al. (2005), Computer-Supported Collaborative Argumentation (CSCA) scaffolds may be of two types- threaded or constraint-based. The threaded discussion, such as WebBoard, supports a simple hierarchical structure usually with messages structured around topics or issues. The second kind of CSCA scaffold is constraint-based. That is, messages are posted adhering to a set of constraints (or rules) that directs the discourse process. For example, in the paper, Jonassen et al. experimented with a set of discourse constraints based on Toulmin's (1958) argument structure of four levels- problem[16], proposal[17], warrant[18] and evidence[19]. By progressively constraining the

[16] A problem represents a problem statement usually posited by the instructor.
[17] A proposal represents a solution posited by the student. It is followed by a warrant.
[18] A warrant represents the type of evidence used to support the proposal. It is of three types- Reason to Support, Reason to Reject, Modify Proposal. It is followed by an evidence.

set of possible responses to a message, students are guided to refine their opinions and converge their understanding as a group. In addition, they are guided not so much by a process of division of labor, as socially constructing shared meaning through the use of specific types of messages, such as proposal or warrant or evidence.

For the purpose of future research related to this thesis, to the extent that a discourse software is capable of embedding the process flow in the UI, to that extent below average students, as well as other students, should be able to continue to engage in discourse without significant investment in time and effort to learn the discourse process (which may deter below average students). This type of discourse software is expected to reduce the high drop out rate experienced by below average undergraduate students in the study. Ideally, both content and process scaffolds are embedded in the discourse software and linked seamlessly into a gentle discourse process so the students may view the concept structure easily without flipping back and forth between the discourse software and the concept structure. In addition, experimentation with a combination of threaded and constraint-based discourse software may bring the best of both worlds (i.e., threaded and constraint-based software) together so that an overall process flow, such as the Critical Thinking Model, may be implemented over a content-based flow, such as Toulmin's argumentation model. This should be helpful because students will be able to receive scaffolding not only on a meta-cognitive level (e.g., Critical Thinking Model), but also step-by-step guidance on how to engage in a message post (e.g., Toulmin's model).

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[19] An evidence represents the justification for the proposal. It is one of four types- Information/ Facts, Personal Opinion/Belief, Personal Experience, or Research Findings.

8.5 Contributions

A major contribution of the study is the result that students who benefitted most from content scaffold had Synthesis-Analysis Learning Approach. These students achieved significantly higher Increases in Group Test Grade and Quantity of Evidence in Group Report (i.e., two out of three cognitive assessments). Since cognitive assessment is more objective than affective assessment, these results stand out. This finding underlies the simple truth that students who are taught and rewarded to comprehend what they are learning goes a long way in terms of increasing their capacity to receive help/scaffolding, which results in an ever increasing spiral of learning outcomes.

A second contribution of the study is the proposal of an original model known as the ALNCDM (Figure 8.1). General trends found in correlation/contextual analyses support the ALNCDM, although validation of the ALNCDM awaits further refinement and subsequent replications (see Section 8.2).

The significance of the ALNCDM is best explained in the words of Alavi and Leidner (2001). They said, there is a "... paucity of theoretically grounded and rigorous research to guide the development of ..." technology-mediated learning. Without pedagogical grounding, TML research can be likened to technology in search of a solution. The ALNCDM represents a concrete step in bridging this gap in TML research.

Another contribution of the thesis is the use of cognitive and affective assessments to measure learning effectiveness (including test grade, essay and student participation as well as student satisfaction). To date, TML research tends to rely on student satisfaction as the measure for effective learning, which is contrary to education researchers' view that student self-report is unreliable as a measure of effective learning

(personal conversation with Dr. Ruiz-Primo 2005). The use of objective multi-method assessments represents another step this thesis is taking to ground TML research in pedagogical theories.

A final contribution of the thesis is empirical evidence showing that below average students have unique needs for process scaffolding. Specifically, process scaffolding needs to be unfolded gently without imposing additional student effort as it will deter student motivation sufficiently as to withdraw from the assignment. This is important in designing scaffolding for technology-mediated learning and needs to be considered carefully in future research. One way this can be achieved is through the use of adaptable UI.

8.6 Applications

With regard to applications of the ALNCDM as a discourse-centered teaching and learning method applicable at the Application level of Bloom's Taxonomy, the experimenter would like to invite educators to conduct their own experiments (as the ALNCDM awaits refinement). This can be done by a) providing the students with a learning artifact beforehand (whether it be hyperlinked browser pages, a list of important information on a handout, PowerPoint slides, a matrix etc.) stating what the students are expected to demonstrate in a learning assessment, b) asking the students to state their viewpoints at the start of discourse, and c) grading the discourse by the amount of evidence from the learning artifact. These three steps contain the underpinnings of the ALNCDM which is evidence-based, and scaffolded in content and process. How much time does it take for a teacher to do this? In my viewpoint, the answer lies in whatever the

teacher can spend- from a few hours to a few weeks. As this thesis has demonstrated, students with Synthesis-Analysis learning approach performed better in two out of three cognitive assessments. This is concrete evidence that content and process scaffolds are helpful for deep learning, and hence worth the investment in time for teacher preparation (to the extent possible).

8.7 Conclusion

This thesis has presented results of a field experiment designed to test the original model called the ALNCDM. The ALNCDM is a technology-mediated, discourse-centered, teaching and learning model aimed at structuring discourse to effect conceptual mastery at the Application level of Bloom's taxonomy. A research approach was designed and tested using 58 groups of undergraduate/graduate students. While results from the main hypotheses were not supported, results from correlation analysis reveals general trends supporting a modified ALNCDM, which awaits further refinement and validation. Other findings include: a) students with synthesis-analysis learning approach performed significantly better on two out of three cognitive assignments with the concept scaffold; b) students with lower GPAs performed significantly better on group test grade with the concept scaffold; and c) graduate students achieved higher satisfaction with group solution and discourse with the process scaffold.

APPENDIX A

WELCOME

This appendix contains student instructions for the Welcome phase of the study.

Overview of the Study **Apr. 1–Apr. 22, 2004**

[PRINT THIS: Click your cursor [here]. Use File/Print in your Browser.]

In this study, you will be writing a comparative analysis report on two articles (Mowshowitz and Keen), working in small discussion groups. A full explanation of the purpose of the research will be available in a Debriefing document at the conclusion. During the study, the students are supposed to be blind to the conditions of the study.

The overall schedule for the study is:

- Preparations (**Apr. 1 - 2, 2004**)
- Group Discourse (**Apr. 5 – 19, 2004**)
- Wrap Up (**Apr. 20 - 22, 2004**)

The main study, Group Discourse, occurs **Apr. 5 - 19, 2004**. You are encouraged to be online daily for this part of the study.

Your grades for the study will be sent to your professor by **May 9, 2004**.

Before you continue, please do the following (in order):

1. Study the calendar.
2. Submit the Consent Form.
3. Read Discourse Assignment.
3. Read 'Grading and Rules'.

Afterwards, please proceed to Preparations

A.1 Welcome/1. Study the Calendar

1. Study the Calendar

Su	M	Tu	W	Th	F	Sa
				4/1 Welcome phase	4/2 Preparations phase Consent From **due**	4/3
4/4	4/5 Discourse phase Pre-Survey **due**	4/6(Day 1) Receive email-Consent Form and Pre-survey received.	4/7(Day 2) Group Assignment conference Groups are assigned. 'Group' conference Post introductions **due**.(10pm)	4/1 (Day 3)	4/9(Day 4) [Graded Discourse]	4/10
4/11	4/12(Day 5) [Graded Discourse]	4/13(Day 6) [Graded Discourse]	4/14(Day 7) [Graded Discourse]	4/15(Day 8) [Graded Discourse]	4/16(Day 9) [Graded Discourse]	4/17
4/18	4/19(Day 10) Final Report **due** [Graded Discourse]	4/20 Wrap Up phase	4/21	4/22 Post-survey **due**	4/23	4/24

Each phase (Welcome, Preparations, Discourse, Wrap Up) will open and close on the dates listed above. Instructions for each phase can be found under Discourse Study (this conference). The instructions will be posted by 10pm the evening prior. (This is done to provide you with Just-In-Time information and to help students pace through the work.) Each phase closes at 10pm on the closing date. Do not email the experimenter for an extension if you have not completed

your work by the deadline.

The Group Assignment and 'Group' conferences will open the evening prior to the dates listed above. These conferences can be found under the Discourse Study conference (on the left side of your screen).

Important Milestone
In past studies, students have completed prior phases and dropped out when the main study begins. In order to protect students who remain in the study, students will not be able to continue with the study if they have not completed Task 'Post Introductions' (see Discourse phase later) by **Apr. 7, 2004** at 10pm

A.2 Welcome/ 2. Submit the Consent Form (Instructions and Form)

2. Submit the Consent Form

1. Download and read the Consent Form.doc (attached).

2. Send an email to iw2@njit.edu by Apr. 2, 2004 at 10pm with the following information.

- Subject: (Your Name)- Consent Form.
- Body: By submitting this email, I am attaching my electronic signature, (your name), to the Consent Form.
- Attach the filled in Consent Form.

Please follow EXACT directions.*

Attachment: Consent Form.doc (completed)

NEW JERSEY INSTITUTE OF TECHNOLOGY
323 MARTIN LUTHER KING BLVD.
NEWARK, NJ 07102

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE OF STUDY: Measuring the Importance of Using Concept Structure to Scaffold Collaborative Discourse

RESEARCH STUDY:
I, [redacted], have been asked to participate in a research study under the direction of Ms. Irene Wong-Bushby and Dr. S.R. Hiltz.
Other professional persons who work with them as study staff may assist to act for them.

PURPOSE:
This research examines the use of concept structure to scaffold (i.e., provide guidance to) collaborative discourse in online courses. Collaborative discourse is a group discussion whereby members of the group work towards a common goal. Through discourse and, in particular, through collaboration, it is expected that the collective intelligence of a group will emerge and produce better outcomes than the best individual member.

DURATION:
My participation in this study will last for three weeks.

PROCEDURES:
I have been told that, during the course of this study, the following will occur:

- take a self-study training unit,
- perform an individual learning activity, and
- discuss the project using a discussion board.

PARTICIPANTS:
I will be one of about 150 participants to participate in this study.

EXCLUSIONS:
I will inform the researcher if any of the following apply to me: none

RISK/DISCOMFORTS:
I have been told that the study described above may involve the following risks and/or discomforts: None

There also may be risks and discomforts that are not yet known.

I fully recognize that there are risks that I may be exposed to by volunteering in this study which are inherent in participating in any study; I understand that I am not covered by NJIT's insurance policy for any injury or loss I might sustain in the course of participating in the study.

CONFIDENTIALITY:
Every effort will be made to maintain the confidentiality of my study records. Officials of NJIT will be allowed to inspect sections of my research records related to this study. If the findings

from the study are published, I will not be identified by name. My identity will remain confidential unless disclosure is required by law.

PAYMENT FOR PARTICIPATION:
I have been told that I will receive $0 compensation for my participation in this study.

RIGHT TO REFUSE OR WITHDRAW:
I understand that my participation is voluntary and I may refuse to participate, or may discontinue my participation at any time with no adverse consequence. I also understand that the investigator has the right to withdraw me from the study at any time.

INDIVIDUAL TO CONTACT:
If I have any questions about my treatment or research procedures I should discuss them with the principal investigator. If I have any addition questions about my rights as a research subject, I may contact:

Richard Greene, M.D., Ph.D., Chair, IRB (973) 596-3281

SIGNATURE OF PARTICIPANT
I have read this entire form, or it has been read to me, and I understand it completely. All of my questions regarding this form or this study have been answered to my complete satisfaction. I agree to participate in this research study. I also grant permission for data in my student record to be used in the study.

Subject: Name: [redacted] Signature: [redacted]

Date: [redacted]

SIGNATURE OF READER/TRANSLATOR IF THE PARTICIPANT DOES NOT READ ENGLISH WELL

The person who has signed above,
_____, does not read English well,
I read English well and am fluent in (name of the language)
_____, a language the subject understands well.
I have translated for the subject the entire content of this form. To the best of my knowledge, the participant understands the content of this form and has had an opportunity to ask questions regarding the consent form and the study, and these questions have been answered to the complete satisfaction of the participant (his/her parent/legal guardian).

Reader/
Translator: Name:_____
Signature:_____
Date:_____

SIGNATURE OF INVESTIGATOR OR RESPONSIBLE INDIVIDUAL

To the best of my knowledge, the participant, _____, has understood the entire content of the above consent form, and comprehends the study. The participants and those of his/her parent/legal guardian have been accurately answered to his/her/their complete satisfaction.

Investigator's Name:_____ Signature:_____

Date:_____

A.3 Welcome/ Read the Discourse Assignment

3. Read the Discourse Assignment

The Assignment

Working in a small group, you will categorize Keen into **one** of the five Mowshowitz philosophies. Your final decision will be submitted in a group report.

The question the group needs to answer is: **which Mowshowitz philosophy do the six Keen statements exemplify?**

For the purpose of this study, variant philosophies (e.g., Statist, Corporatist) will not be considered.

In answering this question, you will need to justify your decision by providing evidence for/against each of the Mowshowitz philosophies. In critical analysis, **it is equally important to consider the evidence for as well as against** a proposition.

Acceptable **evidence include MF ids** (see note 1) from the Mowshowitz Framework and the **six Keen statements** (see note 2).

Limitations

a) As this is a study of the Keen article as an application of Mowshowitz, dimensions that are in Keen but lacking in Mowshowitz will not be incorporated. However, you may cite these additional dimensions in the Final Report, section D (optional).

b) If a group decides there is not enough information to completely categorize Keen's six statements, assumptions should be made so you can categorize it completely. Assumptions made should be listed in section D of the Final Report.

Notes

1. For example, [T1] is an MF id. See lecture slides for MF ids.
2. For example, "A senior level fixer must head the Information function..." is a Keen statement. See lecture slides for the six statements.

B. Final Report Template
(One page in length.)

I. Supported Philosophy

State the **one** philosophy that Keen exemplifies. For this philosophy, list **three** pieces of best **supporting evidence**. A supporting evidence **supports** a Mowshowitz principle. These can be listed as:

MF id: **(+)**Keen statement i.

Example:

[R.1]: (+)Keen#1 A senior level fixer...
[R.2]: (+)Keen#2 There must be some...
[R.2.1]: (+)Keen#6 With the umbrella provided ...

Note1: One of the three pieces of evidence MUST be "Venues of Change".
Note2: The three pieces of evidence all refer to the **same** philosophy.
Note3: A Supported Philosophy must not contain any MF ID that can be negated.

II. Unsupported Philosophies

State the **four** philosophies that Keen negates. For each philosophy, list **one**, at most two, pieces of **negating evidence.** A negating evidence **contradicts** a Mowshowitz principle.These can be listed as:

MF id: **(-)** Keen statement j.

Example:

[T.2]: (-)Keen#1 A senior level fixer...
[PI.3.1]: (-)Keen#4 Formal contracts will be needed...
[E.1]: (-)Keen#1 A senior level fixer...
[P.2]: (-)Keen#1 A senior level fixer...

Note1: Each evidence refers to a **different** philosophy. (Remember you are negating the remaining philosophies.)

III. Summary

Discuss Keen in terms of the Mowshowitz philosophies based on the evidence in sections A and B. The summary should summarize parts A and B. It should be complete as **a standalone report**. [Note: Do this in no more than **ten sentences**.]

IV. Assumptions and Considerations (optional)

List any assumptions and other considerations that went into your decision that were discussed. For instance, are there any limitations in the Mowhsowitz Framework? You may also critique the Mowhsowitz article- is it hard or easy to apply?

A.4 Welcome/ 4. Read Grading and Rules

4. Read Grading and Rules

A. Grading

The total points for the project is 100 (to be weighted by your instructor as stated in your course syllabus). The points for each part will be as follows:

- Welcome phase: Consent Form (10 points)
- Preparations phase: Pre-Survey (20 points)
  - On time: 5
  - Article Assessment: 10
  - Other sections: 5
- Discourse phase: Group Discourse (30 points)
  - On time: 10
  - Student roles: 10
  - Evidence-based: 10
- Discourse phase: Group Report (20 points)

  Quality of report is based on evidence from either the MF or the 6 Keen statements. Merit is based on the strength of justification.

- Wrap Up phase: Post-Survey (20 points)
  - On time: 5
  - Article Assessment: 10
  - Other sections: 5

B. Rules

During the Discourse, all discussions should be conducted in the group discussion board. Do NOT discuss the project in person, private emails or chat. It is the responsibility of the facilitator to monitor all communications are recorded, to safeguard the validity of the study.

APPENDIX B

PREPARATIONS

This appendix contains student instructions for the Preparations phase of the study.

Preparations (4/2/04)

[PRINT THIS: Click your cursor [here]. Use File/Print in your Browser.]

In preparation for the main discourse, please do the following (in order):

- 1. Read the Mowshowitz article
- 2. Read the Lecture Slides
- 3. Read Keen (optional)
- 4. Submit Pre-survey by **Apr. 5, 2004** at 10pm.

Research indicates student preparedness is important for group discourse. Therefore, be sure to complete the assignment in the lecture slides.

Afterwards, proceed to **Group Discourse**.

B.1 Preparations/ Read Mowshowitz

Read Mowshowitz

Read Mowshowitz's On Approaches to the Study of Social Issues in Computing for a pre-quiz.

Attachment: Mowshowitz.pdf

B.2 Preparations/ View Lecture

Lecture Slides

View the lecture slides for a pre-quiz.

Attachment: Lecture.ppt

B.2.1 Preparations/ View Lecture/Mowshowitz with highlights

The lecture refers to Mowshowitz with highlighted statements. Use this file to see the statements.

Attachment: MowshowitzStmt.pdf

B.3 Preparations/ Read Keen(Optional)

Keen Article

The information you need is in the lecture slides. However, some students may choose to read Keen's Information Systems and Organizational Change.

Attachment: Keen-1981.pdf

B.4 Preparations/Pre-survey (Instructions and Form)

Pre-Survey

Complete the Pre-survey questionnaire by Apr. 5, 2004 (Mon..). The pre-survey is at:

http://greenforest.com/njit/CIS455_sp04.asp

Using Content and Process Scaffolds for Collaborative Discourse in Asynchronous Learning Networks

PreSurvey Instrument

Name: _____ **Semester**[1] **:** _____

SocSec# (last four): _____ **Year (YYYY):** _____

Course #: _____ **Professor:** _____

EmailID: _____

Introductory Explanation

This instrument is a semi-structured survey using a combination of open questions and Likert-type scale.This page will be destroyed as soon as the experimenter places a unique code on the rest of the document for identification purposes.

[1] Semester: F (Fall), Sp (Spring), S1 (Summer 1), S2 (Summer 2)

1. [ ] I am a:

   [a] DL student [b] face-to-face student

2. [ ] I am a/an:

   [a] Undergraduate junior [b] Undergraduate senior
   [c] Ph.D. student [d] MBA student
   [e] MSIS student [f] MSCS student
   [g]Other.

3. [ ] My undergraduate major is:

   [a] Accounting [b] Management
   [c] Finance [d] Marketing
   [e] Information systems [f] Engineering
   [g] Computer science [h]Other.

4. [ ] My ethnic background is:

   [a] Black/Afro American [b] Hispanic (Mexican, Puerto-Rican, etc.)
   [c] White [d] Asian or Asian American
   [e] Other.

5. [ ] I am a: [a] Female [b] Male [c] Omit

6. [ ] My age is: [a] 21 or under [b] 22-30 [c] 31-40 [d] Over 40
   [e] Omit

7. [ ] English is my native or first language. [a] Yes [b] No [c] Omit

8. [ ] My GPA is:

   [a] 4.0 [b] higher /equal to 3.5, less than 4.0 [c] higher/equal to 3.0, less than 3.5 [d] less than 3.0 [e] Omit

9. [ ] I have taken _____ classes that use Webboard before this class.

   [a] None. [b] Less than one. [c] One to less than three. [d] Three to less than five. [e] Five or more.

10. [ ] I understand this study requires me to be available for daily discussions during the main study (Project) phase. Yes [Y] No [N]

11. [ ] I am available for online discussions [a] before 5pm [b] after 5pm

Self-Expectations

12. [ ] I believe I will receive an excellent grade in the discourse assignment.
    strongly agree 1---2---3---4---5 strongly disagree

13. [ ] I'm certain I can understand the most difficult material that come up in the discourse.
    strongly agree 1---2---3---4---5 strongly disagree

14. [ ] I'm confident I can understand the basic concepts that come up in the discourse.
    strongly agree 1---2---3---4---5 strongly disagree

15. [ ] I expect to do well in the discourse assignment.
    strongly agree 1---2---3---4---5 strongly disagree

16. [ ] I'm certain I can master the skills required for the discourse assignment.
    strongly agree 1---2---3---4---5 strongly disagree

17. [ ] Considering the difficulty of the assigned reading, the teacher and my skills, I think I will do well in the discourse assignment.
    strongly agree 1---2---3---4---5 strongly disagree

Learning Approach

18. [ ] I have trouble making inferences.
strongly agree 1---2---3---4---5 strongly disagree.

19. [ ] I often memorize material I don't understand.
strongly agree 1---2---3---4---5 strongly disagree.

20. [ ] I can easily handle questions requiring comparison of different concepts.
strongly agree 1---2---3---4---5 strongly disagree.

21. [ ] I do well on essay tests.
strongly agree 1---2---3---4---5 strongly disagree.

22. [ ] I get good grades on term papers.
strongly agree 1---2---3---4---5 strongly disagree.

23. [ ] I often have difficulty finding the right words for expressing my ideas.
strongly agree 1---2---3---4---5 strongly disagree.

24. [ ] I have difficulty planning work when confronted with a complex task.
strongly agree 1---2---3---4---5 strongly disagree.

25. [ ] I read critically.
strongly agree 1---2---3---4---5 strongly disagree.

26. [ ] I have trouble seeing the difference between apparently similar ideas.
strongly agree 1---2---3---4---5 strongly disagree.

27. [ ] I can usually state the underlying message of films and readings.
strongly agree 1---2---3---4---5 strongly disagree.

28. [ ] I have trouble organizing the information that I remember.
strongly agree 1---2---3---4---5 strongly disagree.

29. [ ] I can usually formulate a good guess even when I don't know the answer.
strongly agree 1---2---3---4---5 strongly disagree.

30. [ ] I try to resolve conflicts between the information obtained from different sources.
strongly agree 1---2---3---4---5 strongly disagree.

31. [ ] I find it difficult to handle questions requiring critical evaluation.
strongly agree 1---2---3---4---5 strongly disagree.

32. [ ] I have difficulty learning how to study for a course.
strongly agree 1---2---3---4---5 strongly disagree.

Article Assessment

The purpose of this section is to obtain an assessment of what you learned. Your answer will not influence your grade. (But you do have to answer the question to receive participation grade.)

33. [ ] Federal anti-trust regulations are an example of _____ 'control'.

[a] regulatory [b] formal
[c] non-interventionist [d] out of control
[e] none of the above.

34. [ ] Policies and guidelines from a company's steering committee is an example of _____ 'control'.

[a] regulatory [b] formal
[c] non-interventionist [d] out of control
[e] none of the above.

35. [ ] The statement "Social and political consequences ... are ignored ... because he does not believe in their existence" can be found in ____ philosophy.

[a] Technicism [b] Progressive Individualism
[c] Elitism [d] Pluralism
[e] Radical Criticism.

36. [ ] Which philosophy advocates "active participation in the policy process by competing interest groups"?

[a] Technicism [b] Progressive Individualism
[c] Elitism [d] Pluralism
[e] Radical Criticism.

37. [ ] Mowshowitz listed five categories of scholarly writing: Technicism, Progressive Individualism, Elitism, Pluralism and Radical Criticism. I would categorize Keen's six statements as an example of:

[a] Technicism [b] Progressive Individualism
[c] Elitism [d] Pluralism
[e] Radical Criticism

38. Justify your answer in the previous question in no more than ten sentences using principles from the Mowshowitz Framework (from Lecture.ppt).

39. [ ] The Sarbanes-Oxley Act is a regulatory act that mandates internal financial audits in US Corporations. Your local civil rights organization opposes this on the basis that individual financial data becomes too easily accessible by the federal government. Potentially, the information may be misused by bureaucratic officials who are not aware of the local context. Your civil rights organization wants this data kept at the local government. The federal government needs to request this data on a case by case basis." This exemplifies:

[a] Technicism [b] Progressive Individualism
[c] Elitism [d] Pluralism
[e] Radical Criticism.

40. Justify your answer in the previous question in no more than ten sentences using principles from the Mowshowitz Framework (from Lecture.ppt).

Other Suggestions.

41. Is there anything confusing about this questionnaire?

42. Is there anything confusing about the directions for the assignment?

APPENDIX C

GROUP DISCOURSE

This appendix contains student instructions for the Group Discourse phase of the study.

Group Discourse (4/6 - 4/19/04)

[PRINT THIS: Click your cursor [here]. Use File/Print in your Browser.]

The study now has up to four activities occurring at the same time. You have been assigned an activity when one of the following conferences is **visible** to you. (You are assigned an activity after you have submitted a Consent Form AND completed the Pre-survey questionnaire.)

If your activity is **Red**, proceed to the conference titled **Discourse Red Procedures**.

If your activity is **White**, proceed to the conference titled **Discourse White Procedures**.

If your activity is **Blue**, proceed to the conference titled **Discourse Blue Procedures**.

If your activity is **Orange**, proceed to the conference titled **Discourse Orange Procedures**

These conferences are right under the Discourse Study conference on the left of your screen. If you do not have one of these conferences visible to you (and you have completed the Consent Form AND Pre-survey), send an email to iw2@njit.edu with the **Subject: Unable to see Discourse Red/White/ Blue/Orange Procedures**. Otherwise, please complete the tasks under DiscourseStudy/Preparations first.

Next Steps:
1. Read Discourse Grading Criteria.
2. Proceed to assigned Discourse Red/White/Blue/Orange Procedures conference.
3. Return to this conference (i.e., Discourse Study) for the Wrap Up on 4/20, 2004.

C.1 Group Discourse/Read Discourse Grading Criteria

Discourse Grading

Group discussion grading details were omitted in Preparations/Grading conference. They are presented here as they refer to project tasks discussed in this phase.

a) Fulfill your assigned student roles- Facilitator, Report Writer, Weaver. (10)

> You are expected to know your assignments and fulfill them on time.

b) Regular participation. (10)

> You are encouraged to participate regularly during the discourse. **Daily discussions are recommended.**

c) Evidence-based discourse. (10)

> Credit is awarded for **quality** of discourse. Quality of an individual's discussion is high if: i) your statements are **supported by evidence** from the concept structure/Keen statements, ii) **you ask questions** on statements that **contain no evidence** posted by others, iii) **you ask questions** on statements that **have no connection to the evidence** posted by others, and iv) **you respond to questions** about your statements (with more evidence or a simple acknowledgement).

APPENDIX D

DISCOURSE WHITE PROCEDURES OVERVIEW

This appendix contains student instructions for the White condition (i.e. CS=Y) of the Discourse phase of the study.

[Discourse White Conference]
Discourse Procedures Overview

PRINT THIS: Click your cursor [here]. Use File/Print in your Browser.]

Note: Download MowArtifact.doc before you begin.

The phases of discourse are:

1. Getting Started (Days 1, 2)
    - a) Prepare for discourse. (Day 1)
    - b) Get your group assignment and student assignment. (Day 2)
2. Discourse (Days 3 - 10)
3. Post Final Group Report. (Day 10)

Here is a scenario to help you get started:

Your professor gave you the Final Report Template in class, and put you into groups of 2 or 3 with an assigned role (Facilitator, Report Writer and Weaver). He/she said: 'Go and discuss this and write a final report in 10 days'.

Here's a possible approach for each of the roles:

Facilitator: Suggest some milestones for the group to accomplish the task.

Report Writer: Post the final report outline and ask for input.

Weaver: Post a starter message that provides input to the final report and ask if others agree.

A detailed discourse calendar, with discourse tasks in green, follows:

Su	M	Tu	W	Th	F	Sa
4/4	4/5	4/6(Day 1) 'Group' conference 1a. Prepare for discourse	4/7(Day 2) Group Assignment conference Groups are assigned. 'Group' conference 1b. Post introductions due (10pm)	4/1 (Day 3) 'Group' conference 2. Discourse	4/9(Day 4) [Graded Discourse]	4/10
4/11	4/12(Day 5) [Graded Discourse]	4/13(Day 6) [Graded Discourse]	4/14(Day 7) [Graded Discourse]	4/15(Day 8) [Graded Discourse]	4/16(Day 9) [Graded Discourse]	4/17
4/18	4/19(Day 10) 'Group' conference 3. Post Final Report due [Graded Discourse]	4/20	4/21	4/22	4/23	4/24

[Discourse White Conference cont'd]

D.1 Download Mowshowitz Matrix

Download MowshowitzArtifact Before You Begin

1. Create a Study folder [local drive]: /Study. We will refer to this as *studyFolder.*
2. Download **MowSetup** and **MowshowitzArtifact** to *studyFolder.* [Right-click on *.doc. Select 'Save Target As' to copy the file to your computer.]

3. Read (downloaded) MowSetup.doc in Word.

4. Read (downloaded) MowshowitzArtifact.doc in Word.

5. (Optional) Download a printable version of MowshowitzArtifact.

6. (Optional) Use the Discourse MowshowitzArtifact to aid discourse. (See **'Discourse MowshowitzArtifact'** topic below.)

Attachments: MowSetup.doc, MowshowitzArtifact.doc, MowshowitzArtifactPrint.doc

D.1.1 Discourse MowArtifact

Your facilitator can call for a vote using the Discourse MowshowitzArtifact twice during discourse.

To do this, each team member will enter their vote as a 'Reply' to a Discourse MowshowitzArtifact topic. (There are two such topics: Supporting Discourse MowshowitzArtifact, and Negating Discourse MowshowitzArtifact. Both are under your 'Group' conference/ Administration thread.

For example, suppose the following three Replies were entered under the Supporting Discourse MowshowitzArtifact:

(From Brad) PI.1/ K3, PI.3/K1, PI.4/K2
(From Sam) E1/K1, E2/ K3, E4.2/K6
(From Clare) T1/K1, T4/K5, T3/K2

The DiscourseMowshowitzArtifact will look like this (the next day):

Supporting Philosophies Key= name/Keen# Example: +IWB/2 means (+)Irene Wong-Bushby/Keen#2			
[1] How does the philosophy view 'technology'?	[2] What does the philosophy consider as 'Obstacles' to computer use?	[3] How does the philosophy measure 'Success' of computer use?	[4] What are the main venues for change proposed by the philosophy?
[T.1] . +Clare/K1	[T.2] .	[T.3] . +Clare/K2	[T.4] . +Clare/K5
[PI.1] +Brad/K3.	[PI.2] . [PI.2.1] .	[PI.3] . +Brad/K1 [PI.3.1] .	[PI.4] . [PI.4.1] . [PI.4.2] . +Brad/K2
[E.1] .+Sam/K1	[E.2] . +Sam/K3 [E.2.1]	[E.3] . [E.3.1] .	[E.4] . [E.4.1] . [E.4.2] . +Sam/K6
[P.1] .	[P.2] .	[P.3] .	[P.4] .
[R.1] .	[R.2] . [R.2.1] . [R.2.2] .	[R.3] . [R.3.1] . [R.3.2] .	[R.4] . [R.4.1] . [R.4.2] .

However, the same three Replies entered under the Negating Discourse MowshowitzArtifact:

(From Brad) PI.1/ K3, PI.3/K1, PI.4/K2
(From Sam) E1/K1, E2/ K3, E4.2/K6
(From Clare) T1/K1, T4/K5, T3/K2

will look like this (the next day):

Negating Philosophies Key= name/Keen# Example:- IWB/2 means (-)Irene Wong-Bushby/Keen#2			
[1] How does the philosophy view 'technology'?	[2] What does the philosophy consider as 'Obstacles' to computer use?	[3] How does the philosophy measure 'Success' of computer use?	[4] What are the main venues for change proposed by the philosophy?
[T.1] . -Clare/K1	[T.2] .	[T.3] . -Clare/K2	[T.4] . -Clare/K5
[PI.1] -Brad/K3.	[PI.2] . [PI.2.1] .	[PI.3] . -Brad/K1 [PI.3.1] .	[PI.4] . [PI.4.1] . [PI.4.2] . -Brad/K2
[E.1] .-Sam/K1	[E.2] . -Sam/K3 [E.2.1]	[E.3] . [E.3.1] .	[E.4] . [E.4.1] . [E.4.2] . -Sam/K6
[P.1] .	[P.2] .	[P.3] .	[P.4] .
[R.1] .	[R.2] . [R.2.1] . [R.2.2] .	[R.3] . [R.3.1] . [R.3.2] .	[R.4] . [R.4.1] . [R.4.2] .

[Discourse White Conference cont'd]

D.2 Prepare for Discourse (Day 1)

Task 1a
Prepare for discourse. (Day 1)
Review lecture slides and complete "Getting Started on the Assignment".

D.3 Post Introductions (Day 2)

Task 1b
Get your group and student assignments.

Click on the conference titled Group Assignment, look for a Group Assignment message with your name in the topic as shown below. This conference will be available 4/7/04.

> Example:
>
> Subject: (Your Name)
>
> You are assigned to group X. You should see your group conference titled "Group X" in the list of conferences on the left. Your student role is 'Facilitator' (or 'Report Writer' or 'Weaver').

If your group conference is not visible to you, post a message via a 'Reply' to "Your Name" with subject "Conference is not visible."

After you get your group assignment, click on the conference titled Group X where X is your assigned group. Click on the message Introduction and post an Introduction message via a 'Reply'. Note: You must do this by **Apr. 7 at 10pm** or you will be not be able to continue with the study.

> Example:
>
> Subject: (Your Name)
> Hello, I am the facilitator. I will be available after 9pm to be online. Although I am fine with my role, I'd be happy to switch if anyone wants to.

Facilitator will follow up on issues from this conference.

[Discourse White Conference cont'd]

D.4 Discourse (Days 3 – 10)

Task 2
Discourse. (Days 3 - 10)

Weaver will start the discussion by posting a message via a 'Reply' to Task 2 . All students will participate.

D.5 Post Final Group Report (Day 10)

Task 3
Post Final Group Report. (Day 10).

Report Writer will post final group report via a 'Reply' to Task 3. Be sure to post a draft a few days before.

[Hint: Review Discourse Study conference/ Welcome phase/ Read Discourse Assignment/ Group Report Template for details.]

APPENDIX E

DISCOURSE ORANGE PROCEDURES OVERVIEW

This appendix contains student instructions for the Orange condition (i.e. CS=Y, PS=Y) of the Discourse phase of the study.

[Discourse Orange Procedures Conference]
[PRINT THIS: Click your cursor [here]. Use File/Print in your Browser.]

Note: Download MowArtifact.doc before you begin.

The five phases of discourse are:

1. Share Your Ideas (Days 1, 2, 3)
    - a) Post individual group reports, part A and B only. (Day 1)
    - b) Get your group assignment and student assignment. (Day 2)
    - c) Review individual solutions for your group. (Day 3)
2. Explore Disagreements (Days 4, 5, 6)
    - Ask each other questions and discuss your differences. Support your ideas by using evidence. (Days 4, 5, 6)
3. Synthesize Group Report part A (Day 7)
    - Post draft group report part A and reach consensus on one philosophy and three pieces of supporting evidence . (Day 7).
4. Test Group Report part A. (Days 8, 9)
    - a) Negate the other four philosophies to make sure the group decision is correct. Post individual solutions. [Note: This must be completed by midnight for your solution to be included in the next step.] (Day 8)
    - b) Review individual solutions for your group. [Note: If your solution is not included, make sure you make up step (a) and continue with the study.] (Day 9)
    - c) Discuss individual solutions. (Day 9)
5. Post Final Group Report. (Day 10)

Here is the detailed discourse calendar, with the discourse activities in green:

Su	M	Tu	W	Th	F	Sa
4/4	4/5	4/6(Day 1) Task 1 conference **1a. due [Post indiv. reports A/B]**	4/7(Day 2) Group Assignment conference Groups are assigned. 'Group' conference **1b. due 10pm [Introductions]**	4/1 (Day 3) 'Group' conference 1c. [Rvw. indiv. reports A/B]	4/9(Day 4) 'Group' conference 2. [Explore disagree] [Graded Discourse]	4/10
4/11	4/12(Day 5) [Graded Discourse]	4/13(Day 6) [Graded Discourse]	4/14(Day 7) 'Group' conference **3. [Post Draft Report (A)]** [Graded Discourse]	4/15(Day 8) 'Group' conference **4a. due [Post indiv. reports (B)]** 4b. [Rvw. indiv. reports B] [Graded Discourse]	4/16(Day 9) 'Group' conference 4c. [Discuss indiv. reports] [Graded Discourse]	4/17
4/18	4/19(Day 10) **5. due [Post Final Report]** [Graded Discourse]	4/20	4/21	4/22	4/23	4/24

[Discourse Orange Procedures Conference cont'd]

E.1 Download Mowshowitz matrix

Download MowshowitzArtifact Before You Begin

1. Create a Study folder [local drive]: /Study. We will refer to this as *studyFolder*.
2. Download **MowSetup** and **MowshowitzArtifact** to *studyFolder*. [Right-click on *.doc. Select 'Save Target As' to copy the file to your computer.]

3. Read (downloaded) MowSetup.doc in Word.

4. Read (downloaded) MowshowitzArtifact.doc in Word.

5. (Optional) Download a printable version of MowshowitzArtifact.

Attachments: MowSetup.doc, MowshowitzArtifact.doc, MowshowitzArtifactPrint.doc

[Discourse Orange Procedures Conference cont'd]

E.2 Post Individual Reports A/B (Day 2)

Task 1a
Post Individual Group Reports, part A and B only. (Day 1)

Click on the conference titled Task 1. 'Post a new topic to this conference' giving your individual report as shown below.

Note: This conference is protected. You will not see your message.

Example:

Subject: Irene Wong-Bushby

(Part I Supported Philosophy)
[R.1]: (+)Keen#1 A senior level fixer...
[R.3]: (+)Keen#2 There must be some...
[R.4]: (+)Keen#6 With the umbrella provided ...

(Part II Unsupported Philosophies)
[T.1]: (-)Keen#2 There must be some...
[PI.3]: (-)Keen#4 Formal contracts will be needed...
[E.1]: (-)Keen#1 A senior level fixer...
[P.2]: (-)Keen#1 A senior level fixer...

Note: You must do this step before you are assigned a group.

[Discourse Orange Procedures Conference cont'd]

E.3 Post Introductions (Day 2)

Task 1b
Get your group assignments and post introductions.

Note: You must complete step a (above) before you are assigned to a group. (Day 2)

Click on the conference titled Group Assignment, look for a Group Assignment message with your name in the topic as shown below. This conference will be available 4/6.

> Example:
>
> Subject: (Your Name)
>
> You are assigned to group X. You should see your group conference titled "Group X" in the list of conferences on the left. Your student role is 'Facilitator' (or 'Report Writer' or 'Weaver').

If your group conference is not visible to you, post a message via a 'Reply' to "Your Name" with subject "Conference is not visible."

After you get your group assignment, click on the conference titled Group X where X is your assigned group. Click on the message Introduction and post an Introduction message via a 'Reply'. Note: You must do this by **Apr. 7 at 10pm** or you will be not be able to continue with the study.

> Example:
>
> Subject: (Your Name)
> Hello, I am the facilitator. I will be available after 9pm to be online. Although I am fine with my role, I'd be happy to switch if anyone who wants to.

Facilitator will follow up on issues from this conference.

[Discourse Orange Procedures Conference cont'd]

E.4 Review Individual Reports A/B (Day 3)

Task 1c
Review individual solutions, Supported Philosophies only, for your group. (Day 3)

Still in conference Group X, click on Task 1. Click on topic 'Discourse A' and review individual solutions for your group.

Prepare questions for Task 2.

E.5 Explore Disagreements(Days 4 – 7)

Task 2
Discuss disagreements. Ask each other questions and discuss your differences. Support your ideas by using evidence (i.e., MF id or Keen #). (Days 4, 5, 6)

Weaver will start the discussion by posting a message via a 'Reply' to Task 2 . All students will participate. (Days 4, 5, 6)

Example:

Topic: [R.3]: (+)Keen#2
XYZ suggests [R.3] is supported by Keen#2. This is not clear because ...
Can you please explain?

[Discourse Orange Procedures Conference cont'd]

E.6 Post Draft Report A (Day 7)

Task 3
Post group report part A. (Day 7). Reach consensus on one philosophy and three pieces of supporting evidence.

Report Writer will post a draft group report via a 'Reply' to Task 3. All students will participate in the discussion.

> Example:
>
> Subject: Draft Group Report Part I
>
> Based on the results in Task 2, I suggest the following group solution:
> [R.1]: (+)Keen#1 A senior level fixer...
> [R.3]: (+)Keen#2 There must be some...
> [R.4]: (+)Keen#6 With the umbrella provided ...
>
> While evidence [R.1]: (+)Keen#1 does not have clear consensus, I included it because...

Facilitator will facilitate the consensus process using asynchronous discussions.

[Hint: Review Discourse Study conference/ Welcome phase/ Discourse Assignment/ Final Report Template/ Supported Philosophies only.]

[Discourse Orange Procedures Conference cont'd]

E.7 Post Individual Reports B (Day 8)

Task 4a
Negate (-) the other FOUR philosophies to make sure the group decision is correct. Post individual solutions. Note: This must be completed by midnight for your solution to be included in the next step. (Day 8)

All students will post a message via a 'Reply' to Task 4.

Example:

Topic: (Your Name)

[T.1]: (-)Keen#3 The planning process will ...
[E.3]: (-)Keen#2 There must be some policy planning...
[PI.4.1]: (-)Keen#3 The planning process will...
[P.3]: (-)Keen#5 Hybrid skills must be developed...

[Hint: Review Discourse Study conference/ Welcome phase/ Discourse Assignment/ Final Report Template/ Unsupported Philosophies only.]

E.8 Review Individual Reports B (Day 8)

Task 4a
Negate (-) the other FOUR philosophies to make sure the group decision is correct. Post individual solutions. Note: This must be completed by midnight for your solution to be included in the next step. (Day 8)

All students will post a message via a 'Reply' to Task 4.

Example:

Topic: (Your Name)

[T.1]: (-)Keen#3 The planning process will ...
[E.3]: (-)Keen#2 There must be some policy planning...
[PI.4.1]: (-)Keen#3 The planning process will...
[P.3]: (-)Keen#5 Hybrid skills must be developed...

[Hint: Review Discourse Study conference/ Welcome phase/ Discourse Assignment/ Final Report Template/ Unsupported Philosophies only.]

[Discourse Orange Procedures Conference cont'd]

E.9 Discuss Individual Reports B (Days 9, 10)

Task 4c
Discuss individual solutions. (Day 9)

Weaver will start the discourse by posting a message via a 'Reply' to one of the messages in Task 4 . All students will participate.

> Example:
>
> Subject: [R.1]: (-)Keen#1
>
> XYZ suggests [R.1] is unsupported by Keen#1. This is not clear because ... Can you explain?

E.10 Post Final Group Report (Day 10)

Task 5
5. Post Final Group Report. (Day 10).

Report Writer will post final group report via a 'Reply' to Task 5.

[Hint: Review Discourse Study conference/ Welcome phase/ DiscourseAssignment/ Final Report Template/ Supported and Unsupported Philosophies.]

APPENDIX F

MISCELLANEOUS

This appendix contains miscellaneous student instructions for the study.

F.1 Student Roles

[Group Assignment Conference]
Student Roles Description

In this study, leadership is distributed among three roles. When you receive your group assignment, you will also receive one of the following Student Role assignments:

1. **The Facilitator Role**

The facilitator is the project leader. He/she is responsible for keeping the group on track to meet the project deadlines. He/she will also administer the discussion threads and provide instructions where to post.

2. **The Report Writer Role**

The Group Report writer is responsible for compiling the Final Report. While the final report is due on March 11, a draft version should be available for group discussion a few days before.

3. **The Weaver Role**

The Weaver (Feenburg, 1987) is responsible for keeping the discourse momentum going. This is done by kicking off the discourse, by providing ongoing summaries of the discourse, and by reflecting/synthesizing the discourse (connecting the dots).

Note1 : Students may switch roles if they can find someone who will switch with them. The last day for switching roles is Mar. 4.

Note2: In a 2 student group, the Weaver is a shared responsibility and is not assigned.

F.2 Group Assignment here

Student group assignment and their roles are listed under this thread.

APPENDIX G

WRAP UP(INSTRUCTIONS AND FORM)

This appendix contains wrap up instructions for the study.

[Discourse Study Conference]
Wrap Up

In conclusion, the study would not be complete without the post-survey where you have the opportunity to provide feedback on everything. Please plan approximately 30 minutes for the survey. The web site is:

http://www.greenforest.com/njit/MIS645post_sp04.asp

In addition, five of you will be selected at random for a phone interview. Those who are selected will receive an email over the next two weeks. Your candid feedback is deeply appreciated.

Please complete the post-survey by 3/15 (Monday) 10pm.

My sincere thanks to all of you for completing the study.

Best Wishes,
Irene

Using Content and Process Scaffolds for Collaborative Discourse in Asynchronous Learning Networks

Post-Survey Instrument

SocSec# (last four): _____ **Semester[2]:** _____

Date: _____ **Year (YYYY):** _____

Professor: _____ **Course #:** _____

Introductory Explanation

This instrument is a semi-structured survey using a combination of open questions and a five point Likert-type scale.

[2] F (Fall), Sp (Spring), S1 (Summer 1), S2 (Summer 2)

Self-Expectations

1. [ ] I believe I will receive an excellent grade in the discourse assignment.
   strongly agree 1---2---3---4---5 strongly disagree

2. [ ] I'm certain I understood the most difficult material that came up in the discourse.
   strongly agree 1---2---3---4---5 strongly disagree

3. [ ] I understood the basic concepts that came up in the discourse.
   strongly agree 1---2---3---4---5 strongly disagree

4. [ ] I think I did well in the discourse assignment.
   strongly agree 1---2---3---4---5 strongly disagree

5. [ ] I'm certain I was able to master the skills required for the discourse assignment.
   strongly agree 1---2---3---4---5 strongly disagree

6. [ ] Considering the difficulty of the assigned reading, the teacher and my skills, I think I will do well in the discourse assignment.
   strongly agree 1---2---3---4---5 strongly disagree

Satisfaction with learning artifact

7. [ ] The learning artifact was [0] lecture slides [1] matrix MF concept structure.

8. [ ] The learning artifact helped me pull together information from different sources, such as lectures, readings and discussions.

   strongly agree 1---2---3---4---5 strongly disagree

9. [ ] The learning artifact helped me relate main ideas from readings and concepts from the lecture.

   strongly agree 1---2---3---4---5 strongly disagree

10. [ ] The learning artifact helped me make connections between the readings and concepts from the lecture.

    strongly agree 1---2---3---4---5 strongly disagree

11. [ ] The learning artifact helped me organize my thoughts.

    strongly agree 1---2---3---4---5 strongly disagree

12. [ ] The learning artifact helped me find the most important ideas from the readings and lecture.

    strongly agree 1---2---3---4---5 strongly disagree

13. [ ] The learning artifact helped me go over my class notes and make an outline of important concepts.

    strongly agree 1---2---3---4---5 strongly disagree

Mental Effort

14. The amount of mental effort to follow the study procedures (Welcome, Preparations, Discourse Study) is

    very,very low mental effort 1---2---3---4---[5]---6---7---8---9 very,very high mental effort

15. The amount of mental effort to understand the Mowshowitz article is

    very,very low 1---2---3---4---[5]---6---7---8---9 very,very high
    mental effort mental effort

16. The amount of mental effort to carry out the discourse is.

    very,very low 1---2---3---4---[5]---6---7---8---9 very,very high
    mental effort mental effort

Group Involvement

17. [ ] Group members felt free to criticize ideas, statements, and/or opinions of each other.
strongly agree 1---2---3---4---5 strongly disagree

18. [ ] Group members felt that they were attacked personally when their ideas, statements, and/or opinions were criticized.
strongly agree 1---2---3---4---5 strongly disagree

19. [ ] We reached a good understanding on how we had to function.
strongly agree 1---2---3---4---5 strongly disagree

20. [ ] Group members were suspicious of each other.
strongly agree 1---2---3---4---5 strongly disagree

21. [ ] Group members ensured that we kept in touch with each other.
strongly agree 1---2---3---4---5 strongly disagree

22. [ ] Group members grew to dislike each other.
strongly agree 1---2---3---4---5 strongly disagree

23. [ ] We worked hard on the group assignment.
strongly agree 1---2---3---4---5 strongly disagree

24. [ ] I did the lion's share of the work.
strongly agree 1---2---3---4---5 strongly disagree

25. [ ] I maintained contact with all other group members.
strongly agree 1---2---3---4---5 strongly disagree

26. [ ] Group members obstructed the progress of the work.
strongly agree 1---2---3---4---5 strongly disagree

27. [ ] Group members gave personal information on themselves.
strongly agree 1---2---3---4---5 strongly disagree

28. [ ] Group members were reasonable.
strongly agree 1---2---3---4---5 strongly disagree

29. [ ] The group conducted open and lively conversations and/or discussions.
very rarely or never 1---2---3---4---5 always or very often

30. [ ] Group members disagreed amongst each other.
very rarely or never 1---2---3---4---5 always or very often

31. [ ] Group members took the initiative to get in touch with each other.
very rarely or never 1---2---3---4---5 always or very often

32. [ ] The group had conflicts.
very rarely or never 1---2---3---4---5 always or very often

33. [ ] Group members spontaneously started conversations with each other.
very rarely or never 1---2---3---4---5 always or very often

34. [ ] Group members gossiped about each other.
very rarely or never 1---2---3---4---5 always or very often

35. [ ] Group members asked each other how the work was going.
very rarely or never 1---2---3---4---5 always or very often

36. [ ] Group members did not take each other seriously.
very rarely or never 1---2---3---4---5 always or very often

Group Solution Satisfaction

37. [ ] How satisfied or dissatisfied were you with the quality of your group's solution?

very dissatisfied 1---2---3---4---5 very satisfied

38. [ ] To what extent did you feel personally responsible for the correctness of the group's solutions?

not at all 1---2---3---4---5 very great extent

39. [ ] To what extent did the group's work reflect your inputs?

not at all 1---2---3---4---5 very great extent

40. [ ] To what extent are you confident that the group's solutions were correct?

not at all 1---2---3---4---5 very great extent

41. [ ] To what extent did you feel committed to the group's solutions?

not at all 1---2---3---4---5 very great extent

Group Discussion Satisfaction

42. [ ] The overall quality of the discussion was.

good 1---2---3---4---5 poor.

43. [ ] The content of the discussion was.

carefully developed 1---2---3---4---5 carelessly developed.

44. [ ] The issues explored in the discussion were

substantial 1---2---3---4---5 trivial.

45. [ ] The discussion was competently executed 1---2---3---4---5 incompetently executed.

46. [ ] The discussion was

effective 1---2---3---4---5 ineffective.

47. [ ] The group's movement toward reaching a conclusion on the discussion was

understandable 1---2---3---4---5 confusing.

Article Assessment

The purpose of this section is to obtain an assessment of what you learned. Your answer will not influence your grade. (But you do have to answer the question to receive participation grade.)

48. [ ] Federal anti-trust regulations is an example of _____ 'control'.

[a] regulatory [b] formal
[c] non-interventionist [d] out of control
[e] none of the above.

49. [ ] Policies and guidelines from a company's steering committee is an example of _____ 'control'.

[a] regulatory [b] formal
[c] non-interventionist [d] out of control
[e] none of the above.

50. [ ] The statement "Social and political consequences ... are ignored ... because he does not believe in their existence" can be found in ____ philosophy.

[a] Technicism [b] Progressive Individualism
[c] Elitism [d] Pluralism
[e] RadCriticism

51. [ ] Which philosophy advocates "active participation in the policy process by competing interest groups"?

[a] Technicism [b] Progressive Individualism
[c] Elitism [d] Pluralism
[e] RadCriticism

52. [ ] Moshowitz listed five categories of scholarly writing: Technicism, Progressive Individualism, Elitism, Pluralism and Radical Criticism. I would categorize Keen's six statements as an example of:

[a] Technicism [b] Progressive Individualism
[c] Elitism [d] Pluralism
[e] Radical Criticism

53. Justify your answer in the previous question in no more than ten sentences using principles from the Mowshowitz Framework (from Lecture.ppt).

54. [ ] The Sarbanes-Oxley Act is a regulatory act that mandates internal financial audits in US Corporations. Your local civil rights organization opposes this on the basis that individual financial data becomes too easily accessible by the federal government. Potentially, the information may be misused by bureaucratic officials who are not aware of the local context. Your civil rights organization wants this data kept at the local government. The federal government needs to request this data on a case by case basis." This exemplifies:

[a] Technicism [b] Progressive Individualism
[c] Elitism [d] Pluralism
[e] Radical Criticism.

55. Justify your answer in the previous question in no more than ten sentences using principles from the Mowshowitz Framework (from Lecture.ppt).

Miscellaneous

56. How much time did you spend on the study? _____ hrs.

57. How did you like the study? For example, was the group discussion helpful in furthering your understanding of the Mowshowitz article? Were the learning aids (e.g., lecture slides, the matrix (if applicable)) helpful?

58. Is there anything confusing about this questionnaire?

59. [ ] Did you use a wireless for this study? [Y] Yes [N] No

60. If you used a wireless for any part of the study (that is, if you answered Yes on the previous question), describe your experience. Was it positive? Or not positive? Please explain.

APPENDIX H

DEBRIEFING

This appendix contains student instructions for the Debriefing phase of the study.

[Discourse Study Conference]
Debriefing

The file attached explains the study you just completed. Feel free to post comments under this conference.

Attachment: Debriefing.doc

APPENDIX I

LECTURE SLIDES

This appendix contains the PowerPoint slides for the study.

Mowshowitz, A. (1981).

On Approaches to the Study of Social Issues in Computing

Communications of the ACM, 24(3).

Purpose of the Article

- Gross revenues by American computer corporations in computer technology are huge.
- The distribution of costs/benefits over different groups (government sector, private sector, labor unions, individuals etc.) are far from uniform.
- Mowshowitz proposes 5 philosophies for evaluating "relevance" of computer technology.
- These philosophies represent belief systems we should recognize as we analyze social issues undertaken in public interest.

The Mowshowitz Framework

A framework is a set of organizing principles to understand the five philosophies as a whole.

We will consider four categories of principles (or frames) in the Mowshowitz Framework (MF).

1. How does the philosophy view 'technology'?
2. What does the philosophy consider as 'obstacles' to computer use?
3. How does the philosophy measure 'success' of computer use?
4. What are the main venues for change proposed by the philosophy?

The Mowshowitz Framework cont'd

Frame 1.

How does the philosophy view 'technology'?

Does the philosophy view technology as progress? Or does the philosophy distrust technology?

The Mowshowitz Framework cont'd

Frame 2.

What does the philosophy consider as 'obstacles' to computer use?

What are the obstacles to computer use? Do systems fail for purely system design or technical reasons? Or does the philosophy consider social issues such as human imperfections, social context (etc.) as obstacles to be considered?

The Mowshowitz Framework cont'd

Frame 3.

How does the philosophy measure 'success' of computer use?

Is it primarily economics? Or does the philosophy consider positive social change as a success factor?

The Mowshowitz Framework cont'd

Frame 4.

What are the main venues for change proposed by the philosophy?

Three types of change 'controls':

a) Interventionist: This type of 'controls' indicate the will of the individual to direct events within the system.

There are two types:

- **'Regulatory controls' are *external* controls from outside the organization such as government or professional organizations. E.g. Fair Credit Reporting Act or ACM Code of Ethics.**
- **'Formal controls' are *self-imposed* controls from within the organization. E.g. steering committee policies.**

The Mowshowitz Framework cont'd

Frame 4.

What are the main venues for change proposed by the philosophy? cont'd

b) Non-interventionist: This type of 'controls' indicate the will of the individual NOT to directly change events within the system. E.g. Restructuring the organizational context.

c) Out of control: This type of 'controls' indicates the individual is NOT in a position to effect change within the system. Although it appears non-interventionist, it is rooted in pessimism and helplessness. E.g. Anti-establishment or grass root movements.

Mowshowitz Framework Terminology

- "MF id"

  The unique identifier for a Mowshowitz Framework (MF) principle. For example, [T.1] is the MF id for the principle:" The philosophy has boundless faith in 'technology'."

- "dotdotdot"

  A compound statement may be presented in segments to emphasize major concepts. For example:

  [PI.4] The philosophy advocates ...
  [PI.4.1] ...'regulatory' controls upon system designers, managers and specialists (Reformists); OR
  [PI.4.2] ... 'non-interventionist' controls with an emphasis on restructuring organizational context and experimentation (Pragmatists).

The Five Philosophies of the Mowshowitz Framework

Technicism (T)

[T.1] The philosophy has boundless faith in 'technology'.

[T.2] The philosophy considers 'obstacles' in terms of technical issues, with a lack of critical analysis regarding social/political 'obstacles'.

[T.3] The philosophy measures 'success' in economic terms.

[T.4] The philosophy advocates 'regulatory' and 'formal controls' to protect national (Statist) and corporate (Corporatist) economic interests.

Progressive Individualism (PI)

[PI.1] The philosophy has 'faith in technology' over a period of time.

[PI.2] The philosophy considers 'obstacles' in terms of technical and ...

[PI.2.1] ... social issues related to imperfections in social and technical systems.

[PI.3] The philosophy defines 'success' in economic terms.

[PI.3.1] Pragmatists also define 'success' in terms of desirable social change.

Progressive Individualism cont'd(PI)

[PI.4] The philosophy advocates ...

[PI.4.1] ...'regulatory controls' upon system designers, managers and specialists (Reformists); OR

[PI.4.2] ... 'non-interventionist controls' with an emphasis on restructuring organizational context and experimentation (Pragmatists).

Elitism (E)

[E.1] The philosophy has boundless faith in 'technology'.

[E.2] The philosophy considers 'obstacles' in terms of technical and ...

[E.2.1] ... social issues.

[E.3] The philosophy defines 'success' in economic terms.

[E.3.1] Technical Elitism also defines 'success' in terms of socially responsible computer use.

Elitism cont'd (E)

[E.4] The philosophy advocates 'formal controls' by one of two types of elite: ...

[E.4.1] ... computer specialists as teachers of social computer literacy [Technical Elitism]; OR

[E.4.2] ... managers as coordinators and controllers [Managerial Elitism].

Pluralism (P)

[P1] The philosophy does not have 'faith in technology' as the cure all.

[P2] The philosophy considers 'obstacles' in terms of social issues: specifically the ability to reach consensus by competing special interest groups.

[P.3] The philosophy measures 'success' in social terms with emphasis on empirical research that stresses social diversity.

[P.4] The philosophy advocates 'regulatory controls' that protects the interest of labor unions, political parties, consumer associations, professional societies etc. through an active participatory process by competing interest groups.

Radical Criticism (R)

[R.1] The philosophy distrusts technology, especially mega-technical systems (AKA mega-systems).

[R.2] The philosophy considers 'obstacles' in terms of the root cause (i.e. mega-systems) that...

[R2.1]...redistributes social power to the elite (Devolutionism); OR

[R2.2] ...constitutes a social force that defies individual control (Determinism).

Radical Criticism cont'd (R)

[R.3] The philosophy defines 'success' in social terms such as...

[R.3.1] ...self-awareness that we have become slaves to mega-systems (Determinism); OR

[R.3.2] ...equity in computer use representing all groups (Devolutionism).

Radical Criticism cont'd(R)

[R.4] This philosophy advocates...

[R.4.1] ... mega-systems are 'out of control' and, hence, the need to become self-aware of our condition as slaves to systems (Determinism); OR

[R.4.2] ... 'regulatory controls' are NOT sufficient and, hence, the need for redistribution of power to local organizations via a collaborative process involving conflicting special interest groups (Devolutionism).

Discourse Assignment

What Mowshowitz philosophy does Keen exemplify?

- Use these six source statements for your analysis:

Keen#1: A senior level fixer must head the Information function: he or she must have full authority and resources to negotiate between users and with those affected by information systems.

Keen#2: There must be some policy planning or steering committee which includes senior line managers; it will delegate to technical staff responsibility for projects that do not have significant organizational impact but will be actively involved with ones that are part of the politics of data...

Discourse Assignment cont'd

Keen#3: The planning process will require substantial time and effort in the predesign stages, where objectives are made operational and evolution of the larger system is defined by breaking it into clear phases.

Keen#4: Formal contracts will be needed, in which commitments must be clearly made and such games as Up for Grabs, Reputation, Easy Life and Territory made illegal and ineffectual.

Keen#5: Hybrid skills must be developed in systems staff, they cannot dismiss organizational and political issues as irrelevant or not their responsibility, but must be able to operate in the manager's world and build credibility across the organization.

Discourse Assignment cont'd

Keen#6: With the umbrella provided by the fixer's authority and the steering committee, the tactical approach remains an excellent guide to managing the implementation process for a given project.

[Note: As the title (Information Systems and Organizational Change) suggests, what can we assume about Keen's definition of 'success' in computer use. Do you think it is predominantly economic or social benefits?]

Getting Started on the Assignment

In preparation for discourse, you need to:

Step 1: Review the Mowshowitz Framework [Hint: 'See' the Mow Framework by rereading the article focusing on the significant (i.e. highlighted) source statements].

Step 2: Classify Keen in your mind as one of the Mow philosophies [Hint: Apply the Mow Framework to the six Keen statements.]:

- What is his belief on 'technology'?
- What is his belief on 'obstacles' to computer use?
- What is his belief on 'success' measures?
- What 'controls' does he advocate?
  - Interventionist? (Regulatory or Formal?)
  - Non-interventionist?
  - Out of control?

APPENDIX J

MOWSHOWITZ LEARNING ARTIFACT (THE MATRIX)

This appendix contains the Mowshowitz matrix.

Table J.1 Mowshowitz Matrix- Part 1

Philosophies	**[1] How does the philosophy view 'technology'?**	**[2] What does the philosophy consider as 'Obstacles' to computer use?**	**[3] How does the philosophy measure 'Success' of computer use?**	**[4] What are the main venues for change proposed by the philosophy?**
[T] Technicism	[T.1][i] The philosophy has boundless faith in 'technology'.	[T.2][ii] The philosophy considers 'obstacles' in terms of technical issues, with a lack of critical analysis regarding social/ political 'obstacles'.	[T.3][iii] The philosophy measures 'success' in economic terms.	[T.4][iv] The philosophy advocates 'regulatory/formal controls' to protect national (Statist) and corporate (Corporatist) economic interests.
[PI] Progressive Individualism	[PI.1][v] The philosophy has 'faith in technology' over a period of time.	[PI.2][vi] The philosophy considers 'obstacles' in terms of technical and... [PI.2.1][vii] ...social issues related to imperfections in social and technical systems.	[PI.3][viii] The philosophy defines 'success' in economic terms. [PI.3.1][ix] Pragmatists also define 'success' in terms of desirable social change.	[PI.4] The philosophy advocates ... [PI.4.1][x] ...'regulatory controls' upon system designers, managers and specialists(Reformist); OR [PI.4.2][xi] ...'non-interventionist controls' with an emphasis on restructuring organizational context and experimentation (Pragmatist).
[E] Elitism	[E.1][xii] The philosophy has boundless faith in 'technology'.	[E.2][xiii] The philosophy considers 'obstacles' in terms of technical and ... [E.2.1][xiv] ...social issues.	[E.3][xv] The philosophy defines 'success' in economic terms. [E.3.1][xvi] Technical Elitism also defines 'success' in terms of socially responsible computer use.	[E.4][xvii] The philosophy advocates 'formal controls' by one of two types of elite: ... [E.4.1]xviii ...computer specialists as teachers of social computer literacy [Technical Elitism]; OR [E.4.2]xix ... managers as coordinators and controllers [Managerial Elitism].

Table J.2 Mowshowitz Matrix- Part 2

[P] Pluralism	[P.1][xx] The philosophy does not have 'faith in technology' as the cure all.	[P.2][xxi] The philosophy considers 'obstacles' in terms of social issues: specifically the ability to reach consensus by competing special interest groups.	[P.3][xxii] The philosophy measures 'success' in social terms with emphasis on empirical research that stresses social diversity.	[P.4][xxiii] The philosophy advocates 'regulatory controls' that protects the interest of labor unions, political parties, consumer associations, professional societies etc. through an active participatory process by competing special interest groups.
[R] Radical Criticism	[R.1][xxiv] The philosophy distrusts technology, especially mega-technical systems.	[R.2][xxv] The philosophy considers 'obstacles' in terms of the root cause (i.e., mega-systems) that … [R.2.1][xxvi] …redistributes social power to the elite (Devolutionism); OR [R.2.2][xxvii] …constitutes a social force that defies individual control (Determinism).	[R.3] The philosophy defines 'success' in social terms such as … [R.3.1][xxviii] …self-awareness that we have become slaves to mega-systems (Determinism); OR [R.3.2][xxix] …equity in computer use representing all groups (Devolutionism).	[R.4] The philosophy advocates … [R.4.1]xxx …mega-systems are 'out of control' and, hence, the need to become self-aware of our condition as slaves to systems (Determinism); OR [R.4.2]xxxi …'regulatory controls' are NOT sufficient and, hence, the need for redistribution of power to local organizations via a collaborative process involving conflicting special interest groups (Devolutionism).

APPENDIX K

ALTERNATE ASSIGNMENT

This appendix contains student instructions for the Alternate study.

Alternate Assignment Overview

The purpose of the assignment is to gain a better understanding of the five Moshowitz philosophies by applying them to two comparative articles (Keen and Markus). You will compare Keen and one of the three Markus positions with the five Moshowitz philosophies.

The questions you need to answer are:

a) Which of the Moshowitz philosophy does Keen exemplify?

AND

b) Choose one of the following:

- Which Moshowitz philosophy does People-determined theory exemplify?
- Which Moshowitz philosophy does System-determined theory exemplify?
- Which Moshowitz philosophy does Interaction-determined theory exemplify?

You will need to justify your decision by providing evidence for/against each of the Mosowitz philosophies. For example, you need to justify why you think Keen exemplifies a philosophy as well as why Keen does not exemplify a philosophy. In critical analysis, it is equally important to consider the evidence for as well as against a proposition.

Acceptable evidence must be source statements from the articles.

This assignment is to be submitted in a final report as described below. The report is to be emailed to iw2@njit.edu with the subject "Alternate Assignment" by **Apr. 19, 2004** at 10pm. No late assignments will be accepted.

Resources:

Wong-Bushby, I, Mowshowitz Concept Structure (in Lecture.ppt)

Moshowitz, A. "On approaches to the study of social issues in computing," CACM, March 1981, 144- 155.

Keen, Peter, Information Systems and Organizational Change, Communications

of the ACM, January 1981, Volume 24, Number 1, pages 24-33.
Markus, M. Lynne, Power, Politics, and MIS Implementation, Communications of the ACM, June 1983, Volume 26, Number 6,pages 430-444

Procedures:

-Send Alternate Intent email by **Apr. 2, 2004 at 10pm**
-Read Mowshowitz, Keen and Markus
-View lecture
-Submit the Final Report by **Apr. 19, 2004 at 10pm**
-Submit the Alternate Survey by **Apr. 22, 2004 at 10pm**

Grading:

Alternate intent: 10 points
On time: 10 points
Final report: 60 points
Alternate-survey: 20 points

Your instructor will receive your grade by May 9, 2004. Your final grade will be weighted by your instructor as described in the course syllabus.

K.1 Alternate Assignment Final Report Format

Final Report Format (Two to three pages in length)

A. Significant source statements from Moshowitz, Keen and Markus

- List and number the significant source statements from Moshowitz (M1, M2 ...) that you want to use for your report.
- List and number the significant source statements from Keen (K1, K2 ...) that you want to use for your report.
- Choose and state one Markus position to analyse (i.e., People-determined, System-determined, or Interaction-determined.) List and number the significant source statements from Markus (S1, S2 ...) that you want to use for your report. The source statements should be only from the Markus position you are analysing.

B. Keen Analysis

Supported Positions

State the Moshowitz position that Keen exemplifies. For this position, list the specific Moshowitz source statements that the Keen statements (K1, ...) exemplify. List three supporting source statements.
For Example: [T.1]: **(+)** K1

Unsupported Positions

State the four Moshowitz positions that Keen do not exemplify. For each position, list the Moshowitz source statement that is negated by the Keen statement (K1, ...). List one unsupporting source statement for each position.
For example: [R.2]: **(-)** K2

C. Markus Analysis

State the Markus position you are analysing (i.e., People-determined, System-determined, or Interaction-determined). List the supported positions and unsupported positions as in B above.

D. Summary

The summary should summarize sections B and C. It should be readable as a standalone report.

-Summarize your analysis of Keen in terms of a Moshowitz philosophy. (10 sentences).

-Summarize your analysis of Markus in terms of a Mowshowitz philosophy. (10 sentences).

E. Discussion(Optional)

Discuss any assumptions and limitations that went into your analysis.

[i] The technicist views the computer as an instrument of progress. This is an article of faith based neither on experience or reason.(p. 148)
[ii] The technicist defines the success or failure of particular computer applications in terms of systems design and implementation. (p. 148) Social and political consequences ... are ignored by the technicist because he does not believe in their existence. (p. 148)
[iii] ... what does interest (the imperialist) is how governments and corporations can stimulate economic exploitation of computer technology, encourage applications, create a climate which favors innovation, and open a dialogue between management and labor on questions of systems design (p. 149).
[iv] Some technicists are ... refer(red) to .. as imperialists. The group places great emphasis on the question ... of control ... involving the development and use of computers. (p. 149). The statist is concerned with promoting national interests; he focuses primarily on government aid to computer industry. Two issues dominate his concern: a) economic development and technological innovation, and b) competition, monopoly and equity (p. 149). The corporatist variant of imperialism embraces a perspective ... shared by managers and trade unionists. In this case, regulation refers to the organizational arrangements which govern the ... roles of managers, technical specialists, and workers in the design, implementation, and use of computer systems (p. 149).
[v] The typical progressive may have misgivings about the near term results of computer applications, but believes that computer technology will prove to be beneficial to society in the long run (p. 150)
[vi] Underlying this concern is the belief that it is possible to modify technical systems ... to achieve these ends (p. 150).
[vii] (The progressive's) ... faith is tempered by an appreciation of the imperfections of human judgment, social arrangements and technical systems (p. 150).
[viii] By and large, progressives share the technicist's faith in progress (as the means to economic prosperity and social stability) and individual initiative... (p. 150).
[ix] (Pragmatist) ... assume a more activist posture. They advocate using computers to achieve what they conceive to be desirable social change (p. 150).
[x] (The) reformists seek to secure beneficial effects and avoid misuses of computers by ... urging the introduction of regulatory mechanisms (p. 150). (The) reformists seek to ... avoid misuses of computers by exhorting systems designers, managers, and other computer specialists to accept responsibility for ... their handiwork (p. 150).
[xi] (For the Pragmatist) ... freedom to innovate is highly necessary ... which means the pragmatist shies away from interventionist policies (p. 151). Pragmatists take the position that the use made of computers is determined in part by the social or organizational settings in which they are introduced. (p. 150) ... pragmatism shifts the emphasis to social structure (p. 150). ... individual actions alone are insufficient (p. 150). Pragmatists lay greater stress on socio-technical experimentation ... (p. 150) This group is plagued by the proliferation of journals and other publications; its members are subject to the publish-or-perish rule (p. 151).
[xii] Elitists believe in progress through technical innovation (p. 151).
[xiii] Elitism has much in common with technicism ... They are promotors of the use of computers and have an abiding faith in the ultimate beneficence of computer technology(p. 151)
[xiv] Of all the promotors, elitists are the most sophisticated analysts of social phenomena. This explains their affinity for social engineering... (p. 151)
[xv] Elitists believe in progress through technical innovation... (p. 151) The managerial variant of elitism ... (is based on) effective and efficient production (p. 152).
[xvi] (Technical elitists have a mission that) ... consists of (among other things) informing nonprofessionals about the social implications of computing (p. 152).
[xvii] What differentiates this position from technicism ... is its strong emphasis on ... control mechanisms. Formal mechanisms to control the development and use of computer technology are indispensable to the elitist position. (p. 151). The elitist approach to social issues in computing comes in two varieties... These are distinguished by the candidates they select for elitehood (p. 151) [Note (Hiltz personal conversation): Elitism is NOT regulatory controls from government or professional organizations. The form of controls here is strictly self-imposed (hence called 'formal' to distinguish it from 'regulatory' controls).]

xviii (Technical elitists have a mission that) ... consists of (1) awakening their ... colleagues to the .. responsibility .. for the uses ... (of) computers ..., and (2) informing nonprofessionals about the social implications of computing (p. 152).
xix Managerial elitism ... is very influential ... among those who study the effects of computers on organizations... (p. 152) The central goal ... is rationalization (p. 152) ... managers play strategic roles as coordinators and controllers (p. 15)
[xx] The pluralists have made their mark on the issue of the computer's alleged threat to individual privacy and autonomy (p. 152).
[xxi] The pluralist position derives from the political doctrine of (Pluralism)...the only ... guarantee of socially beneficial applications is active participation in the policy process by competing special interest groups (p. 152) Laudon's work ... places the computer in a sociopolitical context where conflicts between established groups determine the course of events (p. 153). (The pluralist emphasize that) ... special interest groups (labor unions, political parties, consumer associations, professional societies etc.) compete with one another for power, influence, and scarce resources. These conflicts are resolved through negotiation and compromise and result in a shifting but stable consensus ... (p. 152)
[xxii] (The pluralist) ... believes that eternal vigilance is the price of (individual) liberty and equity... (p. 152) Note: What is at stake are (the social values of) liberty and equity. (The pluralists) favor empirical research rather than speculative or historical studies and stress social diversity rather than unity (p. 152).
[xxiii] (Safe computer use) can be assured by a combination of legal, regulatory, and security measures ... (p. 152) Special interest groups (labor unions, political parties, consumer associations, professional societies, etc.) compete with one another for power, influence and scarce resources. (p. 152) (The) only effective guarantee of socially beneficial applications is active participation in the policy process by competing special interest groups (p. 152)
[xxiv] (The philosophy views) ... megatechnical systems whose very size and complexity renders them immune to human control. These ... (systems) move in directions dictated by ... requirements which have little connection with human needs (p. 153).
[xxv] The term "radical" is used here in the sense of "root". These critiques ... identify and analyze the root causes of ... the development and use of science and technology (p. 153)
[xxvi] (Technique) centralizes power ... in the hands of elite managers and technicians (p. 153)
[xxvii] The essence of determinism is that technique constitutes a dynamic social force with a logic of its own ... more powerful than the will of the individual (p. 153) (However, devolutionists do not regard technique) as autonomous forces (p. 153).
[xxviii] (Determinism) asserts that we have become enslaved by our own sociotechnical creations ... (p. 153). It is sufficient to observe that the actors in megatechnical systems have internalized the attitudes, expectations and values of technique (p. 153).
[xxix] (Devolutionist view) ... that active participation in decision making by conflicting groups is necessary ... (p. 153)
xxx (Determinism views) ... megatechnical systems whose very size and complexity renders them immune to human control. (p. 153) (Determinism advocates)... (we) strike a Faustian bargain in which ... they (systems) gain power ... and (we) lose control over use (p. 153). This general loss of understanding ... leads to social commitments dictated by ... technical imperatives (p. 153).
xxxi (Devoluionists) ... do not believe this (self-regulation) is sufficient- constructive intervention in social affairs is seen to be necessary ... (p. 153) (Devolutionists view) ... that active participation in decision making by conflicting groups is necessary ... (p. 153) A fundamental tenet of devolutionism is that nothing short of a redistribution of power (is needed)... (p. 153) (Devolutionists) ... argue that no regulatory mechanism ... (is) effective against (political/social) changes ... (p. 153) ... if public sentiment ... change ... (because of) ... terrorist activity, an energy crisis, or economic collapse, the laws governing the use of personal data systems could (change) ... (p. 154).

REFERENCES

1. Alavi, M, Wheeler, B. and Valacich, J. 1995. Using IT to reengineer business education: An exploratory investigation to collaborative telelearning. MIS Q. September, pp. 293-312.

2. Alavi, M. and Leidner, D., "Technology-Mediated Learning: A Call for Greater Depth and Breadth of Research", Information System Research, March 2001, pp. 1-10.

3. Anderson, J. R., Reder, L. M. and Simon, H. A. (1995). Applications and misapplications of cognitive psychology to mathematics education. Unpublished paper, Pittsburgh, PA: Carnegie Mellon University. Available at: http://act.psy.cmu.edu/ACT/papers/misapplied-abs-ja.html, accessed 02/04.

4. Arbaugh, J. B., and Hiltz, S. R. (2004) Improving Quantitative Research on ALN Effectiveness. In Asynchronous Learning Networks: The Research Frontier. Hiltz,S.R. and Goldman R. (Eds.) Mahwah, New Jersey: Erlbaum Publishing.

5. Atkinson, J. W. (1957). Motivational determinants of risk-taking behaviors. Psychological Review, 64, pp. 359-372.

6. Ausubel, David P. (1963) The Psychology of Meaningful Verbal Learning. New York: Grune and Stratton.

7. Aviv, R., Erlich, A., Ravid, G., and Geva, A. (2003). Network analysis of Knowledge Construction Asynchronous Learning Networks. JALN 7(3). Available at: http://www.ravid.org/gilad/SAMOS-ICICTE.pdf, accessed 02/04.

8. Baker, M., de Vries, E., Lund, K. nd Quignard, M. (2001). Computer-mediated epistemic interactions for co-constructing scientific notions: Lessons learned from a five-year research programme. Paper presented at the Euro conference of Computer-Supported Collaborative Learning, Maastricht, the Netherlands.

9. Berelson, B. (1952). Content Analysis in Communication Research, Glencoe, Ill.: Free Press.

10. Biggs, J., Kember, D., & Leung, D. Y. P. (2001). The revised two-factor study process Questionnaire: R-SPQ-2F. British Journal of Educational Psychology, 71, pp. 133-149.

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

12. Bonk, C., Angeli, C., Malikowski, S. and Supplee, L. (2001). Holy COW: Scaffolding Case Based Conferencing On the Web with Preservice Teachers.

12. Bonk, C., Angeli, C., Malikowski, S. and Supplee, L. (2001). Holy COW: Scaffolding Case Based Conferencing On the Web with Preservice Teachers.

13. Education At a Distance. 15(8). Available at: http://www.usdla.org/html/journal/AUG01_Issue/article01.html, accessed 02/04.

14. Bovy, R. C. 1981. Successful instructional methods: A cognitive information processing approach. ECTJ (29:4), Winter 1981, pp. 203-217.

15. Bruning, R. H., Shraw, G. J., and Ronning R. R. (1995). Cognitive psychology and instruction (2nd ed.). Engle Cliffs, NJ: Prentice Hall, Inc.

16. Cates, W. M. and Bruce, R. R. (2002) Conceptualizing Learner Support Space. Educational Technology Research & Development, 48(1), pp. 85-98.

17. Chambers, J. M, Cleveland, W .S., Kleiner, B., and Tukey, P. A. (1983), Graphical Methods for Data Analysis, Belmont, CA: Wadsworth International Group.

18. Chi, M. T. H. & Bassock, M. (1991). Learning from examples vs. self-explanations. In Resnkck, L.B. (Ed.), Knowing, learning and instruction: Essays in honor of Robert Glaser. Hillsdale, NJ: Lawrence Erlbaum Associates.

19. Chiu, D. H., Huang C. C., and Change, W. T. (2000). The evaluation and influence of interaction in network supported collaborative concept mapping. Computers and Education (34), pp. 17-25.

20. Clark, H. H. and Brennan S. E.(1991) Grounding in Communication. In: Resnick, L. B., Levine, J., and Teasley, S. D. (Eds.) Perspectives on Socially Shared Cognition (American Psychological Association, Washington, 1991).

21. Cohen, J. (1988) Statistical Power Analysis for the Behavioral Sciences (2d ed.). Hillsdale, N.J.: Erlbaum.

22. Crawford, P. (2000). Self directed learning unit- Muresk Institute of Agriculture. In Herrmann, A. & Kulski, M. M. (Eds.), Flexible futures in tertiary teaching. Proceedings of the 9th Annual Teaching Learning Forum, February 2000. Perth, W. Australia: Curtin U. of Technology.

23. Cronin, P. (1997). Learning and assessment of instruction. Unpublished report, Edinburgh: University of Edinburgh Center for Cognitive Science.

24. Daft, R. L. and Lengel, R. H. (1986) Organizational information requirements, media richness, and structural design. Management Science, 32, 5, pp. 554-571.

25. de Vries, E., Lund, K. & Baker, M. (2002). Computer-mediated epistemic dialogue: Explanation and argumentation as vehicles for understanding scientific notions. Journal of the Learning Sciences, 11, pp. 63-103.

26. Dennis, A. R., Valacich, J. S. (1999) Rethinking media richness: Towards a theory of media synchronicity, HICSS, 32. Avail. at: http://www.computer.org/proceedings/hicss/0001/00011/00011017abs.htm?SMSESSION=NO, accessed 02/04.

27. Dennis, A. R. 1996 Information exchange and use in group decision making: you can lead a group to information but you can't make it think. MIS Quarterly, 10, 4. Avail. at: http://www.misq.org/archivist/vol/no20/issue4/vol20n4art3.html, accessed 02/04.

28. Dole, J. A. & Sinatra, G. M. (1998). Reconceptualizing change in the cognitive construction of knowledge. Educational Psychologist, 33 (2/3), pp. 109-128.

29. Feenberg, A. (1989) Mindweave: Communication, computers and distance education. Oxford: Pergamon Press.

30. Felder, R. M. and Soloman, B. A., Index of Learning Styles. Avail. at: http://www.ncsu.edu/felder-public/ILSpage.html, accessed 02/04.

31. Fjermestad, J. and Hiltz, S. R. 1999 An Assessment of Group Support Systems Experimental Research: Methodology and Results. Journal of Management Information Systems. Winter. Vol 15(3), pp. 7-150.

32. Flynn, J. L. 1992. Cooperative learning and Gagne's events of instruction: A syncretic view. Educational Technology, October, pp. 53-60.

33. Frase, L. T. (1969). Paragraph organization of written materials: The influence of conceptual clustering upon the level and organization of recall. Journal of Educational Psychology, 60, pp. 394-401.

34. Gagne, R. M. 1977 The conditions of learning, 3rd ed. Holt, Rinehart, and Winston, New York.

35. Garrison, D. R., Anderson, T. and Archer, W. (2001). Critical thinking, cognitive presence, and computer confereincing in distance education. The American Journal of Distance Education. 15(1), pp. 7-23.

36. George, S., and Leroux, P. (2001). Project-based learning as a basis for a CSCL environment: An example in educational robotics. Paper presented at the Euro conference of Computer-Supported Collaborative Learning, Maastricht, the Netherlands.

37. Gruber, H. (Ed.), & Voneche, J. J. (Ed.). 1995. The essential Piaget (100th Anniversary Ed.). New York: Jason Aronson.

38. Gunawardena, C., Lowe, C., and Anderson, T. (1997). Analysis of 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), pp. 397-431.

39. Han,H. J. (2003) Distributed Group Support Systems:Group Decision Making Integrating Mobile Devices With Web-Based Group Communication Unpublished Thesis. NJIT.

40. Hara, N., Bonk, C., & Angeli, C. (1998). Content Analysis of Online Discussion in an AppliedEducational Psychology Course. In N. Hara (Ed.) Instructional Science, 28:2, pp. 115-152.

41. Henri, F. 1992. Computer conferencing and content analysis. In Computer supported collaborative learning, ed. C.O/Malley. Heidelberg, Germany: Springer-Verlag.

42. Herring, S. C. (2004) Computer-mediated Discourse Analysis: An Approach to Researching Online Behavior. In Brab, S. A., Kling, R., and Gray, J. H. (Eds.).Designing for Virtual Communities in the Service of Learning. New York: Cambridge University Press.

43. Hilmer, K. and Dennis, A. (2001) Stimulating Thinking: Cultivating Better Decisions with Groupware Through Categorization. Journal of Information Systems, 17(3), pp. 93-114.

44. Hiltz, S. R., and Turoff, M., 1985. "Structuring computer-mediated communication to avoid information overload," Communications of the ACM, 28 (7), July, pp. 680-689.

45. Hiltz, S. R. and Benbunan-Fich, R. 1997 Supporting collaborative learning in asynchronous learning networks. Keynote address for the UNESCO/Open University symposium on virtual learning environments and the role of the teacher. Milton Keynes, England. April.

46. Hiltz, S. R., and Goldman, R.(Eds.) (2003) Asynchronous Learning Networks: The Research Frontier. Mahwah, New Jersey: Erlbaum.

47. Jegede, O. J., Alaiyemola, F. F. and Okebukola, P. A. O. (1990). The effect of concept mapping on students' anxiety and achievement in biology. Journal of Research in Science Teaching, 27, pp. 950-960.

48. Johnson-Lenz, P., and Johnson-Lenz, T., 1991. Post Mechanistic Groupware Primitives: Rhythms, boundaries and containers. International Journal of Man-Machine Studies, 34, pp. 395-417.

49. Jonassen, D., Davidson, M., Collins, M., Campbell, J. & Haag, B. (1995). Constructivism and computer-mediated communication in distance education. The American Journal of Distance Education, 9(2), pp. 7-26.

50. Jonassen, D. H. (2003). Using cognitive tools to represent problems. Journal of Research of Technology in Education. 35(30). Avail. at: http://www.iste.org/jrte/35/3/abstracts/jonassen.cfm, accessed 02/04.

51. Jonassen, D. H. and Remidez Jr., H. (2005). Mapping alternative discourse structures onto computer conferences. Int. Journal Knowledge and Learning, Vol. 1 Nos. 1/2.

52. Jonassen, D. H., Yacci, K. and Beissner, M.(1993) Structural Knowledge: Techniques for Representing, Conveing and Acquiring Structural Knowledge. New Jersey: Lawrence Erlbaum Associates.

53. Kakitalo, K., Hakkinen, P., Leinonen, P. and Jarvela, S. (2002). Mechanisms of common ground in case-based web discussions in teacher education. Internet and Higher Education. 5. Avail. at: http://www.info.uta.fi/ttutk/conference/makitalo.htm, accessed 02/04.

54. Keen, G. W. (1981). Information Systems and Organizational Change. Communications of the ACM, 24(1), pp. 24 – 33.

55. Kreijns, K., Kirschner, P. A. and Jochems, W. (2004). Determining Sociability, Social Space, and Social Presence in (A)snchronous Collaborative Groups. Cyberpsychology & Behavior.

56. Marton, F., Hounsell, D. and Entwistle, N. (eds) (1984). The Experience of Learning. Edinburgh: Scottish Academic Press.

57. Massey, A. P., Montoya-Weiss, M. M. and Hung, Y. 2003. Because time matters: Temporal coordination in global virtual project teams. Journal of Management Information Systems, 19(4), pp. pp. 129-155.

58. McLoughlin, C. and Luca, J. (2000) Cognitive engagement and higher order thinking through computer conferencing: We know why but do we know how? In Herrmann, A. & Kulski, M. M. (Eds.), Flexible futures in tertiary teaching. Proceedings of the 9th Annual Teaching Learning Forum, 2-4 February 2000. Perth, Western Australia: Curtin University of Technology.

59. Merrill, M. D. (1994) Instructional Design Theory. Englewood Cliffs: Educational Technology Publications.

60. Merrill, M. D. (2000) Knowledge Objects and Mental-Models. In: Wiley, D. (Ed.) The Instructional Use of Learning Objects.

61. Meyer, B. J. F. (1975). The organization of prose and it's effect on memory. Amsterdam: North Holland.

62. Meyer, K. A. (2003). Face-To-Face Versus Threaded Discussions: The Role of Time and Higher-Order Thinking. JALN, 7(3).

63. Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 63, pp. 81-97.

64. Miller, S. M., and Miller, L. L. (1999). Using Instructional Theory to Facilitate Communication in Web-based Courses. Educational Technology & Society, 2(3). Avail. at: http://ifets.ieee.org/periodical/vol_3_99/miller.html, accessed 02/04.

65. Minsky, M. (1975) A framework for representing knowledge. In Winston, P. H. (Ed.) The Psychology of Computer Vision. New York: McGraw-Hill.

66. Mitchell, P. D., and Taylor, S. G. (1991). Concept mapping as an aid to computer mediated conversation: An application of conversation theory. Paper presented to Association for Educational Communications and Technology, Orlando, Fl.

67. Mowshowitz, A. (1981). On Approaches to the Study of Social Issues in Computing. Communications of the ACM. 24(3), pp. 146-155.

68. National Center for Education Statistics, 2003. Avail. at: http://nces.ed.gov/surveys/frss/publications/2004011/2.asp, accessed 02/04.

69. Novak, J. D. (1998) Learning, Creating and Using Knowledge. Concept maps as Facilitative Tools in Schools and Corporations. Mahway, New Jersey: Erlbaum Associates.

70. Novak, J. D. and Gowin, D. G. (1984) Learning How to Learn. Cambridge University Press.

71. Nunnally, J. C. (1978). Psychometric Theory (2nd ed.). New York: McGraw-Hill.

72. Nussbaum, E. M. and Sinatra, G. M. (2003) Argument and Conceptual Engagement. Contemporary Educational Psychology. 28, pp. 384-395.

73. Oliver, M. and Shaw, G. P. (2003). Asynchronous discussion in support of medical education. JALN. 7(1). Avail. at: http://www.aln.org/publications/jaln/v7n1/pdf/v7n1_oliver.pdf, accessed 02/04.

74. O'Loughlin, M. 1992. Rethinking science education: Beyond Piagetian constructivism toward a sociaocultural model of teaching and learning. Journal of Research in Science Teaching (29:8), pp. 791-820.

75. O'Neil, H. F., Jr., & Herl, H. E. (1998, April). Reliability and validity of a trait measure of self-regulation. Presented at the annual meeting of the American Educational Research Association, San Diego, CA.

76. Orr, B. 1997. A significant difference. Avail. at: http://teleeducation.nb.ca/anygood/asigdiff.shtml, accessed 02/04.

77. Paas, F. (1992). Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive-load approach. Journal of Educational Psychology, 84, pp. 429-434.

78. Paas, F. Tuovinen, J. E., Tabbers, H. and van Gerven, P. W. M. (2003). Cognitive load measurement as a means to advance cognitive load theory. Educational Psychologist, 38(1), pp. 63-71.

79. Parsons. J. E., & Goff, S. (1978). Achievement motivation: Dual modality. Educational Psychologist, 13, pp. 93-96.

80. Pincas, A. (1998). Successful online course design: Virtual frameworks for discourse construction. Educational Technology & Society, 1(1).

81. Pintrich, P. R., and Schunk, D. H. (1995) Motivation in Education: Theory, Research, and Applications. New York: Prentice Hall.

82. Pintrich, P. R., Smith, D. A. F., Garcia, T., and McKeachie,W. J. (1991) A Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ).

83. Ravenscroft, A. (1997). Learning as knowledge refinement: a computer based approach. Unpublished Ph.D. thesis, Computer Based learning Unit, University of Leeds, UK.

84. Ravenscroft, A. (2000). Designing argumentation for conceptual development. Computers and Education (34), pp. 241-255.

85. Richardson, J. T. E., Eysenck, M. W., and Warren Piper, D. (eds) (1987). Student Learning: Research in Education and Cognitive Psychology. Milton Keynes: SRHE; Open University Press.

86. Rourke, L, Anderson, T., Garrison, D. R. and Archer, W. (2000). Methodological issues in the content analysis of computer transfer transcripts. International Journal of Artificial Intelligence in Education, 11. Avail. at: http://computing.unn.ac.uk/staff/cgpb4/ijaied/members01/archive/vol_12/rourke/paper.pdf, accessed 02/04.

87. Rourke, L., and Anderson, T. (2002) Using Peer Teams to Lead Online Discussions. Journal of Interactive Media in Education. (1). Avail. at: http://www-jime.open.ac.uk/2002/1/rourke-anderson-02-1-t.html, accessed 02/04.

88. Rumelhart, D. E. (1980). Schemata: The building blocks of cognition. In Spiro, R. J., Bruce, B. C. & Brewer, W. F. (Eds.), Theoretical issues in reading coomprehension: Perspectives from cognitive psychology, linguistics, artifical intelligence, and education. Hillsdale, NJ: Lawrence Erlbaum Associates.

89. Russell, T. 1999. The no significance difference phenomenon. Office of instructional telecommunications, North Carolina State University, Chapel Hill, N.C.

90. Schank, R. C., & Abelson, R. P. (1977). Scripts, plans, goals and understanding. Hillsdale, NJ: Lawrence Erlbaum Associates.

91. Schmeck, Ribich & Ramanaiah. (1977) Inventory of Learning Process ILP. Avail. at: http://www-dsz.service.rug.nl/bss/so/topics/research/gent2.htm, accessed 02/04.

92. Schuell, T. J. 1986. Cognitive conceptions of learning. Review of Educational Research, Winter, pp. 411-436.

93. Schwartz,S. H. (1971). Modes of representation and problem solving: Well evolved is half solved. Journal of Experimental Psychology, 91, pp. 347-350.

94. Shavelson, R. J., and Ruiz-Primo, M. A. (2000) Windows into the Mind. Invited address, Facolta'di Ingegneria dell'Universita 'degli Studi di Ancona, June 27.

95. Shen, S. (2004). Collaborative Examination in Asynchronous Learning Networks. Unpublished Ph.D. thesis proposal. NJIT.

96. Slavin, R. E. 1990 Cooperative learning: Theory, research and practice, Prentice Hall, Englewood Cliffs, NJ.

97. Stephens, M. A. (1974). EDF Statistics for Goodness of Fit and Some Comparisons, Journal of the American Statistical Association, Vol. 69, pp. 730.

98. Stoyanova, N., and Kommers, P. (2001) Learning Effectiveness of Concept Mapping in Computer Supported Collaborative Problem Solving Design. Avail. at: http://www.mmi.unimass.nl/euro-cscl/presentations.html, accessed 02/04.

99. Strijbos, J., Martens, R. L., Jochems, W. M. G., and Kirschner, P. A. (2004). The effect of functional roles on perceived grup efficiency and communication during computer-supported collaborative learning. Paper presented at the 2004 Annual Meeting of the American Educational Research Association (AERA), April 12 – 16, San Diego, CA.

100. Suthers, D. D. (2001) Towards a Systematic Study of Representational Guidance for Collaborative learning Discourse. Journal of Universal Computer Science. 7(3). Avail. at: http://lilt.ics.hawaii.edu/lilt/papers/2001/Suthers-JUCS-01.pdf, accessed 02/04.

101. Suthers, D., and Hundhausen, C. D. (2002) The Effects of Representation on Students' Elaborations in Collaborative Inquiry. CSCL 2002.

102. Sweller, J., van Merrienboer, J. J. G., and Paas, F. (1998). Cognitive architecture and instructional design. Educational Psychology review, 10, pp. 251-296.

103. Tu, C. H., and Isaacs, M. (2002). An examination of social presence to increase interaction in online classes. American Journal of Distance Education 16(3), pp. 131-150.

104. Van Boxtel, C., and Veerman, A. (2002) Diagram-mediated Collaborative Learning Diagrams as tools to provoke and support elaboration and elaboration. Euro CSCL 2001. Avail. at: http://www.mmi.unimaas.nl/euro-cscl/ presentations.html, accessed 02/04.

105. Veerman, A. (2004) Constructive discussions through electronic dialogue. In Arguing to Learn. Andriessen, J., Baker, M., and Suthers, D. (Eds.) Kluwer Academic Publishers.

106. Vonderwell, S. (2003). An examination of asynchronous communication experiences and perspectives of students in an online course: a case study. The Internet and Higher Education (6), pp. 77-90.

107. Vrasidas, C. and McIsaac, M. S. (1999). Factors Influencing Interaction in an Online Course. The American Journal of Distance Education. 13(3), pp. 22-36.

108. Vygotsky, L. S. (1980). Mind in society : The development of higher psychological processes. Cambridge: Harvard University Press.

109. Walther, J. B. 1996. Computer-mediated communication: Intrapersonal, interpersonal, and hyperpersonal interaction. Communication Research, 23, 1 February, pp. 3-43.

110. Whipple, W. R. 1987 Collaborative learning: Recognizing it when we see it. Bulletin of the American association for higher education. (40:2), October, 4-6.

111. White, B. (2004). How can cognitive modelling, role playing and collaborative inquiry foster young learner's meta-socio-cognitive development? Paper presented at the 2004 Annual Meeting of the American Educational Research Association (AERA), April 12 – 16, San Diego, CA.

112. Whitworth, B., Gallupe, G. and McQueen, R. 2000. A cognitive three-process model of computer-mediated group interaction. Group Decision and Negotiation, 9, pp. 431-456.

113. Zimmerman, B. J. (1998). Academic standing and the development of personal skill: A self-regulatory perspective. Educational Psychologist, 33(2/3), pp. 73-86.