BUILDING A TAXONOMY AND NOMENCLATURE OF COLLABORATIVE WRITING TO IMPROVE INTERDISCIPLINARY RESEARCH AND PRACTICE

Paul Benjamin Lowry
Aaron Curtis
Michelle René Lowry
Brigham Young University

This article provides a taxonomy of, nomenclature for, and discussion of issues related to collaborative writing. The goal is to enhance its research, improve its application in academia and industry, and help produce technologies that better support collaborative writing. To write collaboratively and build supportive technologies, practitioners and academics need to use a consistent nomenclature and taxonomy of collaborative writing. This article defines key collaborative writing terms and builds a taxonomy, including collaborative writing activities, strategies, control modes, work modes, and roles. This article stresses that effective choices in group awareness, participation, and coordination are critical to successful collaborative writing outcomes, and that these outcomes may be promoted through collaborative writing software, chat software, face-to-face meetings, and group processes.

Keywords: collaborative writing; taxonomy; collaboration; group awareness; collaborative writing software

Collaborative writing (CW) is a highly essential writing and group act in which prominence is likely to increase. CW is widely performed in industry, academia,

and government (Anderson, 1985; Baecker, Glass, Mitchell, & Posner, 1994; Beck, 1993; Couture & Rymer, 1989; Cross, 1993; Lowry, Albrecht, Nunamaker, & Lee, 2002; Mabrito, 1992; Smart, 1993). CW is a useful form of group work because of its many potential benefits, such as learning (Trimbur, 1985); socialization and new ideas (LeFevre, 1987); maximum input, varying viewpoints, checks and balances, experience, joint knowledge, writing expertise, accuracy, and more understandable documents (Ede & Lunsford, 1990); higher document quality (Beck, 1993); and enhanced interpersonal relationships (Rice & Huguley, 1994). The importance of CW is likely to continue into the foreseeable future, especially as most work in business involves collaborative work (Barbour, 1990); meanwhile, increasing globalization magnifies the need for collaborative work, and the Internet magnifies the ability to collaborate.

Given the importance of CW and its interdisciplinary nature, researchers have examined it from several interdisciplinary perspectives. Articles have been published on such topics as CW strategies (Ede & Lunsford, 1990), issues encountered by MBA students using basic CW technologies (Forman, 1991), processes and practices in the military (Rice & Huguley, 1994), e-Government (Lowry et al., 2002), a research bibliography (Bosley, Morgan, & Allen, 1990), a case study on authority in CW groups (Loehr, 1995), a survey on CW in engineering co-op experiences (Kreth, 2000), CW in the workplace (Duin, 1991), large CW groups (McIsaac & Aschauer, 1990), an ethnographic study of large CW groups (Cross, 1998, 2001), CW experiments using computer-mediated communication (Galegher & Kraut, 1994), creating a CW course (Belanger & Greer, 1992), CW hypertext technologies (Rada & Wang, 1998), and CW experiments using CW-specific software (Lowry et al., 2002; Olson, Olson, Storrosten, & Carter, 1993).

Although notable interdisciplinary CW research has been produced, much of the research is disjointed, assumes contrasting definitions of CW (Beck, 1993), and lacks a common taxonomy and nomenclature for interdisciplinary discussion. This lack of a common understanding of CW undermines the efforts of practitioners and researchers, especially in interdisciplinary efforts, such as developing technologies to support CW. Ede and Lunsford (1990) maintain that a lack of a common nomenclature caused difficulties in their CW research, suggesting that "we had difficulty eliciting information, primarily because we lack a vocabulary to discuss what people do when they write collaboratively" (p. 63). In an attempt to solve this problem, these scholars propose a description of different CW strategies, a solution that shows the value of a typology in that it improved the specificity of their research results:

> Our survey results suggest that writing groups use [CW strategies] frequently, though hardly anyone had a name for them. In fact, some told us they realized they were following set or pre-established organizational patterns only after completing our survey, demonstrating the principle that what lacks a name, we often simply do not recognize. (p. 64)

In teaching CW in the classroom, Duin (1990) concludes similarly that students need a common nomenclature to succeed in CW projects:

> If we assign collaborative projects and tell groups simply to figure out a way to complete the work, the groups will muddle through the process, but they will not be equipped with the terms or the tools that will help them in future collaborative projects in college and in the business community. . . . [By developing] a common vocabulary with which to frame their discussion and collaborative processes, they learn what is important to each person working on the project, and they begin to understand how issues such as control over the text or flexibility with manuscript formats affect their joint work. (p. 49)

The lack of an interdisciplinary approach and common understanding of CW undermines the ability of researchers and practitioners to solve the core issues of CW, which require interdisciplinary collaboration for resolution. The lack of common terminology and taxonomies in CW research would be akin to having the many disciplines involved in the study and treatment of cancer—such as medicine,

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The lack of an interdisciplinary approach and common understanding of CW undermines the ability of researchers and practitioners to solve the core issues.

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biology, biochemistry, dietetics, nursing, and biomedical engineering—were to use completely different terms and taxonomies for cancer research. Such a state in cancer research would be considered absurd and counterproductive. Although such a lack of common nomenclature and taxonomies in cancer research would not be responsible for the existence of cancer, it would certainly impair the interdisciplinary cancer research community's ability to collaboratively discuss and treat cancer problems.

Although CW may not be as dramatic as cancer research, CW is a highly salient area of collaborative research and practice that has significant impact on academia, industry, and government. Thus, we believe that the interdisciplinary CW community that is interested in CW is impaired by a lack of a common nomenclature that undermines progress on critical CW issues. Often, CW issues are studied in isolation and through one perspective, whether it be through science (computer science, information systems, information technology, or software engineering), social science (group decision making, social psychology, sociology, applied psychology, communication, group dynamics, organizational behavior, or change manage-

ment), or through the humanities (rhetorical discourse, linguistics, English, or composition). Much can be gained by building on the strengths of each area, through a common discourse, to create interdisciplinary solutions to pressing CW issues.

Examples of issues in CW that will likely need interdisciplinary research for resolution include issues with poor task definition, personality differences, leadership, group dynamics, managing a group, and hidden agendas (Forman & Katsky, 1986); inequitable work distribution and difficulties monitoring progress (Kraut, Galegher, & Egido, 1988); self-disclosure, control, trust, perception, roles, and reward (Lay, 1989); ideology (Porter, 1990); freeloading (Barbour, 1990); confusion, time management, expense, excessive diversity of ideas, disjointed efforts, and lack of cohesion (DuFrene & Nelson, 1990); stylistics inconsistencies, satisfaction, and creativity (Ede & Lunsford, 1990); communication and planning (Horton, Rogers, Austin, & McCormick, 1991); distributed work (Ellis, Gibbs, & Rein, 1991); duplication of effort (Horton et al., 1991); organizational culture issues, commitment issues, power, and difficulty accepting criticism (Locker, 1992); conflicting needs and organizing work (Sharples et al., 1993); conflict (Cross, 1994); coordinating work and challenging and questioning authority (Galegher & Kraut, 1994); version control (Tammaro, Moseir, Goodwin, & Spitz, 1997); and effective use of technology (Adkins, Reinig, Kruse, & Mittleman, 1999). To make progress on these issues, more interdisciplinary research needs to be conducted to learn about appropriate CW processes and activities that predict success and failure of different kinds of CW teams that work on various writing tasks. Like interdisciplinary cancer research, interdisciplinary CW research will be aided by use of a common taxonomy and nomenclature.

A consistent nomenclature and taxonomy of CW would also aid the interdisciplinary CW community in continuing to build on its rich research tradition. Too often in our disciplines we are quick to move on to the latest and greatest trends, yet slow to build on the rich contributions of the past. This article attempts to partially fill this need by proposing a nomenclature and taxonomy of CW that strengthens the foundation for CW research and issue resolution.

This article proposes a common taxonomy and nomenclature of CW, as follows: The next section starts by presenting key literature that defines the difference between single-author writing and CW. The proposed typology is then presented. We then show a specific example of how application of the proposed nomenclature and typology advanced our research in distributed CW technologies. Finally, given this example, we delineate many interdisciplinary research opportunities that can benefit from this common nomenclature and taxonomy.

DEFINING CW

This section starts by proposing complementary definitions for single-author writing and CW. Flower and Hayes (1981) describe the three cognitive processes in single-author writing as planning, translation, and reviewing. Planning involves

organizing information, setting goals, and generating information relevant to the writing task. Translation, or drafting, builds on the deliverables from the planning stage by turning plans and research notes into text to meet the overall goal. Finally, reviewing involves evaluating the drafted text and editing the text or revising the original ideas and goals. These processes need not be rigidly sequential; the acts of planning, translating, and reviewing can be iterative. In sum, we define single-author writing as writing conducted by one individual that involves planning, drafting, and reviewing.

CW builds on single-author writing by involving multiple people, thus increasing the complexity of the writing process (Galegher & Kraut, 1994). Although CW is a group effort, many activities in CW are often divided and conducted on an individual basis (Tammaro et al., 1997). One of the reasons for the amplified complexity is the increased need to coordinate between multiple viewpoints and work efforts (Baecker, Nastos, Posner, & Mawby, 1993), and the need to establish consensus (Galegher & Kraut, 1994). The increased complexity can be further explained in terms of social complexity, intellectual complexity, and procedural complexity (Galegher & Kraut, 1994). Fluctuating group membership is common in CW and adds to social complexity. Just as team membership can fluctuate in CW groups, so can commitment (Beck, 1993; Locker, 1992). CW group members commonly show great enthusiasm in the brainstorming and planning stages, but their commitment can wane in writing tasks that take place over extended periods. CW groups are also often challenged with outside conflicting commitments (Kraut et al., 1988), which can be different for every member of a CW group. Lay (Lay & Karis, 1991) provides several other reasons why CW can be complex, including (a) CW documents are complex artifacts, (b) processes of preparing documents are more multifaceted under collaboration, (c) writing processes generate strong emotions, (d) groups can revise CW documents infinitely, (e) it is challenging for collaborative writers to converge toward a common goal and understanding of a document or even use a common language, and (f) success in CW is difficult to predict and guarantee.

Adding to the complexity of CW, the proper order of CW processes can change based on group and task characteristics. For example, it has been claimed that the complexity of CW requires a nonlinear, dynamic process (Galegher & Kraut, 1994). On the other hand, CW can be done in a sequential fashion, even if such an approach may not always be optimal. Although CW is certainly dynamic and often nonlinear, it still generally follows a linear progression: There is a starting and an ending point, but what happens between the starting and ending points can be difficult to predict. For example, it would not be logical to conduct planning and team formation after an initial draft is formed, yet multiple unpredictable iterations of outlining, drafting, and revising may be required to create an initial draft. Other elements of CW are also difficult to predict: The goals, strategies, and roles of CW participants often dynamically change throughout a project (Horton et al., 1991). The process complexity of CW is compounded by the possibility of multiple writing strategies, writing activities, document control modes, roles, and work modes.

Given that CW is such a complex, dynamic process, it is not surprising that researchers and practitioners often disagree on the definition of CW (Beck, 1993). Allen, Atkinson, Morgan, Moore, and Snow (1987) define CW as "collaborators producing a shared document, engaging in substantive interaction about that document, and sharing decision-making power and responsibility for it" (p. 70). Bosley (1989) proposes CW "as two or more people working together to produce one written document in a situation in which a group takes responsibility for having produced the document" (p. 6). Galegher and Kraut (1994) emphasize the social nature of CW, which involves

> negotiation about the meaning of facts, a demand for consensus as to an appropriate solution, division of labor based on concerns for fairness and quality of work, coordination of individual contributions, and resolution of questions about authority within the group. (p. 113)

Similarly, others have emphasized that CW can be seen as a social practice that has different meanings to different participants (Bruffee, 1987; Rimmershaw, 1992; Trimbur, 1985). Rice and Huguley (1994) offer yet another definition which emphasizes the primary activities of CW:

> *Collaborative* [italics added] is any writing performed collectively by more than one person that is used to produce a single text; and we define *writing* [italics added] as any activity that leads to a completed document, including brainstorming or idea generating, gathering research, planning and organizing, drafting, revision, and editing. (pp. 163-164)

The limitation of these and the many other definitions of CW is that they do not generalize well to the interdisciplinary nature of CW because they are often restricted to the authors' particular research interests in CW, whether it be socialization or CW activities or composition.

Adding to the confusion, CW researchers and practitioners do not even agree on a common term for CW. Although CW appears to be the most commonly used term in research to describe the process of writing as a group (Beard, Rymer, & Williams, 1989; Bosley, 1989; Duin, 1990; Ede & Lunsford, 1990; Lay, 1989; Trimbur, 1985), many other similar terms have contradictory definitions. Examples of similar and synonymous terms include the following: coauthoring (DuFrene & Nelson, 1990), coauthorship (Ede & Lunsford, 1990), collaborative authoring (Kaye, 1993; Newman & Newman, 1992), collaborative composing (Anderson, 1989; Clifford, 1981), collaborative editing (Blicq, 1998; Higuchi & Takahashi, 1995), cooperative writing (O'Donnell et al., 1985), group writing (Couture & Rymer, 1989; Ede & Lunsford, 1990; Gere, 1987), group authorship (Ede & Lunsford, 1990), joint authoring (Newman & Newman, 1992), joint authorship (Thralls, 1992), shared-document collaboration (Allen et al., 1987), and team writing (Bovee & Thill, 1989). Several of these researchers have used more than one term for CW, sometimes in the same article.

Despite the complexity of CW, we believe that CW has an underlying structure that can be defined universally and presented in an interdisciplinary taxonomy. We build the basis of our definition of CW and taxonomy by leveraging six axioms, proposed as follows: (a) Single-author writing involves the minimum activities of planning, drafting, and revising; (b) CW extends on single-author writing by involving multiple parties and the minimum activities of planning, drafting, and revising; (c) by involving multiple parties working toward a common writing task, CW becomes a group and social act that requires other activities not involved in single-author writing, such as building consensus; (d) once multiple people are working toward one writing task, an effective CW experience will then require

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communicating, negotiating, coordinating, group researching, monitoring, rewarding, punishing, recording, socializing, and so forth, as supported by substantial research on the importance of effective group dynamics in CW tasks (Ede & Lunsford, 1990; Forman & Katsky, 1986; Locker, 1992); (e) building on group literature (Dubs & Hayne, 1992), any optimally performed group task should include pretask activities to set up for the task (e.g., group formation) and posttask activities to finalize the task delivery, as has been documented in student CW groups (Bogert & Butt, 1990); and (f) group tasks, and thus CW, should include team formation, team planning (Burnett, 1990), execution of the desired task, and finalization of the task (Dubs & Hayne, 1992). CW research supports that writing tasks cannot be separate from key group activities without negative repercussions (Anderson, 1989; Bovee & Thill, 1989; Duin, 1990; Forman & Kelly, 1990; Johnson & Johnson, 1987; Locker, 1989).

Extending these axioms from CW and group literature, we depict the overall process for CW as the model seen in Figure 1. This model demonstrates our proposed definition of CW, which emphasizes CW as a group act that does not solely rely on document production, even though document production may be the most central, highly dynamic activity.

Building on the framework espoused in Figure 1, we propose the following definition of CW: CW is an iterative and social process that involves a team focused on a common objective that negotiates, coordinates, and communicates during the creation of a common document. The potential scope of CW goes beyond the more basic act of joint composition to include the likelihood of pre- and posttask activities, team formation, and planning. Furthermore, based on the desired writing task,
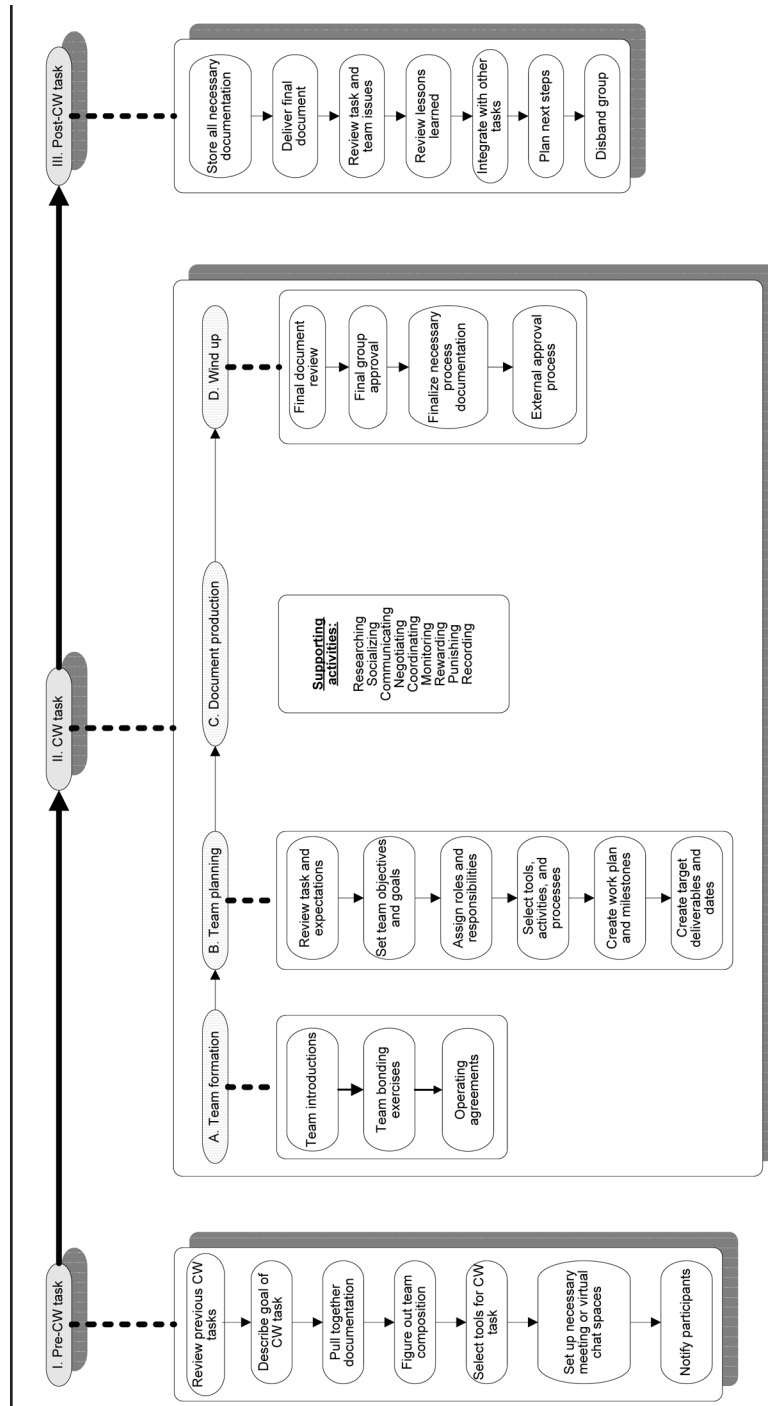
I. Pre-CW task

- Review previous CW tasks
- Describe goal of CW task
- Pull together documentation
- Figure out team composition
- Select tools for CW task
- Set up necessary meeting or virtual chat spaces
- Notify participants

II. CW task

A. Team formation
- Team introductions
- Team bonding exercises
- Operating agreements

B. Team planning
- Review task and expectations
- Set team objectives and goals
- Assign roles and responsibilities
- Select tools, activities, and processes
- Create work plan and milestones
- Create target deliverables and dates

C. Document production

Supporting activities:
Researching
Socializing
Communicating
Negotiating
Coordinating
Monitoring
Rewarding
Punishing
Recording

D. Wind up
- Final document review
- Final group approval
- Finalize necessary process documentation
- External approval process

III. Post-CW task
- Store all necessary documentation
- Deliver final document
- Review task and team issues
- Review lessons learned
- Integrate with other tasks
- Plan next steps
- Disband group

Figure 1. Tasks and Activities of Collaborative Writing (CW)

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CW includes the possibility of many different writing strategies, activities, document control approaches, team roles, and work modes.[1]

Although this definition is broad, it opens up the potential for new insights and ways of improving CW because the definition is not limited to writing. This definition provides a broad, universal base from which practitioners and researchers from many fields can study CW from a holistic perspective. See Table 1 for a list of our proposed CW terms. The next section expands this definition of CW by creating a taxonomy of the processes and components of CW in terms of writing strategies, activities, document control modes, and roles.

A TAXONOMY OF CW

This section presents a taxonomy of CW in terms of writing strategies, activities, document control modes, and roles. In proposing a common taxonomy of CW, we have striven to use terminology that is recognizable, easy to remember, and interdisciplinary. We have also leaned toward using terms that are most frequently cited in literature; thus, we extended much of our taxonomy work from Horton et al. (1991). Where conflicting terms and definitions have been given, we have striven to focus on terms that add clarity.

CW Strategies

CW groups must have an agreed-upon strategy to produce a collaboratively written document successfully (Allen et al., 1987). A team's CW strategy has been defined as the plan that an integrated team is going to use to write collaboratively (Ede & Lunsford, 1990). Alternatively, it has been defined as how a team coordinates its writing (Horton et al., 1991). We build on these two definitions by proposing a new definition as a team's overall approach for coordinating the writing of a collaborative document; the important distinction in our definition being that strategies are high-level approaches, and plans tend to have more specific, tactile information. We believe this is a more precise definition because the literature discussing strategies almost universally refers to the overall writing approach that a team chooses.

As discussed, one difficulty of choosing and implementing CW strategies is that collaborators generally lack the requisite nomenclature to describe their group's strategy, which can make coordinating with team members difficult (Ede & Lunsford, 1990). In other words, group members may know what they generally want to do but have difficulty expressing it. Addressing this issue, Ede and Lunsford (1990) preliminarily determined that CW groups generally follow seven strategies. Follow-up studies clarify that the most prevalent CW strategies can be described as group single-author writing, sequential single writing, parallel writing, reactive writing, and mixed mode writing.

Table 1.   Key Collaborative Writing (CW) Terms

Term	Definition	Common Synonym
CW	CW is an iterative and social process that involves a team focused on a common objective that negotiates, coordinates, and communicates during the creation of a common document. The potential scope of CW goes beyond the more basic act of joint composition to include the likelihood of pre- and posttask activities, team formation, and planning. Furthermore, based on the desired writing task, CW includes the possibility of many different writing strategies, activities, document control approaches, team roles, and work modes.	Coauthoring,[a] collaborative authoring,[a] collaborative composing,[b] collaborative editing,[c] group writing, group authorship,[a] joint authoring,[a] shared-document collaboration, team writing
CW activity	A major process that generally occurs in the act of CW.	
CW document control modes	Methods used to manage control of the text that a group is developing.	
CW roles	A formal or informal responsibility in CW that a participant has in a CW group, which is generally known to the group and lasts for an unknown or set amount of time.	CW responsibilities
CW software	Software that allows CW groups to produce a shared document and helps CW groups perform the major CW activities.	CW technology, CW tools
CW strategy	A team's overall approach for coordinating the writing of a collaborative document.	Coordination approach
CW work modes	A group awareness and process decision as to when and where a CW group will do its writing, respectively, in terms of same or different place and same or different times.	
Cooperative writing	Synonymous with CW.	
Group authoring	Synonymous with collaborative authoring.	
Group drafting	The specific CW task of drafting, not the entire CW process.	
Group editing	The specific CW tasks of editing, reviewing, and revising; not the entire CW process.	
Single-author writing	Writing conducted by one individual that involves planning, drafting, and reviewing.	Single writing

a. Sometimes this refers only to publishing tasks.
b. Sometimes this refers only to creative writing tasks in English composition.
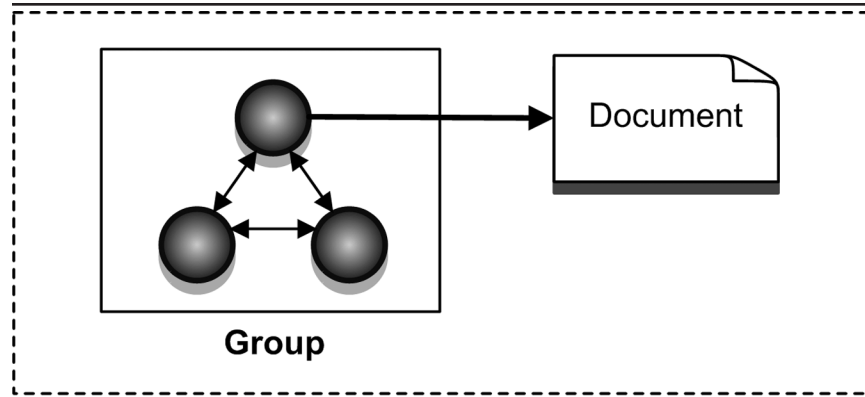c. Sometimes this refers only to the activities of editing, reviewing, and revising.

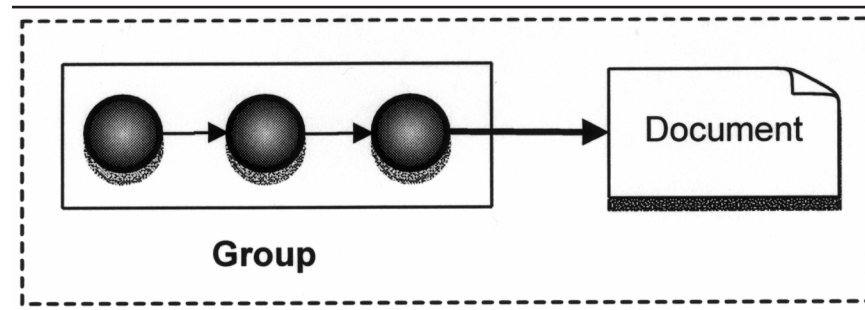**Figure 2.   Group Single-Author Writing**

Figure 3.   Sequential Writing

We define group single-author writing as occurring when one person is directed to write for an entire team.[2] This strategy is commonly used when consensus on the written results is not strongly important to group members because the CW task is generally simple. However, group single-author writing is still a form of CW because it involves a team that worked toward coordinated consensus that is reflected in a document that is written by one of the team members, as depicted in Figure 2.

A more frequently used variation of single-author writing is sequential writing, where one person writes at a given time; each writer completes his or her task and then passes it on to the next person, who becomes the next single writer (Sharples, 1992). This is depicted in Figure 3. The benefits of sequential writing include simplified organization and improved coordination for distributed work.

However, several disadvantages exist with employing a sequential writing strategy. First, such a strategy diminishes social interaction; for example, sequential writing can easily create a lack of group consensus because differing ideas often are not adequately addressed. Second, this approach is often problematic without
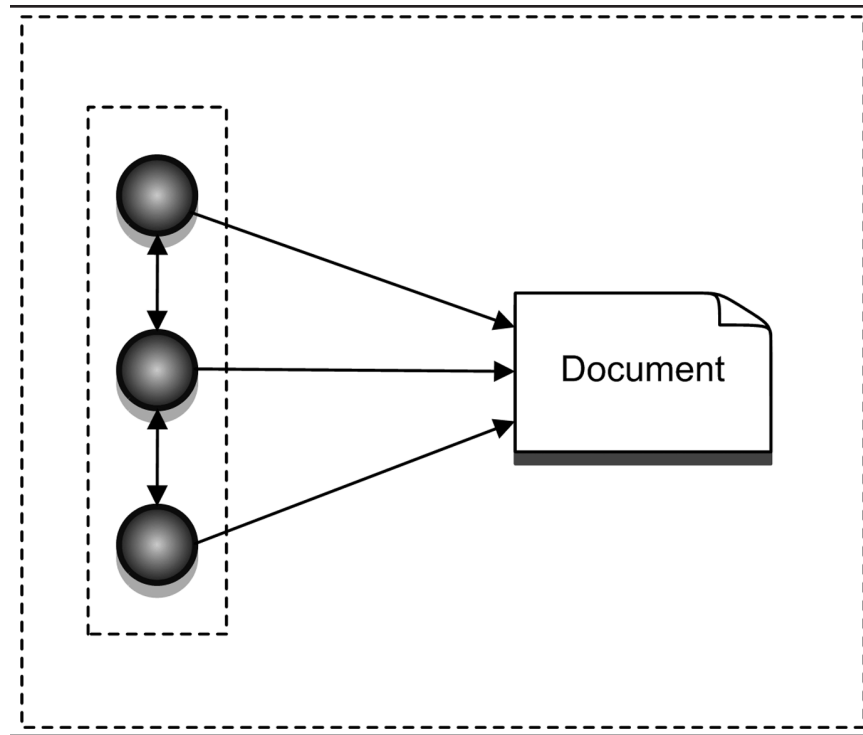
Figure 4.   Parallel Writing

effective version control; otherwise, subsequent writers can easily override the work of others by making new changes. Third, ensuring that all document sections are addressed adequately and that a document has been segmented into appropriate work segments presents a challenge. Fourth, one uncooperative writer can possibly undermine the entire CW process (Duin, 1991). Finally, the order of writing disproportionately affects the final content—one author can greatly bias the contributions of subsequent writers.

Parallel writing occurs when a team divides CW work into discrete units and works in parallel (Sharples et al., 1993), as depicted in Figure 4. This strategy is also referred to as a separate writer strategy (Posner & Baecker, 1992) or a partitioned writing strategy (Ellis et al., 1991). We chose the term *parallel writing* because it conveys work in parallel by multiple writers, and such work does not necessarily have to be partitioned into separate sections. The rewards of this strategy include more efficiency than sequential single writing and more working autonomy and anonymity, although specialized CW technologies must be used to gain these benefits (Ellis et al., 1991). In contrast, some problems that can occur with the parallel writing strategy include oblivious writers (Ellis et al., 1991), poor communication (Ellis et al., 1991), stylistic differences, and information overload.
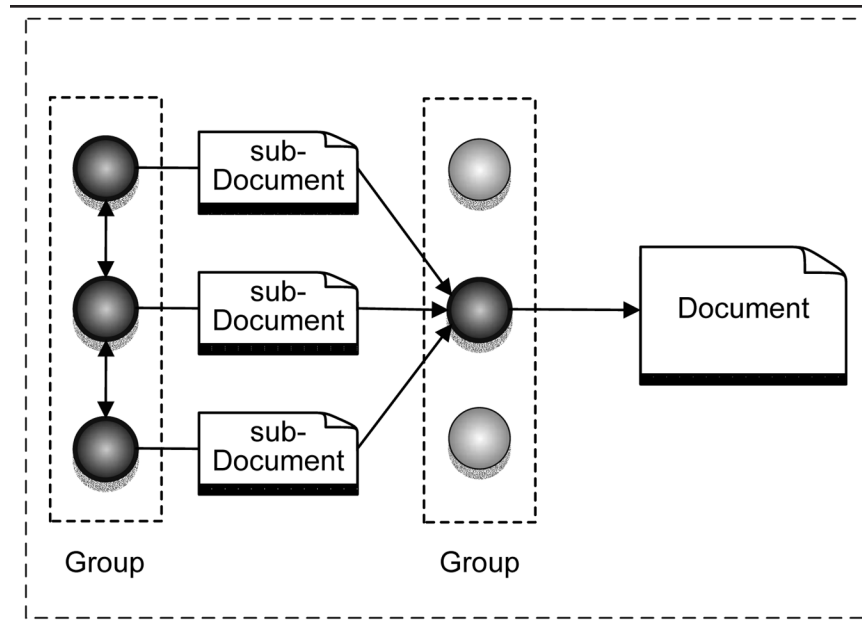
Figure 5.   Horizontal-Division Writing

Parallel writing can be further divided into two main types: (a) horizontal-division writing and (b) stratified-division writing. Horizontal-division writing is the most common form of parallel writing in which each participant is responsible for a particular section of a document (Stratton, 1989), as depicted in Figure 5.[3] The chief disadvantage of this approach is that divisions are often arbitrary and are not based on core competencies. In contrast, stratified-division writing is a form of parallel writing in which participants play a particular role, such as editor, author, or reviewer, based on their core talents (Stratton, 1989), as depicted in Figure 6.

We define reactive writing as a strategy that occurs when writers create a document in real time, reacting and adjusting to each other's changes and additions (Sharples et al., 1993) without significant preplanning and explicit coordination (as depicted in Figure 7). Previously, this strategy has been named by several conflicting terms, such as joint writing (which is too easily confused with CW; Posner & Baecker, 1992), consensus writing (which inaccurately implies that consensus always occurs; Ellis et al., 1991), and reflective writing (which inaccurately conveys that reflection is a part of the process; Ellis et al., 1991). We chose the term *reactive writing* because reaction is the only common thread that occurs in this form of writing, which may involve consensus or dispute, reflection, or off-the-cuff contributions. For example, as a given author writes a section, others may simultaneously review the section and create new sections in response that may contradict or concur with the author and that may be well thought out or reactionary. The
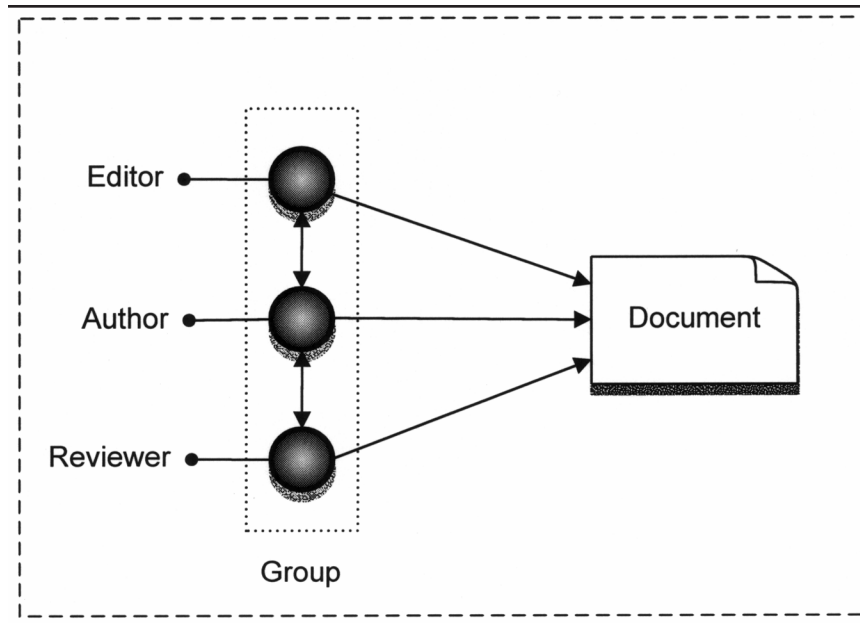
Figure 6.   Stratified-Division Writing

common thread in all reactive writing is that the work is not preplanned and does not involve explicit coordination. Advantages of reactive writing include the possibility of building consensus through free expression and the development of creativity. The primary downside of this strategy is that it makes coordination difficult and can cause difficulties with version control (Adkins et al., 1999)—these difficulties likely limit greatly the size of teams that can use this approach effectively. Table 2 summarizes the major writing strategies.

CW Activities

As noted, CW involves many group activities such as prewriting activities (i.e., figure out team composition, select tool), task execution activities (i.e., group formation, planning, and work wind-up), and postwriting activities (i.e., deliver document, review lessons learned, plan next steps). In addition to these, some key activities of CW, familiar to most writers, are those involved during the actual production of a group's document. These key activities are listed and defined in Table 3.

These CW activities tend to occur in dynamic, iterative ways (Galegher & Kraut, 1994); such a dynamic approach is modeled in Figure 8.

In addition, several other activities can also occur in CW at unpredictable times to support the overall writing task, depending on the nature of the task and group.
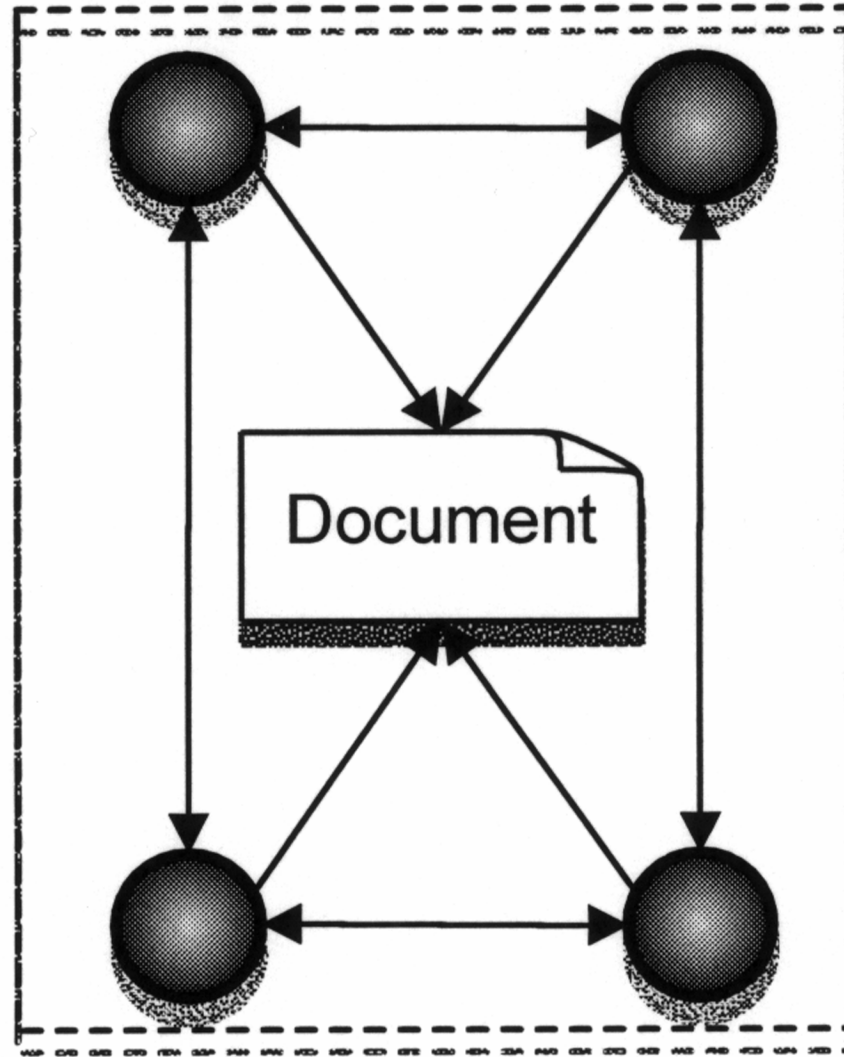
Figure 7.   Reactive Writing

Examples of these unpredictable, yet highly important, support activities include socialization (Bruffee, 1987; Galegher & Kraut, 1994; LeFevre, 1987), research (Adkins et al., 1999), communication (Duin, 1991), negotiation (Baecker et al., 1994), and coordination (Kirby & Rodden, 1995). Again, these activities are not necessarily performed sequentially; they are performed through iterative rounds of reading and review (Delisle & Schwartz, 1989). Using these activities, we can now

Table 2. Summary of Writing Strategies

Writing Strategy	When to Use	Pros	Cons
Single-author writing	When little buy-in is needed; for simple tasks, such as meeting notes and agendas; groups are small	Efficient and style consistency	May not clearly represent group's intentions and less consensus produced
Sequential single writing	Asynchronous work with poor structure and coordination; when it is difficult to meet often; for fairly straightforward writing tasks; small groups	Easy to organize and simplifies planning	Lose sense of group, subsequent writers may invalidate previous work, lack of consensus, version control problems, inefficient, and one-person bottlenecks
Parallel writing—horizontal division	High volume of rapid input is needed; software capable of supporting this strategy is available; a mildly complex writing task is easily segmented; distributed groups have good structure and coordination; groups are small to large	Efficient and high volume of output	Writers can be blind to each other's work, redundant work can be produced if poorly planned, stylistic differences, potential information overload, and does not recognize individual talent differences well
Parallel writing—stratification	When high volume of rapid input is needed; have software capable of supporting this strategy; writing task that is difficult to segment and fairly complicated; distributed groups with good structure and coordination; people have different talents that can be used; groups are small to large	Efficient, high volume of quality output, less redundancy, and better use of individual talent	Writers can be blind to each other's work, redundant work can be produced if poorly planned, stylistic differences, and potential information overload
Reactive writing	When high levels of consensus on writing process and content are needed; need high levels of creativity; groups are small	Can build creativity and consensus	Extremely difficult to coordinate, problems with version control, and most software does not effectively support this strategy

expand Figure 1 to include a more comprehensive view of CW as depicted in Figure 9.

It is important to emphasize that Figure 9 is simply a framework for guiding overall CW activities. The emphasis that should be given to each activity and stage in the group process depends on the nature of the task being conducted—significant differences are likely in how CW should naturally occur in business, government, and academia, according to the task being conducted. For example, the

Table 3. The Common Activities of Collaborative Writing

Activity	Definition From Research
Brainstorming	Developing new ideas for a paper draft (Posner & Baecker, 1992).
Converging on brainstorming	Deciding what to do with the brainstormed ideas as a group (Lowry, Albrecht, Nunamaker, & Lee, 2002).
Outlining	Creating a high-level direction in which the document will be going, including major sections and subsections (Adkins, Reinig, Kruse, & Mittleman, 1999).
Drafting	Writing the initial incomplete text of a document (this is typically synonymous with the term writing, but the term drafting is used to convey incompleteness in the writing) (Galegher & Kraut, 1994; Horton, Rogers, Austin, & McCormick, 1991). This is also synonymous with composing (Odell, 1985).
Reviewing	Having a participant or an editor read and annotate document draft sections for content, grammar, and style improvements (Galegher & Kraut, 1994).
Revising	Responding to review comments by making changes in the draft that reflect the review comments (Galegher & Kraut, 1994). Revising is used over editing to distinguish this activity more clearly from copyediting and from the editorial process of reviewing.
Copyediting	The process of making final changes that are universally administered to a document to make a document more consistent (such as copy edits, grammar, logic), usually made by one person charged with this responsibility (often called editing [Posner & Baecker, 1992], which is a less descriptive term).

construction of a corporate strategy document will likely require in-depth communication and negotiation, and rounds of iterative reviewing and revising where most participants simply give input to the process, as opposed to equally sharing the writing task (Lowry & Nunamaker, 2002). Additionally, government CW is traditionally marked by extensive, lengthy review processes that may involve hundreds of people (Lowry et al., 2002). On the other hand, academic papers tend to be written by small groups that equally share in the writing task. All of these different tasks and environments would naturally require implementation of different strategies, emphasis of activities, roles, control modes, and so forth. Examples of the many forms of CW tasks that require tradeoffs in these areas include term papers, academic journal articles, books, monographs, proposals, reports, operating procedures, memos, white papers, newsletters, policy manuals, strategy documents, directives, regulations, user manuals, training manuals, and short stories; goal statements and legal briefs (Allen et al., 1987); position papers, discussion papers, action summaries, decision papers, citations and recommendations for awards, mission orders, progress reports, operations orders and plans, and personnel reports (Wilds, 1989); and bulletins, case studies, presentation notes, and instructional materials (Ede & Lunsford, 1990).
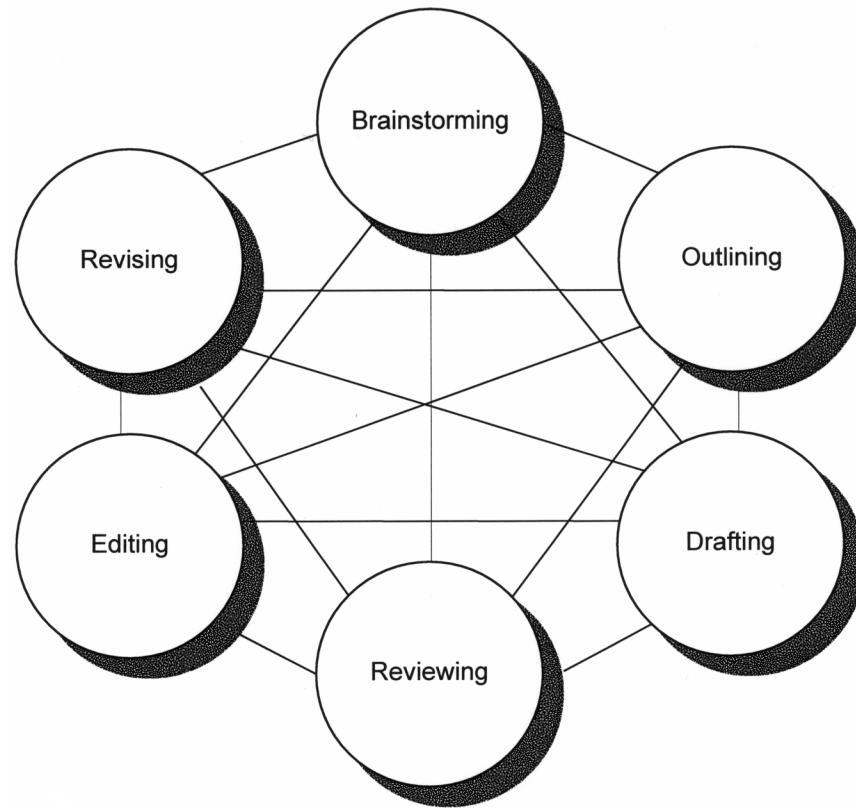
Figure 8.   Iterative Collaborative Writing Activities

Document Control Modes

Document control modes are the chosen approaches used to manage control of a collaborative document (Posner & Baecker, 1992) or, in other words, who has the key responsibility for the document. The main document control modes are centralized, relay, independent, and shared, as elaborated by Posner and Baecker (1992); these modes are elaborated as follows: Centralized control occurs when one person (such as an editor or a facilitator) controls the document throughout the writing activity, as depicted in Figure 10. This form of control is useful to maintain group focus, especially when working toward a strict deadline.

Relay control occurs when one person at a time is in control but controls changes within the group, similar to a baton being passed from one runner to another in a relay race, as depicted in Figure 11. This democratic technique is less efficient than centralized control but is useful in groups that have an expressed need to share power.
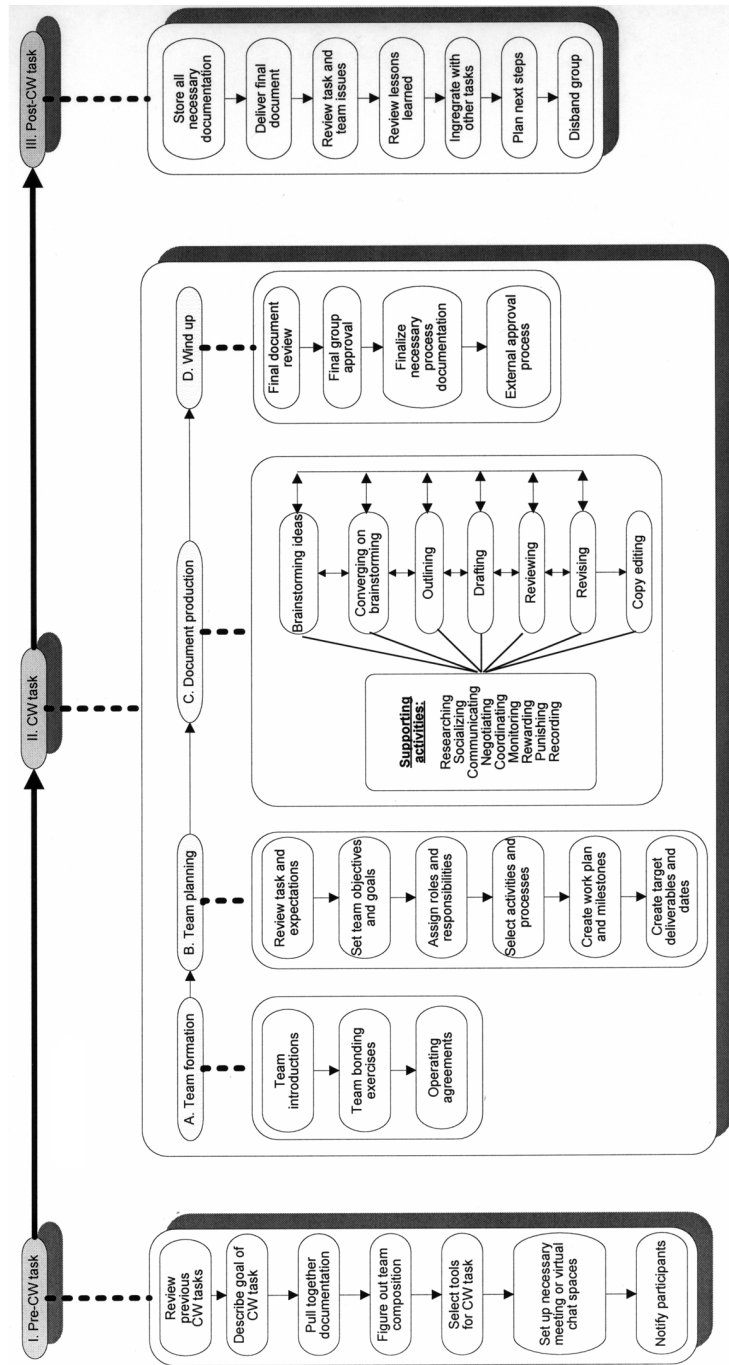
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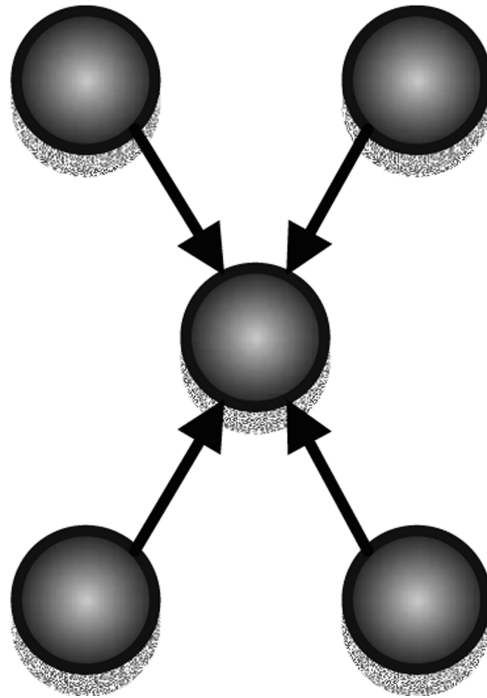**Figure 9. Expanded Tasks and Activities of Collaborative Writing (CW)**

Figure 10. Centralized Control

Independent control occurs when each team member works on a separate part of the document and maintains control of his or her portion throughout the writing process, as depicted in Figure 12. Many times this is a negative control tactic in groups that lack agreement, but it is quite useful for groups that work remotely on discrete units of work, such as independent chapters in a book. Independent control often requires an editor to pull the semi-independent units of work together.

Shared control occurs when all team members have simultaneous and equal access and writing privileges throughout the writing activity, as depicted in Figure 13. This can be a highly effective, nonthreatening form of control in groups that work face-to-face, engage in frequent communication, and have high levels of trust; in remote groups and less functional groups, this mode can lead to conflict.

CW Roles

Several roles are used in CW, and a given participant's role may change over time (Neuwirth, Kaufer, Chandhok, & Morris, 1990) depending on the activity the CW group is engaged in (Beck & Bellotti, 1993). The common roles that are found
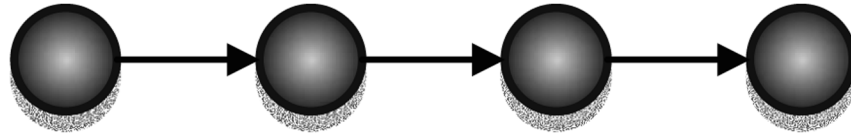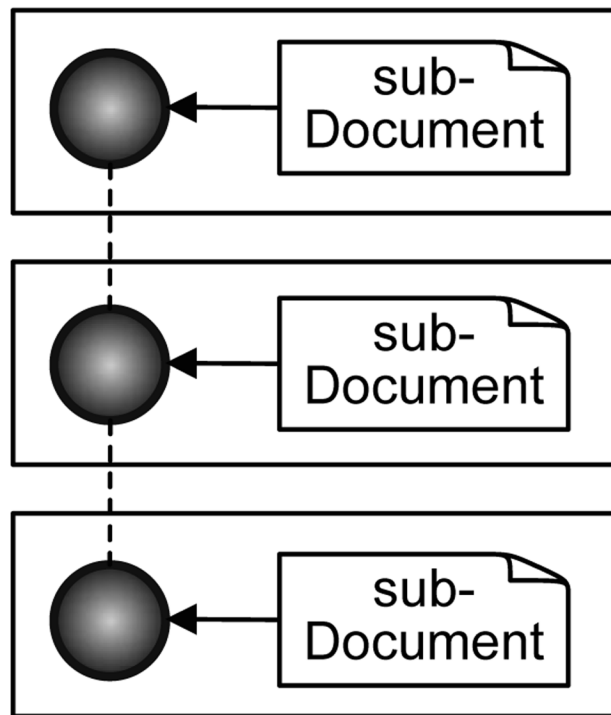
Figure 11. Relay Control

Figure 12.   Independent Control

in CW include writer, consultant, editor, reviewer, scribe, and facilitator, as summarized in Table 4. The term *roles* is used because descriptive role definitions often convey the corresponding task responsibilities (e.g., a consultant gives ideas but does not own the results of the writing task) and because collaborative writers can plan multiple, shifting roles over time. Roles can improve CW outcomes when participants are assigned roles that allow them to make their best contribution
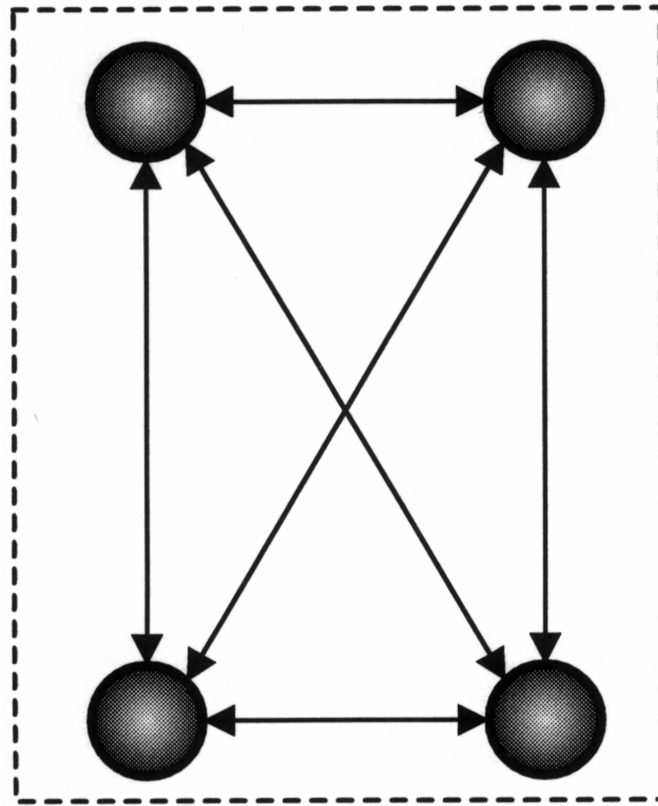
Figure 13. Shared Control

(Stratton, 1989). However, selecting an appropriate team leader can be especially difficult (Forman, 1989). For example, a strong-willed person who dominates the group process is often not the optimal leader; yet ironically, there are occasions when a dictator is useful.

CW Work Modes

The considerations involved in choosing the CW work mode can be summarized as decisions between the degree of proximity (how physically close a group is) and the degree of synchronicity (when a group writes). Consistent with other collaborative work, we term the combination of these decisions as a group's work mode (Ellis et al., 1991), as depicted in Figure 14.[4]

The four work modes of CW directly influence the level of group awareness experienced in a group (Fuchs, Pankoke-Babatz, & Prinz, 1995). Group awareness

Table 4. Common Collaborative Writing Roles

Role	Definition
Writer	A person who is responsible for writing a portion of the content in a collaborative writing document (Posner & Baecker, 1992).
Consultant	A person who is normally external to a project team who provides content- and process-related feedback but has no ownership or responsibility for content production (Posner & Baecker, 1992).
Editor	A person who has responsibility and ownership for the overall content production of the writers, who can make both content and style changes to a shared document (Posner & Baecker, 1992).
Reviewer	A person who is internal or external to a collaborative writing team who provides specific content feedback but does not have responsibility to invoke the content changes (Posner & Baecker, 1992).
Team leader	A person who is part of a collaborative writing team, who may fully participate in authorship and reviewing activities, but also leads the team through appropriate processes, planning, rewarding, and motivating.
Facilitator	A person who is external to the collaborative writing team who leads a team through appropriate processes and does not give content-related feedback (Adkins, Reinig, Kruse, & Mittleman, 1999).

is better understanding one's own work activities through understanding the activities of other group members (Dourish & Bly, 1992). Group awareness in CW differs based on the work mode employed because the underlying differences in synchronicity and proximity affect directly how much group members can understand what is happening (Schlichter, Koch, & Burger, 1997). For example, asynchronous-distributed group members do not have face-to-face conversations and typically do not see the work of others; thus, asynchronous-distributed group work typically has less group awareness than face-to-face work. Dourish and Bellotti (1992) suggest that because CW is a relatively unstructured task, awareness is critical to success. Group awareness is also important in CW because awareness influences coordination, and awareness and coordination are required for successful outcomes (Dourish & Bellotti, 1992; Kirby & Rodden, 1995; Schlichter et al., 1997; Sharples, 1993). Group awareness can be manifested in the combination of four different forms, all of which will impact CW, as listed in Table 5.

In summary, CW is a complex and dynamic group process in which many considerations and issues must be addressed. Accordingly, CW groups must pay particular attention to the ramifications of the work modes, strategies, activities, roles, document control, and group awareness approaches they chose to employ. Clearly, these decisions will be different depending on the nature of the group and the task. Another important consideration is the choice of CW software, as discussed in the next section.

Figure 14.   Collaborative Writing Work Modes
SOURCE: Adapted from Ellis, Gibbs, and Rein (1991).

EXAMPLE APPLICATION: APPLYING TAXONOMY TO TECHNOLOGY

One of the key purposes of our proposed taxonomy of CW is to advance interdisciplinary practice and research in this topic. We were interested particularly in improving CW through designing advanced collaborative software. Thus, we have applied this taxonomy to the study of technologies that would improve CW, the application of which should provide a stable nomenclature for using and improving such technologies. CW technologies may come and go, but the underlying principals of what processes and activities CW technologies need to support are much more stable over time when built on a strong taxonomic foundation. Given our expanded definition of CW, the following definition of CW software naturally follows: A specialized form of group support system that allows CW groups to perform naturally the major CW activities such as premeeting planning, brainstorming, converging on brainstorming, outlining, drafting, reviewing, revising, copy editing, and final wrap-up, along with support of less predictable group activities such as researching, socializing, communicating, negotiating, coordinating, monitoring, rewarding, punishing, and recording.

Because CW is a complex group task with many activities, it follows that CW software requires more than support of basic communication and coordination—it requires the support of a concerted, dynamic team effort. Thus, CW software

Table 5. Four Manifestations of Group Awareness

Form of Group Awareness	Definition
Informal awareness	Knowing where participants of a team are working, whether this is in the same location or distributed locations
Group-structural awareness	Knowing how a group is structured formally and informally in terms of roles, responsibilities, status, process, and positions on issues
Social awareness	Knowing the degree to which participants are interested, paying attention, their level of commitment, and their emotional state
Workspace awareness	Knowing what other participants are doing in the shared electronic workspace

SOURCES: Modified from Greenberg, Gutwin, and Cockburn (1996) and Schlichter, Koch, and Burger (1997).

needs to be based on group support systems, not simpler computer-mediated-communication software such as e-mail. Table 6 compares the definition of CW software to other common technology terms. Figure 15 overviews all the technologies that have been defined to make up collaborative software, including CW software. Once we applied our definition of CW, along with its associated taxonomy, to CW software, the requirements for designing appropriate CW software naturally appeared.

It terms of key requirements that were derived by applying the taxonomy to our research, it became clear that a good CW tool must have some kind of brainstorming tool, support for different strategies, including parallel work, and so forth. Although previous CW tools show promise, many documented issues still exist about the use of these tools, especially because none of these tools has been designed to fully accommodate Internet-based, distributed work. Furthermore, too many tools ignore CW as a holistic process, which involves heavy group communication and can be conducted through many different strategies and work modes. The taxonomy underpinned our process of creating the key design requirements of a CW tool and in determining the gap in previously created CW tools. As such, we were able to produce a new tool that was designed to truly support CW for face-to-face and distributed (synchronous and asynchronous) work modes.

The tool that was built, called *Collaboratus*, is designed to better support Internet-based, distributed CW than other tools. *Collaboratus* builds on the taxonomy of CW by functioning as a tool that supports the activities (e.g., brainstorming, outlining, writing, revising, etc.), strategies (e.g., sequential or parallel work), roles, document control modes, and work mode choices common to CW. The evolutionary development of *Collaboratus* is described in Lowry et al. (2002). The work on *Collaboratus* has led to an additional stream of research that builds on this taxonomy. Examples of additional research that has been produced include extending this taxonomy using thinkLets for better supporting distributed work for specific writing tasks (Lowry & Nunamaker, 2002), improving asynchronous-
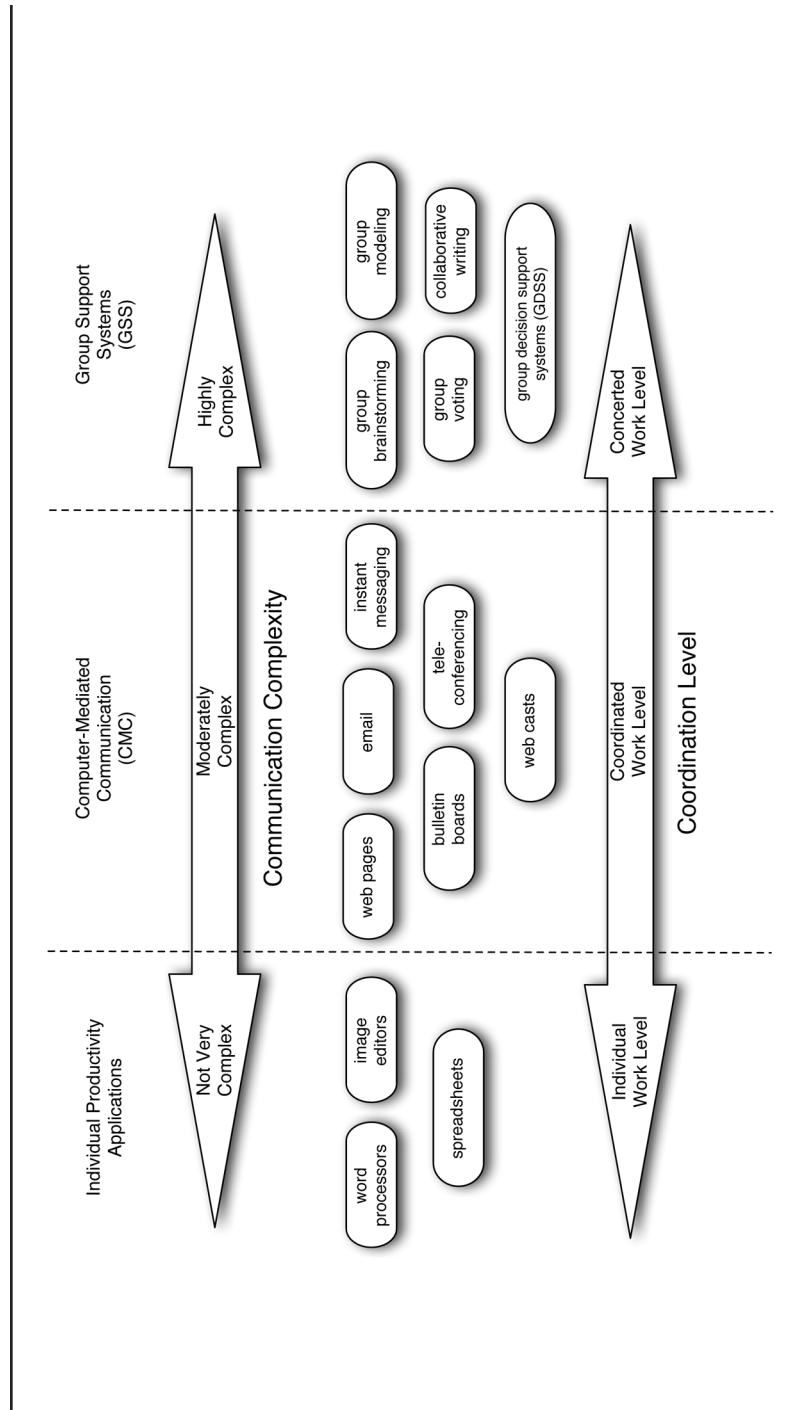
Figure 15. Collaborative Technologies Overview
SOURCE: This extends the concept of levels of collaborative software by Nunamaker, Briggs, Mittleman, Vogel, and Balthazard (1997).

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Table 6.   Defining Collaborative Software Terms

Computer-mediated communication	Software systems that have been designed primarily around basic communication, such as e-mail or chat boards, that do not provide support for advanced coordination, shared document updating, complex forms of communication, detailed decision making, or advanced levels of task and process structure.
Collaborative software	Synonymous with groupware.
Computer-supported cooperative work	An academic research area, not a technology that focuses on understanding group interaction in the context of supportive software and processes.
Collaborative writing tools	Synonymous with collaborative writing software.
Collaborative writing software	Software that allows collaborative writing groups to produce a shared document and assists collaborative writing groups perform the major collaborative writing activities.
Electronic meeting systems	Synonymous with group support system.
Group decision support systems	Software and associated supported processes designed to improve group decision making.
Groupware	A family of software that has been designed to support common group tasks in various levels of shared electronic environments. Groupware includes software that has various levels of relationship and coordination support, such as computer-mediated communication systems, group decision support systems, and group support systems.
Group support systems	Software and associated support processes that have been designed to improve outcomes of group meetings through high levels of coordination. Group support systems include group decision support systems.

distributed CW groups through increased process structure (Lowry, 2002a), examining proximity effects in asynchronous-distributed CW groups (Lowry, 2002b), and using empirical research to demonstrate *Collaboratus'* efficacy in providing enhanced group awareness and CW support in synchronous-distributed settings (Lowry & Nunamaker, 2003).

In summary, applying a consistent taxonomy and nomenclature to CW tool development helped us create a rich set of requirements and tool possibilities that better addressed the interdisciplinary issues of CW that previous tools did not address. Application of the taxonomy to other interdisciplinary research areas will likely yield similar benefits.

RESEARCH OPPORTUNITIES

The application of the proposed CW taxonomy to the development of supportive CW technologies shows the potential of this taxonomy to guide interdisciplinary

research. On a basic level, the taxonomy helps guide the questions that need to be asked in applying CW to a target domain or to address many of the issues that arise from the complexity of CW. Building on this taxonomy and using concepts by DeSanctis and Gallupe (1987), we pose additional questions about group characteristics, tools, location, and work context (Lowry et al., 2002)—creating a research framework that provides virtually endless research opportunities in CW.[5] Figure 16 depicts these possibilities by showing some of the key input decisions in an overall CW process (the overall CW process depicted in the middle of Figure 16 is simply an extension of Figure 9, without visually expanding all the elements).

> We define reactive writing as a strategy that occurs when writers create a document in real time.

It has been long recognized that CW is a social and communicative act (Bruffee, 1987; Trimbur, 1985); thus, we believe that CW processes and eventual outcomes are affected by intermediary outcome moderators such as quality of communication and relationships. For example, a group will have worse results if it has poor communication and weak relationships. Additionally, the supporting activities of CW also become moderators to a given CW process; for example, if no monitoring and rewarding occurs in a novice CW group, its outcomes will likely be suboptimal. Finally, every choice in CW activities, whether they are pretask activities, the processes of the task itself, or posttask activities, has direct effects on the outcomes. To further illustrate the research domain possibilities, we suggest a nonexhaustive list of some key questions that can be addressed by future research, in terms of CW strategies, roles, and activities.

CW Strategies

More research needs to be conducted to determine optimal CW strategies for different tasks and group sizes. Research can examine the best strategies according to the outcomes that are most desirable for a task. For example, an effort to produce a journal article collaboratively must put a high premium on quality, often at the expense of personal satisfaction. Additionally, it would be useful to verify if reactive writing will generally develop more creativity (such as number of original ideas) than parallel writing, even though reactive writing is harder to coordinate. To address this question, it would be important to look at different sizes of reactive writing to determine at what group size coordination starts to become unwieldy.
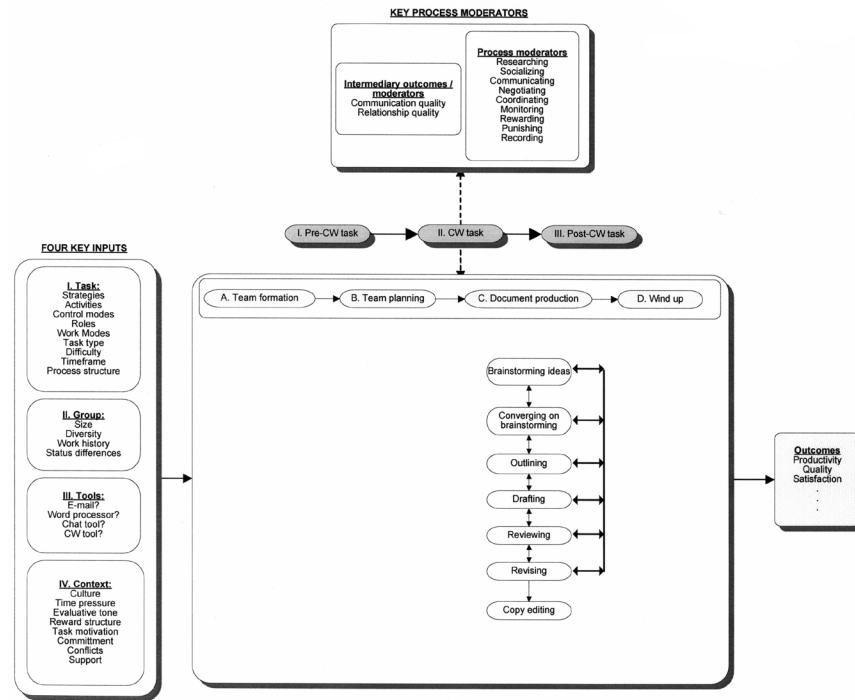
Figure 16. Collaborative Writing (CW) Research Framework

CW Roles

It would also be useful to mix the exploration of parallel writing strategies with the use of roles. For example, because horizontal-division writing requires each participant to own one particular section of a document, such divisions are often arbitrary and cause group members to act in roles for which they are not best suited. Thus, horizontal-division writing likely produces lower quality of documents but causes faster production than stratified-division writing, where each participant plays a particular role, such as editor, author, or reviewer, based on his or her core talents. Verifying these claims through more research would provide obvious benefit in guiding the decisions of CW groups.

CW Activities

Research on CW activities should further determine which activities need to be performed by an entire group and which can be performed by individuals,

according to different task types. For example, it is common in business settings for one person to create a document draft and then distribute the draft for collaborative review. Although this practice may be common, it may not always be the best approach. Although such a practice may be acceptable for agreeing on the meeting notes for a nonstrategic meeting, it is likely unacceptable in efforts that require significant buy-in and that have significant strategic impact on a company—such as a policies and procedures manual or a mission statement.

It would also be informative if researchers could look at the effects of including or not including some of the key supporting activities. For example, what happens when socialization opportunities are eliminated from a company's efforts to develop a mission statement? Do students need socialization to achieve more satisfaction and higher quality results? What happens when the richness of coordination and group awareness is diminished by distributed work modes?

CONCLUSION

This article has shown that CW is a critical form of communication and that despite its complexities, CW is likely to continue in its importance in the future. If properly performed, CW can be more effective than single-author writing, and this explains its heavy use in education and industry. Furthermore, CW is a form of group work that has a substantial research history but also has many inconsistencies and areas for improvement, as evidenced by the scant CW research that has been published in peer-reviewed journals. Given the interdisciplinary nature of CW and its importance, CW research and practice can benefit from the use of a common taxonomy and nomenclature. Such a foundation is essential because an enhanced nomenclature and understanding can increase the communication quality of CW research and training, CW issue resolution, and conducting CW activities. This increased interdisciplinary collaboration and communication will strengthen the research foundation and tradition of CW.

NOTES

1. Collaborative writing's (CW's) focus on teamwork around a common objective is a critical definitional point: Writing does not become collaborative just because multiple people are involved. For example, a single-authored journal article that goes through the standard review and editorial processes does not represent CW, because editors and reviewers are not focused necessarily on the same writing objective and may have conflicting loyalties and motivations.

2. Group single-author writing has also be referred to as single-author writing (Posner & Baecker, 1992), a term that is easily confused with the act of writing by one person.

3. More than 72% of respondents in Ede and Lunsford's (1990) study use this strategy at least on an occasional basis.

4. Ellis, Gibbs, and Rein (1991) also proposed a fifth possible mode, mixed mode, which represents a mode that mixes any of the four modes at any point in time for a given group.

5. Context has a particularly important effect on CW in business because so many decisions are affected by policies, procedures, and larger organizational contexts (Locker, 1992; Mathes, 1989).

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