Student Learning Style and Asynchronous Computer-Mediated Conferencing (CMC) Interaction

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This article describes a study of the relation between learning style, as measured by the Kolb Learning Style Inventory, and online communication behavior, as measured by analysis of transcripts of computer-mediated conferencing (CMC) interaction using a previously developed tool. Analysis of over fifty-nine hundred sentences, generated by forty graduate students in moderated online conferences from two different courses, showed that some theoretical predications of the Kolb learning style model were confirmed, especially for the dichotomous types Convergers and Divergers, and Assimilators and Accommodators.

In this study, learning style denotes individual differences or preferences among learners, which impact learning. Learning style has been defined as the cognitive, affective, and psychological traits that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment (Keefe 1979). This definition recognizes learning style is individual, stable, and predictable (Rourke and Lysynchuk 2000), and thus of potential value to moderators of online interaction (Harasim and Calvert 2002; Stacey 1999).

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In an early discussion of transactional distance, Moore (1991) observed a relation between learning style and perceived distance in any learning relationship; specific learner characteristics, including learning style, influence the amount of dialogue and structure individually optimum for learning. He called for "time and effort … to be devoted to understanding the needs of individual learner populations, and individual learners" (5). In a later work, Moore and Kearsley (1996) added that dialogue and structure might better be viewed as clusters of variables, requiring more examination.

> There is … need for much more research of an empirical nature to identify the many variables that lie within structure, dialog, and autonomy, and to explore them more thoroughly. It is essential that we empirically test specific variables that comprise these broad dimensions, and the relationships among them. (6)

Since these injunctions appeared, researchers have explored the clusters of variables present within important distance education environments related to dialogue, structure, autonomy, and interaction. These inquiries confirm the presence of individual learner differences and preferences affecting outcomes such as satisfaction, fulfillment of expectations, and engagement in the learning process (Atherton 2002; Liu and Ginther 1999; Ross 1998). Such research has proven useful to practitioners in raising awareness of the potential for mismatches between teaching strategies and learner preferences in relation to learner dependence–independence (Joughin 1992), and autonomy and self-direction (Grow 1991).

Other research has identified important differences in communication preferences or styles arising from differences in gender (Fahy 2002a; Herring 1992; Rodino 1997), learning motives and intentions (Donath 1999), experience with technology (Blocher 1997), "list effects" (the influence of the dominant participant group on the whole) (Herring 1996), moderator style (Garrison, Anderson, and Archer 2001), the capabilities of the technologies themselves (Maier et al. 1996), and differences in media use (Mayer 2001).

This study focused on communication behaviors in relation to learning styles and types. As online programs increasingly rely on computer-mediated conferencing (CMC) to provide dialogue and structure, through learner–tutor, learner–learner, and learner–content interaction (Gunawardena 1999; Moore 1989), knowledge of the individual uses of and responses to CMC-based interaction should be of practical use to online instructors and moderators, and to researchers examining phenomena such as CMC-based communities of inquiry (Garrison, Anderson, and Archer 2001).

Background of the Study

The Kolb Learning Style Inventory

In this study, learning style was determined by the Kolb Learning Style Inventory (Kolb 1985). Kolb (1984, 1993) held that learning style is the characteristic way an individual learns from or deals with new ideas or situations in daily life, "a … way of responding to and using stimuli in the context of learning" (Clark 2000, par. 1).

> These various learning styles or intelligences are points along a scale that help us to discover the different forms of mental representation; they are not good characterizations of what people are (or are not) like. … What these various instruments are doing is allocating the person along some point on a continuum (similar to measuring height or weight). In other words, do not pigeon-hole people, as we are all capable of learning under any style or intelligence no matter what our preference is. (Clark 2000, par. 4)

Kolb data were studied here in relation to online interaction activities of two classes of graduate students, participating in CMC conferences as part of their coursework, and moderated by the authors. Communication behavior was described using a previously developed tool, the Transcript Analysis Tool (TAT) (Fahy 2002a, 2002b, 2003; Fahy, Crawford, and Ally 2001). The purposes of the study were first, to survey and describe the Kolb learning styles in the two groups of participants, and then to relate the Kolb types to patterns of online communication behavior as described by the TAT.

The differences observed in learning and communication styles were viewed as part of what Marton and Säljö (1997, 40) refer to as the "functional background of differences" in any learning situation that can lead to varying outcomes among individuals immersed in the same environment. Curiosity about why individuals respond and interact differently in the same online communities, and why they derive different outcomes from the same opportunities, including achievement of "community of inquiry" (Garrison, Anderson, and Archer 2000), was a motivation of the study.

Although there are many instruments for describing learning and cognitive style (O'Connor 2003; Rourke and Lysynchuk 2000), the Kolb Learning Style Inventory has some attractions. It is consistent with an andragogic teaching philosophy; in Atherton's (2002, para. 1) words, the Kolb is "one of the most useful descriptive models of the adult learning process available." As a measure of learning style, it has been widely used satisfactorily in a variety of research situations, including cross-cultural

contexts (Experiential Learning 2004). Reported interrater reliability for the instrument ranges from .71 to .86 (Veres, Sims, and Locklear 1991), and from .91 to .99 (Garland 2002). These facts, along with the instrument's brevity and conciseness, suited it for this study.

The Kolb represents learning and cognitive style in terms of Levin's "cycle of adult learning" (Cartwright 1951; Kolb 1984) (see Figure 1). This model addresses learner processing and perception activities, as shown. The cycle analogy shows how common phases may occur or recur at different times and rates. In the model, perception ranges from concrete (sensing, feeling) to abstract (thinking, reasoning), and processing from active (testing, experiencing) to passive (watching, reflecting) (Atherton 2002; Gray and Palmer 2001; Kolb 1993; Marton and Säljö 1997).

Kolb's theory holds that individuals move through these stages as they learn: when perceiving some new phenomenon or fact, they are assimilative; when experimenting with new material, they are convergent; when considering the implications of new knowledge, or attempting to relate to it in some way, they are divergent; and when integrating new information or experiences, they are accommodative. As noted, the order in which these stages are accomplished, and the ease with which they are completed, vary individually, reflecting individual differences such as
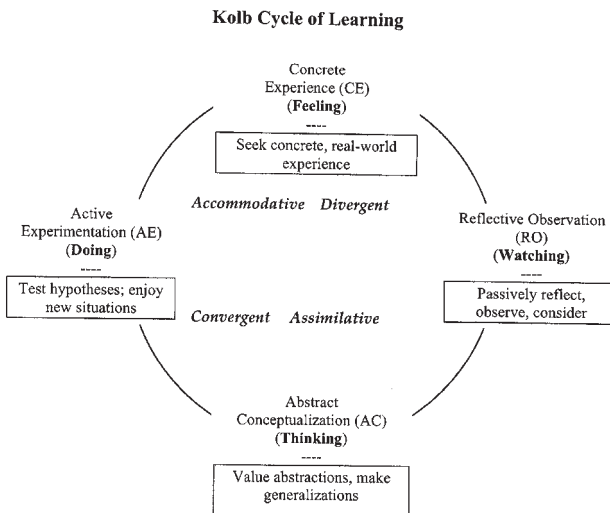

Figure 1. Kolb Categories and Associated Behaviors
Adapted from David A. Kolb, *Learning Style Inventory.* Copyright © 1993. Reprinted by permission of the Hay Group.

sources of energizing relationships (from groups for extraverts, or from solitary experiences for introverts), and the view taken of experience (atomistic for inductive thinkers, holistic for the more deductive).

Teaching should "chase the learner around the cycle" (Atherton 2002). "Teaching around the cycle" (Felder 1996) involves various elements: explanations of the relevance of new learning (for those with concrete and reflective styles); provision of basic information (for the abstract and reflective); practice opportunities (for the abstract and active); and real-world applications of new knowledge (for the concrete and active).

Learning style is not without its critics. Szabo (1998) noted conflicting results are common in learning style research, some studies showing better recall among students taught in their preferred modality, others showing no differences. In distance education there are particular difficulties. Gray and Palmer (2001) noted few theoretical frameworks for judging the impact of learning style in online learning exist. Loomis (2000) observed "little if any" learning style research has been done on asynchronous learning networks. Despite these limitations, there is continuing, even increasing, interest by online practitioners and researchers in the topic (Policy Center 2003).

The Study

Participants

Graduate students enrolled in one of two Athabasca University master's level courses (one a required "core" course, the other an elective) voluntarily completed the Kolb Learning Style Inventory. The inventory was distributed and returned by mail or fax; one of the researchers scored and interpreted the submissions.

Forty of fifty-two students (77%) participated. CMC use was similar in both courses: students were to post comments in response to questions posed by the instructor, or in reply to other students' posts. Ten and fifteen marks, respectively, were awarded for CMC participation in the option and core course. The instructors moderated the conferences, to provide "instructor presence" (Garrison, Anderson, and Archer 2001).

The Instrument

The Kolb Learning Style Inventory used in this study is an ipsative (rather than a normative) measure of learning style (Baron 1996; Policy

Center 2003), producing a scale that describes the participants' relative learning style. Participants rank each of twelve sentences, using the four phrases "most like you," "second most like you," "third most like you," and "least like you" (Kolb 1985). Four points are allotted for each "most like" rating, three for each "second most," and so on, totaling ten points per sentence. When the points (maximum total 120) are summed, a profile is obtained, ranking the participant's preferences for "watching," "thinking," "doing," and "feeling" (Figure 1).

The Transcript Analysis Tool (TAT)

Previous literature has reported analysis of transcripts of CMC interaction using the TAT, examining communication styles and networking preferences (Fahy 2002a, 2002b, 2003; Fahy, Crawford, and Ally 2001). The TAT focuses on eight sentence-level elements within the transcript (Fahy, Crawford, and Ally 2001):

1. Questioning (type 1A, vertical; type 1B, horizontal)
2. Statements (type 2A, nonreferential; type 2B, referential)
3. Reflections
4. Scaffolding–engaging
5. Quotations–citations (type 5A, quotations and paraphrases; type 5B, citations)

In about 2% of the cases, more than one code is assigned to a sentence, in recognition of the fact that sentences may include more than one type of interaction, and that forcing such communications into a single category may damage the validity of the analysis (Fahy 2001; Rourke et al. 2001). ATLAS.ti was used for coding and analysis of transcripts; SPSS-PC was used for statistical routines.

Three research questions were posed:

1. What pattern of learning styles was found in the two study groups using the Kolb Inventory?
2. What differences in communication style, as measured by the TAT, were found in relation to the learning styles observed?
3. What implications for online interaction and community building, if any, arise from the answers to these questions?

Results

Learning Style Patterns

The presence of the four Kolb learning styles was determined in relation to gender, and for the two courses used in the study (Table 1). Chen (1999) found, in a study of learning style in older adults, that the largest groups were Assimilators (42%) and Divergers (31%), with Convergers and Accommodators comprising the remaining 27%. Here also, Assimilators comprised the largest group (37%), but Convergers were second, at 33%. Not only did Accommodators and Divergers constitute less than one-third (29%) of the total, but those two groups included only three males (out of twelve persons of this type). The differences reported in Tables 1 and 2 were not statistically significant, perhaps due to the relatively homogeneous backgrounds of these graduate students (other possible explanations are discussed later).

Table 2 shows the occurrence of the four Kolb types in the two courses studied.

Communication Patterns Shown by the TAT

To address the second question, communications in the two groups were examined using the TAT to determine whether styles of interaction differed by gender, course (core, option), or Kolb type (Converger, Diverger, Assimilator, Accommodator). Table 3 shows gender distributions of TAT categories found in the transcripts of the two courses (none of the differences are significant).

Some previous studies (Fahy 2002b; Herring 1992, 1996) reported a relation between gender and online interaction patterns, but none was found

Table 1. Gender Distribution of Kolb Categories, Core and Option Courses Combined

Kolb Category	Female (*n* = 27)		Male (*n* = 13)		Total (*n* = 40)	
	#	%	#	%	#	%
Divergers	3	11	2	15	5	12.5
Assimilators	11	41	4	30	15	37.5
Convergers	7	26	6	46	13	32.5
Accommodators	6	22	1	8	7	17.5
Total	27	100	13	99	40	100

Note: Because of rounding, the values of the percentages may not total 100%.

Table 2. Kolb Types by Course

Kolb Category	Core (n = 23)		Option (n = 17)		Total (n = 40)	
	#	%	#	%	#	%
Divergers	4	17	1	6	5	12.5
Assimilators	7	30	8	47	15	37.5
Convergers	9	39	4	24	13	32.5
Accommodators	3	13	4	24	7	17.5
Total	23	99	17	101	40	100

Note: Because of rounding, the values of the percentages may not total 100%.

Table 3. Gender and Transcript Analysis Tool (TAT) Frequencies

TAT Types	Males (n = 13)		Females (n = 27)		Total (n = 40)	
	#	%	#	%	#	%
1A: Vertical questions	26	1	38	1	64	1
1B: Horizontal questions	90	4	136	3	226	4
2A: Expository statements	1203	59	2444	63	3647	62
2B: Referential statements	119	6	263	7	382	6
3: Reflections	66	3	133	3	199	3
4: Scaffolding, engaging	366	18	554	14	920	16
5A: Quotations, paraphrases	84	4	175	4	259	4
5B: Citations	73	4	155	4	228	4
Total	2027	99	3898	99	5925	100

Note: Because of rounding, the values of the percentages may not total 100%.

here. Reasons may include the fact this conference was moderated (other studies used the transcripts from unmoderated listservs); small sample sizes (Fahy 2001; Lawlor 2004; Poscente 2003); and differences in the subject matter, moderating styles, quality of feedback, and levels of the participants' prior experience with CMC (Maushak et al. 2000).

Statistical differences emerged at the course level (Table 4): the option course students generated proportionately more expository statements (2A) and quotations and paraphrases (5A), while the core course generated more reflections (3). Although the core course instructor used somewhat

Table 4. Course and Transcript Analysis Tool (TAT) Frequencies

| TAT Types | Students | | | | | | | Instructors | | | |
| | Core (*n* = 23) | | Option (*n* = 17) | | Total (*n* = 40) | | | Core | | Option | |
	#	%	#	%	#	%	Prob. (*t*)	#	%	#	%
1A: Vertical questions	33	1	31	1	64	1	.484	0	0	55	11
1B: Horizontal questions	146	5	80	3	226	4	.308	13	6	40	8
2A: Expository statements	1720	56	1927	68	3647	62	**.042**	106	51	209	41
2B: Referential statements	201	7	181	6	382	6	.388	17	8	80	16
3: Reflections	170	5	29	1	199	3	**.000**	3	1	3	1
4: Scaffolding, engaging	584	19	336	12	920	16	.320	56	27	68	13
5A: Quotations, paraphrases	87	3	172	6	259	4	**.018**	5	2	35	7
5B: Citations	151	5	77	3	228	4	.363	7	3	20	4
Total	3092	101	2833	100	5925	100		207	98	510	101

Note: Because of rounding, the values of the percentages may not total 100%.

more expository statements (TAT type 2A), the core course students used this sentence type more often. Though the option instructor used referential statements (2B) twice as often as the core instructor, his students did not differ in their use of this sentence type from the core students.

Poscente (2003) noted a tendency for students in CMC to imitate the style of the moderator. Here, the instructor asked direct questions and referred to relevant student remarks, but the students more often responded with direct statements, answers, or elaborations; when the instructor provided considerable scaffolding (approximately one-fourth of his posts), students used more reflections. In sum, imitation was not apparent, nor were "list effects" (Herring 1996), findings similar to Lawlor's (2004).

Differences in Kolb Results

The Kolb model posits that learners differ in their preferences for the opposing dimensions of action–reflection and concreteness–abstraction. According to the theory, concrete–active Accommodators should differ most from abstract–reflective Assimilators, while concrete–reflective Divergers should differ most from abstract–active Convergers. Table 5 shows the comparison of Convergers with Divergers.

Table 5 confirms that Convergers and Divergers communicated differently, as predicted by Kolb theory: Convergers made significantly more postings and made longer postings (in numbers of words) than did Divergers. This greater verbosity was reflected in TAT results: Convergers

Table 5. Convergers Compared With Divergers

TAT Type	Convergers (*n* = 13)		Divergers (*n* = 5)		
	M	*SD*	*M*	*SD*	**Prob. (*t*)**
Number of postings	19.46	8.09	8.80	5.26	**.007**
Number of words	3034	1567	1540	566	**.009**
1A: Vertical questions	1.92	1.66	1.00	1.23	.226
1B: Horizontal questions	8.31	6.01	3.60	3.29	**.053**
2A: Expository statements	125.85	68.83	47.00	24.65	**.003**
2B: Referential statements	10.38	7.37	4.20	4.03	**.040**
3: Reflections	6.38	5.85	3.20	3.49	.182
4: Scaffolding	30.62	22.13	12.80	9.63	**.031**
5A: Quotes, paraphrases	8.62	7.52	1.20	0.84	**.004**
5B: Citations	9.92	9.52	1.60	2.61	**.011**

Note: TAT = Transcript Analysis Tool.

made significantly more use of all the TAT types of sentences, except vertical questions (1A) and reflections (3).

In the Kolb model, Convergers are attracted to real problems, preferring practical applications to theorizing or reflection, are pragmatic and hands-on in problem solving, and are drawn to and benefit from opportunities for guidance and feedback as they practice new skills or explore new knowledge (Chapman 2003; Felder 1996). Convergers use their intuition in problem solving, and they may appear less concerned about relationships when engaged in technical questions (Policy Center 2003). They prefer "public" interaction (Atherton 2002).

In this study, the greater involvement of Convergers in a moderated, content-focused discussion is consistent with these expectations, and with the actual online environment: two-thirds of the interaction here dealt with expository or referential statements, while a further 8% dealt with citations, documentation, and references (5A and 5B). In total, over three-quarters of the interaction was, from the point of view of Convergers, "substantive"—directly related to the problem-discussion and resolving processes they would be theoretically expected to favor. At the same time, departures from the preferred Converger style were minimal: there was little reflection (type 3), and there were fewer network-maintenance-related activities such as scaffolding and engaging (type 4).

Divergers, on the other hand, preferring observation (to discussion), privacy, thought and reflection on new information, and use of the imagination, would be expected, according to Kolb theory, to be less attracted to the factual, linear discussion of the kind found in the CMC conferences. Their lesser participation, as shown previously, confirms this response (Chapman 2003; Policy Center 2003).

Table 6 shows how the second set of theoretically opposed pairs, Assimilators and Accommodators, compared.

Here, the only difference noted was in relation to scaffolding and engaging: Accommodators generated more scaffolding and engaging (type 4) sentences than did Assimilators. In TAT terms, type 4 statements initiate or sustain dialogue, and include others by encouraging, reaching out, thanking, recognizing, and acknowledging others' contributions. Type 4 includes all activities intended to initiate, sustain, and strengthen the social network. According to the Kolb model, Accommodators tend to rely on their feelings and prefer to be active and doing, while Assimilators prefer thinking and watching (Chapman 2003). Accommodators are also drawn to the process of discovery, and the application of new knowledge to real problems, while Assimilators are more theory-oriented, preferring observation and

Table 6. Assimilators Compared With Accommodators

TAT Type	Assimilators (*n* = 15)		Accommodators (*n* = 7)		Prob. (*t*)
	M	*SD*	*M*	*SD*	
Number of postings	14.0	8.05	14.0	7.23	.999
Number of words	2343	1236	2338	1963	.994
1A: Vertical questions	1.27	1.49	2.14	2.48	.412
1B: Horizontal questions	4.93	4.27	3.71	3.82	.514
2A: Expository statements	83.60	48.96	74.57	54.74	.717
2B: Referential statements	9.93	5.30	11.00	9.38	.786
3: Reflections	5.07	4.62	3.43	2.44	.291
4: Scaffolding	24.33	15.09	13.29	9.20	**.048**
5A: Quotes, paraphrases	7.13	11.28	4.86	5.18	.524
5B: Citations	4.60	4.62	3.14	3.02	.392

Note: TAT = Transcript Analysis Tool.

reflection (Felder 1996; Policy Center 2003). In this respect, the greater attention of Accommodators to the health and maintenance of the social network, while the only difference observed between the two groups, is consistent with theoretical expectations.

Implications for Interaction and Community Building

In relation to this question, an intriguing finding was the greater involvement of the Convergers over the three other groups, and especially over their theoretical opposite type, the Divergers. The orientation of Convergers is to abstraction over concreteness, action over reflection. Though asynchronous CMC is celebrated for permitting time for reflection (French et al. 1999), Divergers did not respond in this study with more involvement, even with this expected advantage.

An explanation may lie in the nature of the interaction, as shown by the TAT. Convergers did not appear to find the discussion's factual nature (shown by the high proportion of type 2A statements) uncongenial to their preference for the abstract. The lack of immediacy or synchronicity in interaction may have enabled Convergers to process others' comments into

abstractions, permitting the application of intuition. Also, the predominantly factual discussion may have appealed to the Convergers' pragmatic orientation to real-world problems and experiences. The low level of "socializing" (TAT type 4 sentences) also would have suited this group. In all these respects, the opposite would have been true for Divergers. (These speculations obviously require further investigation.)

Discussion and Conclusions

This study examined differences in learning style in relation to observable features of online interaction found in transcripts. The intention was to assess learning style as a factor in the interaction of an online learning community, developed and sustained wholly by CMC. While the study was not primarily intended to confirm the construct of learning style per se (this basic assumption was made, for the study's purposes), some of the findings were found to be theoretically consistent with predictions of the Kolb model.

As noted, there is consensus that the whole "cycle of learning" (Felder 1996; Gray and Palmer 2001) should normally be completed by all learners, as a part of a balanced instructional strategy, regardless of learning style or preference. Completing the whole cycle requires learners to be functional (if not comfortable) in all learning environments, engaging in activities requiring action–reflection and abstraction–concreteness.

Regarding this view, the results warn that even in an environment in which the complete learning cycle might be intended, individual differences in amounts and types of interaction may still be expected. Learning and communication styles may be seen as propensities, disposing certain behaviors but not rigidly dictating them. In practical terms, some learning styles (Convergers, in this study) may be disposed to greater participation, finding online interaction (and online communities) attractive, while other styles find the requirement to interact regularly less useful, even toilsome. How different learning and communication styles promote or inhibit learning for various individual learning types remains unanswered.

To summarize the answers to the study's three questions: First, differences in learning style were not found to be associated with gender, or with the two courses from which the participants came. This finding is at odds with some previous studies, where gender was found to be a factor in the context of task type and purpose of group communications (DeSanctis and Gallupe 1987; Fahy 2002b; Herring 1992, 1996).

The finding that Convergers seemed most engaged with the online network was consistent with theoretical expectations: Convergers' prefer-

ences are better met by a practical, moderated, content-oriented discussion, with relatively little socializing or other "distractions" (Walther 1996). Other researchers have speculated that hypermedia favor those able and willing to impose their own structure on new information (Rourke and Lysynchuk 2000), a good description of the behavior of Convergers here.

Although the Accommodators appeared to be most comfortable in the online environment, they were not the majority among the participants, most of whom were Assimilators. Assimilators are oriented to reflection and abstraction (not surprising in a sample of graduate students). The issue for use of CMC with students of this orientation is that they may sometimes simply "lurk"—in fact, perhaps, reflecting on the discussion and their possible contribution. The caution to moderators not to prematurely disparage such behavior should be clear.

The findings of the TAT analysis showed among all groups expository statements (type 2A) were the dominant type of interaction, followed very distantly by scaffolding–engaging comments (type 4). The proportion of type 2A sentences (there were a total of 3,647 of these, 62% of all sentences) varied only 4% (from 64% for Accommodators to 59% for Assimilators); however, the range of type 4 sentences, with a much smaller total (920; 16% of all sentences), was 6% (from 17% for Divergers and Assimilators, to 11% for Accommodators). This suggests that differences in involvement with the online network (especially type 4 "engaging") may distinguish groups more than their focus on the factual elements of the discussion (type 2A statements). In these groups, the best indicator of learning type was engagement in noncontent-related conference activity—attending to the social environment with TAT type 4 comments—not content-related interaction (in which all Kolb types engaged regularly and nearly equally).

There is potential value in the results of the study for instructors and moderators of courses using CMC. The active-abstract character of the Converger group differed most from its opposite (the Divergers), and was the learning style which was most involved in the online community (Convergers averaged considerably more words and posts). By their greater engagement, Convergers demonstrated their willingness to spend more time and energy on the network itself. The choice to spend time on online community health may be seen as governed by the principle that the value gained from such efforts must be equal to or greater than the costs. Convergers must find value in their extra efforts (the exact nature of the "payoffs" would be a fruitful topic of further study) (Ridley and Avery 1979).

Finally, if it is true that preference for social interaction varies by learning style, there are immediate implications for CMC and other social inter-

action strategies in teaching. Not only might some participants find online interaction unnecessary to learning, they may, in extreme cases, even find it inimical (DeSanctis and Gallupe 1987; Walther 1996). This individual difference makes the good intentions of programmers quite irrelevant: if students are not permitted to participate in CMC as their individual styles and preferences dispose, the requirement for online interaction may ironically become a potential barrier to learning.

References

Atherton, J. S. 2002. Learning and teaching: Learning from experience. Available online at http://www.dmu.ac.uk/~jamesa/learning/experien.htm

Baron, H. 1996. Strengths and limitations of ipsative measurement. *Journal of Occupational and Organizational Psychology* 69:49–56.

Blocher, M. 1997. Self-regulation of strategies and motivation to enhance interaction and social presence in computer-mediated communication. Ph.D. diss., Arizona State University, Tempe.

Cartwright, D. (ed.). 1951. *Field theory in social science: Selected theoretical papers by Kurt Lewin.* New York: Harper Torchbooks.

Chapman, A. 2003. Kolb learning styles. Available online at http://www.businessballs.com/kolblearningstyles.htm

Chen, T. 1999. The relationship between learning style and attitude toward distance education among older adult learners at National Open University of Taiwan. Ph.D. diss., The Pennsylvania State University, University Park.

Clark, D. 2000. Learning styles. Available online at http://www.nwlink.com/~donclark/hrd/learning/styles.html

DeSanctis, G., and R. B. Gallupe. 1987. A foundation for the study of group decision support systems. *Management Science* 33 (5): 589–609.

Donath, J. 1999. Identity and deception in the virtual community. In *Communities in cyberspace,* ed. M. Smith and P. Kollock, 29–59. London: Routledge. Available online at http://smg.media.mit.edu/people/judith/Identity/IdentityDeception.html

Experiential Learning. 2004. Available online at http://www.learningfromexperience.com/Tech_spec_LSI.pdf

Fahy, P. J. 2001. Addressing some common problems in transcript analysis. *International Review of Research in Open and Distance Learning* 1 (2). Available online at http://www.irrodl.org/content/v1.2/research.html#Fahy

———. 2002a. Use of linguistic qualifiers and intensifiers in a computer conference. *The American Journal of Distance Education* 16 (1): 5–22.

———. 2002b. Epistolary and expository interaction patterns in a computer conference transcript. *Journal of Distance Education* 17 (1): 20–35.

———. 2003. Indicators of support in online interaction. *International Review of Research in Open and Distance Learning* 4 (1). Available online at http://www.irrodl.org/content/v4.1/fahy.html

Fahy, P. J., G. Crawford, and M. Ally. 2001. Patterns of interaction in a computer conference transcript. *International Review of Research in Open and Distance Learning* 2 (1). Available online at http://www.irrodl.org/content/v2.1/fahy.html

Felder, R. M. 1996. Matters of style. Available online at http://www.ncsu.edu/felder-public/Papers/LS-Prism.htm

French, D., C. Hale, C. Johnson, and G. Farr (eds.). 1999. *Internet-based learning.* London: Kogan Page.

Garland, D. 2002. Learning style characteristics of the online student: A study of learning styles, learner engagement and gender. Ph.D. diss., University of Missouri, Columbia.

Garrison, R., T. Anderson, and W. Archer. 2000. Critical inquiry in a text-based environment: Computer conferencing in higher education. *Internet and Higher Education* 2 (2): 87–105.

———. 2001. Critical thinking, cognitive presence, and computer conferencing in distance education. *The American Journal of Distance Education* 15 (1): 7–23.

Gray, D., and J. Palmer. 2001. Learning styles and Web-based training: The 4MAT methodology. *WebNet Journal,* (April–June) 43–51.

Grow, G. 1991. Teaching learners to be self-directed. *Adult Education Quarterly* 41 (3): 125–149.

Gunawardena, L. 1999. The challenge of designing and evaluating "interaction" in Web-based distance education. Paper presented at WebNet 99, World Conference on the WWW and Internet. ERIC, ED 448718.

Harasim, L., and T. Calvert. 2002. Seven years of telelearning research in Canada (1995–2002). *Journal of Distance Education* 17 (3): 1–3.

Herring, S. C. 1992. Gender and participation in computer-mediated linguistic discourse. Paper presented at the Annual Meeting of the Linguistic Society of America, Philadelphia, January 9–12. ERIC, ED 345552.

———. 1996. Two variants of an electronic message schema. In *Computer-mediated communication,* ed. S. C. Herring, 81–106. Philadelphia: John Benjamins.

Joughin, G. 1992. Cognitive style and adult learning principles. *International Journal of Lifelong Learning* 11 (1): 3–14.

Keefe, J. W., ed. 1979. *Student learning styles: Diagnosing and prescribing programs.* Reston, VA: National Association of Secondary School Principals.

Kolb, D. 1984. *Experiential learning: Experience as the source of learning and development.* Englewood Cliffs: Prentice Hall.

———. 1985. Learning-style inventory: Self-scoring inventory and interpretation booklet. Boston: McBer and Company.

———. 1993. *Learning Style Inventory.* Boston: McBer and Company.

Lawlor, C. 2004. Gendered interactions in computer mediated conferencing: Participation, purposive differences, and "list effects." Master's thesis, Athabasca University, Alberta, Canada.

Liu, Y., and D. Ginther. 1999. Cognitive styles and distance education. *Online Journal of Distance Administration* 2 (3): 22–41.

Loomis, K. D. 2000. Learning styles and asynchronous learning: Comparing the LASSI model to class performance. *Journal of Asynchronous Learning Networks* 4 (1): 23–32.

Maier, P., L. Barnett, A. Warren, and D. Brunner. 1996. *Using technology in teaching and learning.* London: Kogan Page.

Marton, F., and F. Säljö. 1997. Approaches to learning. In *The experience of learning,* 2nd ed., ed. F. Marton, D. Hounsell, and N. Entwistle, 39–58. Edinburgh: Scottish Academic Press.

Maushak, N., H. H. Chen, L. Martin, B. Shaw, and D. Unfred. 2000. Distance education: Looking beyond the No Significant Difference. Annual proceedings of Selected Research and Development Papers, National Convention of the Association for Educational Communications and Technology, Denver, CO, October. ERIC, ED 455779.

Mayer, R. E. 2001. *Multimedia learning.* New York: Cambridge University Press.

Moore, M. G. 1989. Three types of interaction. *The American Journal of Distance Education* 3 (2): 1–6.

———. 1991. Editorial: Distance education theory. *The American Journal of Distance Education* 5 (3): 1–6.

Moore, M. G., and G. Kearsley. 1996. *Distance education: A systems view.* Belmont, CA: Wadsworth.

O'Connor, T. 2003. Using learning styles to adapt technology for higher education. Available online at http://web.indstate.edu/ctl/styles/learning.html

Policy Center on the First Year of College, Brevard College. 2003. Learning styles assessment instruments. Available online at http://www.brevard.edu/fyc/resources/Learningstyles.htm

Poscente, K. 2003. Trigger analysis in computer mediated conferencing. Master's thesis. Athabasca University, Alberta, Canada.

Ridley, C., and A. Avery. 1979. Social network influence on the dyadic relationship. In *Social exchange in developing relationships,* ed. R. Burgess and T. Huston, 223–246. New York: Academic.

Rodino, M. 1997. Breaking out of binaries: Reconceptualizing gender and its relationship to language in computer-mediated communication. *Journal of Computer-Mediated Communications* 13 (3). Available online at http://www.ascusc.org/jcmc/vol3/issue3/rodino.html

Ross, J. 1998. On-line but off course: A wish list for distance educators. *International Electronic Journal for Leadership in Learning* 2 (3). Available online at http://www.acs.ucalgary.ca/~iejll/volume2/Ross2_3.html

Rourke, L., T. Anderson, D. R. Garrison, and W. Archer. 2001. Methodological issues in the content analysis of computer conference transcripts. *International Journal of Artificial Intelligence in Education* 12:8–22.

Rourke, L., and L. Lysynchuk. 2000. The influence of learning style on achievement in hypertext. Paper presented at the AERA Conference, April. ERIC, ED 446102.

Stacey, E. 1999. Collaborative learning in an online environment. *Journal of Distance Education* 14 (2): 14–33.

Szabo, M. 1998. *Survey of educational technology research.* The Educational Technology Professional Development Project (ETPDP) Series. Edmonton, Alberta, Canada: Grant MacEwan Community College and Northern Alberta Institute of Technology.

Veres, J. G., R. Sims, and T. Locklear. 1991. Improving the reliability of Kolb's Revised Learning Style Inventory. *Educational and Psychological Measurement* 51:143–150.

Walther, J. B. 1996. Computer-mediated communication: Impersonal, interpersonal and hyperpersonal interaction. *Communication Research* 20 (1): 3–43.