Synchronous, Distributed Collaborative Writing for Policy Agenda Setting
Using Collaboratus, an Internet-Based Collaboration Tool

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Abstract

Collaborative writing (CW) in policy agenda setting and grant development is an important aspect of community development. However, solutions need to be found to better deal with distributed CW. This paper establishes a basis for improving distributed, CW for policy agenda setting, and similar efforts, by using an Internet-based collaborative tool. This work utilizes key research to better understand the constructs and potential outcomes of CW. Findings include that using Collaboratus for distributed CW can provide significant improvements over traditional methods, potentially benefiting those involved in distributed rural community development initiatives and similar efforts.

1.0 Introduction

One issue facing rural communities is the need to work collaboratively across significant distances. Much of this work involves making decisions and creating documents such as policy papers and grant proposals. Given the challenges presented by such distributed work, we propose that CW via an Internet-based system is a potential solution to this particular rural development problem.

CW is a social act that involves interpersonal communication, group dynamics, work communities, and social influence. Collaborative writers will necessarily conflict, agree, disagree, come to consensus, diverge, battle, harmonize, give, take, argue, persuade, and dissuade. From this perspective, this paper develops theory and an experiment to better predict and control distributed, CW outcomes. To develop this theory, we first turn to literature to create a theoretical foundation for the social aspects of CW. Given this foundation, we present a distributed, collaborative, Collaboratus, which is hypothesized to improve distributed CW. Finally, related hypotheses on Collaboratus are proposed, tested, and further explained in a laboratory experiment.

2.0 Literature Review and Theory

This section reviews key literature that will build the basis for interpersonal relationships and communication theory in CW to predict CW outcomes. This theory is built on the belief that successful CW groups depend on successful interpersonal relationships.

Communication researchers have posited that the most important dimensions in relational communication are dominance, affiliation, and involvement [1]. Dominance is part of a group’s persuasion processes and dynamics, where a given party successfully wields influence on the group’s outcomes; dominance can also be thought of as control, persuasion, or influence [2]. Conformance is often the bipolar companion of dominance, where individuals yield to dominant individuals, which can have varied manifestations such as supplication, hostility, or agreement [2]. Agreement is manifested through attitudes, perceptions, and behaviors in how a group cooperates, makes decisions, interacts, and persuades [3, 4]. Discord is the worst case of “agreement”, simply resulting in negative group conflict and overt behaviors that undermine the CW group’s progress. The proposed, optimal, middle ground for CW agreement is consensus, where some conflict and disagreement occurs, but people work out their differences to achieve optimal creativity and performance. Several streams of research substantiate that consensus can be optimal, including [5]. Moreover, groups achieving consensus have more internal agreement [6], exhibit less opinionatedness and more objectivity [7], make fewer redundant statements [8], make less random comments and are more responsive [9] than non-consensus groups.

In CW literature, agreement is typically used as a multidimensional construct that measures the degree of consensus a group achieved in the decisions related to their CW document. In this context, agreement relates to behavioral manifestations of quality of participation, status, and struggles for participation and leadership [3], but ultimately must involve group decisions and attitudes. Both constructive conflict and destructive conflict are important in determining consensus.

Meanwhile, affiliation deals with how group members regard and treat each other [1]. This may or may not include intimacy, as socialization can include superficial discussions. Also, affiliation can have positive or negatives valences, where some people can be hostile and others can be friendly. Involvement measures how engaged group members are with each
Involvement tends to act as an intensifier with the other measures. Thus, a potentially explosive situation is created in socialization that not only has high levels of negative affiliation, but also has high levels of involvement. The next section presents an overview of key literature that is used to create theoretical propositions for CW.

### 2.1 Social Psychology and Group View

This section reviews the social research that directly applies to the interpersonal aspects of CW.

**Conformance:** When group members verbally announce their decisions in the presence of a group, high levels of conformity are often created [10]. Subjects who work alone on a task often outperform groups of people who are negatively influenced by confederates [11]. Likewise, non-anonymous decision-making has been clearly shown to promote conformity, while anonymity in judgment making decreases conformity [12]. One explanation for such conformity is that team members do not want to criticize any of a team’s efforts because of desire for politeness or concerns of group member retaliation or rejection [13].

Two sources likely explain conformity: (1) **normative influence**, which is driven by the need for social approval the desire to avoid social rejection [12, 14]. Thus, gaining the approval of attractive group members can be a rewarding process that serves as an effective incentive for group conformity [14, 15]. Groups with important, shared goals become more interdependent and vulnerable to one another especially through influences of normative processes [12, 14].

(2) **Informational influence** is the second form of influence where group members use the behaviors and attitudes of other group members to infer truth [12, 14]. Typically group members will turn to informational sources of conformity when they face difficult or ambiguous tasks [12, 14]. Research suggests that collaborative technology can diminish conformance pressure, by creating an intermediary that abstracts group influence and pressure. For example, GSS group members are less likely to change their strongly held opinions than individuals in F2F (face-to-face) groups [16]. The following propositions derive from this social literature:

**P1. Anonymity during brainstorming in CW should decrease conformity and increase involvement.**

**P2. F2F CW groups are likely to have more conformity than distributed CW groups.**

**P3. CW groups that have existing social connections, group history, and those that use effective group formation exercises will increase conformity processes through normative influence and will have higher affiliation.**

**P4. Difficult CW tasks, such as policy agenda setting, will promote reliance on informational influence and increase involvement.**

**Minority influence:** The bulk of early minority influence research incorrectly concluded that people naturally submit to the force of majority opinions in groups, and that those who do not are rejected [14, 17]. Instead, more accurate to think of minority thinkers as catalysts of change within groups [18]. Likewise, teams can be more effective by creating “heterogeneous” composition that includes team members with different personality types [19].

Research indicates majority influence is the likely default unless the minority is able to successfully exert influence, which is most probable when a minority presents a consistent, objective, stable alternative group norm [20]. However, in acting consistent they need to be careful to not be too dogmatic and inflexible or they will not effectively influence the majority [14, 20]. Instead, a minority’s consistent, thoughtful, and confident promotion of its position encourages the majority to view the minority as confident and credible [14, 21].

In addition, groups process opinions differently depending on whether they originate from majorities or minorities [22]: Opinions from a majority encourage people to try to align their comments with the majority. Meanwhile, minority opinions, when properly presented, promote a different process where group members actually try to understand minority’s viewpoint. These different processes cause majorities to influence through compliance (public acceptance) while minorities influence through conversion (private acceptance) [14]. One possible explanation for these differences is that the stress and conformance pressure induced by majorities often leads to superficial processing of issues, and thus a rapid convergence of opinion; while minorities stimulate creativity and bring in new insights, which creates a divergence of opinions and brings in new branches of information and new alternatives [14, 23]. Thus, majorities still tend to have greater influence in groups (even if negative); however, groups exposed to minority influences tend to find more accurate and creative solutions [24]. An exception is that double minorities (demographic minorities that have a minority opinion) have been found to have less influence on groups [25]. However, technology may decrease this problem through increased anonymity.

Group support systems (GSS) often increase the quality of minority involvement in groups. For example, research has shown when GSS are used in groups, the majority is less likely to put the minority on
the defensive or dominate the minority, regardless of task type [26]. Additionally, GSS use in groups encourages minorities to more freely express their opinions, resulting in better group decisions [27] and better use of information [28]. However, occasionally using GSS with a group dominated by a majority can hinder group decision-making because contention can cause group members to spend their time gathering information instead of discussing issues [27]. Such a scenario can be improved by adding more heterogeneous group composition, which provides a greater range of solutions than homogeneous groups [29].

P7. Successful use of heterogeneity in CW team composition can cause less rapid convergence of opinions, more divergence of thought, and more disputation, ultimately promoting more consensus and quality.

P8. CW groups that use collaborative technology will promote stronger minority influence than non-technology groups.

P9. F2F CW will decrease minority influence, while distributed CW will increase minority influence.

Group polarization: Stoner [30] founded group polarization research by discovering decisions and attitudes of groups can become more extreme than those produced by their individual members acting alone. This phenomenon was originally called “risky shift”, yet, researchers soon found that groups were often more conservative and cautious than individuals [31]; thus, the term “group polarization” was coined [32]. Polarization has also been found beyond group decisions involving risk taking: For example, highly prejudiced students become more prejudiced after peer group discussions on racial issues, while non-prejudiced students become less prejudiced after such discussions [33]. Likewise, simulated juries presented with weak incriminating evidence increased their leniency after jury deliberations, while juries presented with stronger evidence were less lenient [34].

Different communication processes have been found in risky and cautious groups: For example, risky groups have been shown to have more disagreement, more than twice as many statements, higher focus on task considerations, and utilize more “non-self”-oriented statements than cautious groups [35]. Also, positive communicative responses to minority arguments in groups mitigate the degree to which groups shift toward majority opinions [36].

P5. High levels of disagreement in CW will promote groups to take riskier positions.

P6. Involving effective minority opinions in CW will help mitigate the potential for group polarization.

Status effects: Differences in perceived and real “status” of group members has been shown to directly affect group agreement. For example, high status group members often take more opportunities to provide input, and that those with the most turns have the greatest influence on discussions [37]. Status effects also directly relate to research on “in-group” and “out-group” members: When group membership is a salient feature, the influence of out-group members on in-group members is reduced [5] – they have less inclusive affiliation.

Obedience research can be seen as a special case of status research, where Milgram’s obedience paradigm research [38] is a classic example: He set up a study where participants thought they were administering various levels of shock to another person. Interestingly, 65 percent of the participants obeyed the experimenter’s commands to administer a level of shock that was labeled as dangerous, even though the “victim” feigned twitching and screaming from the shock [38]. He later explained this phenomenon in terms of status, or a hierarchical role relationship, where the individual no longer feels responsible for his own actions and passes responsibility to an authority figure [38]. While this research primarily focused on dyads, similar status effects have been found in group research.

Similar results were presented by [39] who found that high status (MBA students) subjects dominated low status (undergraduate) members, regardless of whether they worked F2F or through CMC (computer-mediated communication). Dominance leads to lower participation of those who are dominated and ultimately to pseudo consensus. Additionally, this research found that if status labels were hidden and high-status members were in the minority, status differences in participation and in influence were reduced [39].

Turning to how technology affects status, CMC research has indicated CMC groups can have more equal participation and more involvement than non-CMC groups [40, 41]. Not only are F2F groups more likely to generate a dominant individual than CMC groups, but also asking opinions appears to help CMC groups and to hinder F2F groups [42]. However not all CMC software diminishes status effects, thus conflicting results have been found: For example, Straus [43] found evidence in his research that CMC groups had less agreement than F2F groups. While, Chidambaram [44] found similar results, he found that this trend reversed itself in groups conducting more than three sessions. This suggests learning curves and adoption and diffusion of group technology may play important roles in producing agreement. Since GSS
software is typically more advanced than CMC software, it can more greatly reduce status effects that foster dominance; through features such as parallel communication, better task structure, and more anonymity. For example, structured GSS groups can have a more even distribution of participation than unstructured groups [45]; although increased participation is not equivalent to lack of dominance, it does increase the probability that dominance will not exist. Furthermore, interactive GSS groups can have more even participation than non-interactive groups [46], suggesting some status equalization. Likewise, GSS groups can have less interpersonal conflict, more constructive conflict and more productive conflict than non-GSS groups [47]. Moreover, although GSS groups can have more participation, they are sometimes less likely to reach agreement than F2F groups [48], which may suggest dominance/conformance is not occurring as strongly.

P10. CW groups with large, apparent differences in status will more likely experience dominance and conformance, and less participation.

P11. CW processes that hide or mitigate status effects (e.g. anonymous brainstorming) will promote more consensus and participation.

P12. Use of an in-group leader in CW, especially one of high authority in the organization, will result in more conformance and dominance, and less participation.

P13. Use of CW software that incorporates anonymous brainstorming, GUI interfaces, group views, parallel communication, and equal roles will mitigate negative status effects.

P14. F2F CW is more likely to result in status effect problems than non-F2F, distributed CW.

Task structure: The processes and tasks a group chooses affects all kinds of outcomes such as agenda creation, turn taking in communication, decisions, how decisions are made, and underlying agreement [50]. For example, in free discussions different outcomes occur depending on the order in which group members discuss issues and the routine procedures they employ such as straw polling [50]. Not surprisingly, poor task structure can have negative consequences: For example, unstructured tasks or processes that encourage advocacy can result in adverse group decisions [51].

Many outcomes with GSS groups can be explained by variances in task and process structure such as group size, work mode and work location, group history, use of leadership and facilitation. For example, facilitation techniques that increase process structure appear to significantly affect consensus building: Likewise, chauffeur-driven groups often achieve significantly higher post-meeting consensus than do facilitator-driven groups [52]. F2F groups had higher consensus with preference tasks than non-F2F groups [53]; however, several researchers show higher levels of consensus with GSS groups performing intellective tasks [54].

Additionally, human leadership and/or computer feedback has a profound effect on a group’s ability to reach consensus [55]. For example, groups that use elected leaders typically have an influence imbalance, which negatively affects agreement; although, use of GSS reduces influence imbalance significantly [56]. Likewise, GSS use can inhibit the emergence of new leaders in groups lacking established leaders, which promotes more democratic group discussions in the absence of an elected leader [56]. Finally, in terms of group location, distributed work teams experience several negative factors that can negatively affect agreement in groups [57]: less group focus, less social interaction, less non-verbal cues, free loading, and blind work. Also not surprising is that large groups require more voting to reach consensus on decision-making tasks than small groups [58]. While large groups do not necessarily have less agreement, they are more likely to take more time to build consensus, which can jeopardize the agreement process.

P15. CW processes that are unstructured or that encourage advocacy will result in poorer agreement and participation.

P16. Increasing process structure through facilitation and/or CW software will improve consensus, involvement, and affiliation within CW.

P17. CW groups that use external group leaders or facilitators will have better agreement, involvement, and affiliation than groups that use in-group leaders or facilitators.

P18. Large CW groups will take longer to develop consensus and positive affiliation than small groups, but will be less likely to be dominated by one individual.

P19. Likewise, distributed groups will struggle longer than F2F groups to build consensus and achieve positive affiliation, but will also be less likely to be dominated by one individual.

2.2 Construct framework

This section provides a construct framework that can be further used for theoretical predictions with CW (see Figure 1). First, we define the input variables as the choices made when initially starting a CW task. These variables include the group’s composition characteristics, the task and process structure, the tools used, and the context of the tool use (based on [59]). Second, the primary mediators through which all CW tasks flow through are the actual CW activities and
processes a group chooses to employ, such as brainstorming, outlining, and drafting. Yet, the combination of the input variables and the process mediators alone do not account for the final CW outcomes -- the intermediary outcome moderators also wield great influence. These moderators include key aspects of dominance, involvement, and affiliation that a group is experiencing, and can be classified in terms of interpersonal relationships, socialization, perceived group characteristics, and communication. Additionally, to better measure and understand these moderator variable, it is useful to try to measure them in terms of attitude strength and behavior, based on social psychology research in attitude-behavior consistency [60].

For measurement purposes, attitudes are generally perceived measures as reported by group participants, while behaviors are objectively observed measures. For example, a weak attitude of agreement indicates superficial agreement that may be based on heuristic processing or social norms of public commitment or compliance. In contrast, a strong attitude of agreement indicates the concept of private “conversion”, or a longer lasting agreement based on systematic processing. Meanwhile, behavioral manifestations of agreement are observable behaviors that further indicate the level of agreement in a CW group, such as discord, dominance/conformance, and consensus.

2.3 Collaboratus hypotheses

Collaboratus is a Java-based, collaborative application that was designed to improve work and communication of distributed, collaborative groups [61, 62][63][64][65]. Collaboratus supports several collaborative activities such as brainstorming, outlining, and process modeling. The most important contribution to CW is that Collaboratus allows synchronous and asynchronous groups to work on the same CW document through a web browser. Authors can work at the same time on different sections of the document and see the work others are doing at any time. They can also create and view annotations, and multiple versions of document sections at the same time. As a result of its design Collaboratus should help groups overcome conformance, dominance, negative affiliation, and negative status effects by providing anonymity in CW brainstorming and CW review, supporting parallel work, increasing group awareness, and supporting distributed work.

Furthermore, improved communication, social affiliation, consensus and equality of participation is likely promoted by Collaboratus’ discussion features, anonymous voting, annotations, group awareness, and support for larger teams. Ultimately, these features should support better discussions, more positive affiliation, and better socialization than traditional tools. Increased group awareness and involvement should be promoted because other group members can instantly view all public work, whether the group is working on an outline, a collaborative document, or in a brainstorming session. Thus, group members can keep track of what is happening, more easily observe group progress, and better address issues. Additionally, Collaboratus’ support for version control, annotations, and history viewing should also encourage more group awareness and open dialogues.

Moreover, Collaboratus should increase support of minority influencers and more heterogeneous teams because of the support for anonymity, ongoing communication, voting, a group-oriented interface, annotations, messaging, and overall automation. Furthermore, because Collaboratus was designed for collaboration it can support significantly more group members than traditional tools such as Microsoft Word. Finally, Collaboratus promises several advances in collaboration by supporting stronger task structure through enhanced group awareness, knowledge management, and communication capabilities for distributed teams.

The specific purpose of the current research experiment was to validate that Collaboratus would indeed be a superior tool for building writing communities in distributed settings, as compared to Microsoft Word™. Additionally, we set out to validate several of the above-listed propositions involving the effect of dominance, affiliation, and involvement on CW outcomes. Hypotheses were constructed, on the basis that both treatment and control groups would use NetMeeting™ for all communication in a simultaneous, distributed setting using teams of three participants. Most hypotheses can be broken down into two, sub-hypotheses: (1) “a”, which refers to perceived
measures and (2) “b”, which refers to observed measures (hypothesis 1, 7, and 8 are exceptions).

H1a: Collaboratus groups will produce documents of greater lengths than Word groups.
H1b: Collaboratus groups will have longer chat lengths than Word groups.
H2: Collaboratus groups will have higher perceived and judged quality than Word groups.
H3: Collaboratus groups will have higher perceived and observed satisfaction than Word groups.
H4: Collaboratus groups will have more perceived and observed agreement than Word groups.
H5: Collaboratus groups will have higher levels of perceived and observed participation than Word groups.
H6: Collaboratus groups will have higher perceived and observed strength of interpersonal relationships, positive affiliation, and socialization than Word groups.
H7: Collaboratus groups will have less coordination communication than Word groups.
H8: Collaboratus groups will display more simultaneous work strategies than Word groups.

3.0 Method

The general research design for this experiment was a between-groups independent design: A x g(A) x s(gA) where A is the control or treatment, g is the randomly assigned group nested within A and s are the randomly assigned subjects nested within g and A [66].

The participants were 100-level MIS students who received class credit for participation. The CW assignment focused on an environment that is similar to one in which rural communities face: stating problems in a community, prioritizing the problems, making a decision as to which problems to address, proposing a potential solution and implementation process for review. Participants were given strict rules and were required to actively participate in all four experiment sessions to receive full credit. Initially 66 students agreed to participate. Five students decided not to participate one day before the first experiment session. An additional 12 students did not show up for the first session, and were dropped from the experiment. Two additional students attended the first session, then later dropped out. Thus, 47 students fully participated in the experiment, although 8 chose to not report demographic data (males n= 21 females n = 18, average age = 20.79, age sd = 3.17, average GPA, 3.335, GPA sd=.633).

All four experiment sessions took place during class time and lasted approximately one hour. Each session was approximately a half a week to a week apart. Both the treatment and control groups worked at the same time in different GSS rooms.

Subjects were assigned to sit at workstations where none of their team members would be visually observable. They were forbidden to speak, and conducted all their communication using NetMeeting. Each session was carefully scripted and timed to ensure consistency between treatment and control groups, in guiding them through all the major activities of CW (team formation, brainstorming, outlining, drafting, reviewing, final draft). All participants were trained on NetMeeting and Collaboratus. The control groups were not told they would not be using Collaboratus until the start of their writing exercise in the second session.

Participants completed three questionnaires. Prior to the first session students completed a survey on their previous CW experiences. Participants were also required to complete two additional surveys within 24 hours of the last session: a usability survey and a survey to capture the perceived measures.

The perceived DV measures were collected by the post-test survey, and include the following: perceived agreement (11 items, $\alpha=$.8925), perceived satisfaction (4 items, $\alpha=$.8666), perceived quality (8 items, $\alpha=$.8787), perceived strength of interpersonal relationships (2 items, $\alpha=$.9084), perceived respect (2 items, $\alpha=$.7325) and perceived participation (6 items, $\alpha=$.7713). Perceived heterogeneity was a simplistic one-item measure, as were measures of simultaneous work with low coordination, and simultaneous work with high coordination. In addition, to better measure perceived satisfaction, results were also tabulated from the pre-test and post-test from questions that asked opinions on how much the participants enjoyed CW – attributing any significant change to satisfaction / dissatisfaction (3 items pre-test $\alpha=$.7034, 3 items post-test, $\alpha=$.8370). Furthermore, perceived strength of personal relationships was further enhanced by a post-test measure that asked participants to rate how well they knew team members before and after the project, and examining the corresponding increase.

The observed measures were taken from each group's paper and the chat session logs. Length was calculated by the total number of words produced in a document. The observed participation in chat sessions was calculated simply by the number of words contributed by all of a group’s members. This is the primary measure of involvement, which measures how engaged group members are with each other regardless of the dominance and/or affiliation that is taking place [1]. In addition, the full chat transcripts of all work sessions for all work groups were captured electronically from NetMeeting and coded for different observed message types.

All dialogues for the group writing sessions (sessions 3 and 4) were broken up into distinct fragments consisting of a subject-verb that were coded by two
judges into one of the following communication categories: coordination (a non-social message designed to help coordinate the work effort; session three .9961, session four .9732), confusion and/or dissatisfaction (overt expressions of confusion and/or dissatisfaction; session; session three .9629, session four .7923), agreement / consensus (agreement / consensus messages that include agreement positive session three .9462, agreement negative session three .9583, agreement positive session four .8226, agreement negative session four .9821), dominance / conformance (messages that show positive regard toward other group members in respect to the group task such as courtesies, pats on the back, congratulations; 2 items, session three .9773, session four .8755), negative affiliation (messages that indicate a disregard or disrespect for group member, such as name calling, profanity, and inappropriate comments; not enough occurrences for reliable measures), and socialization (messages where group members positively affiliate, but are simply enjoying and relating to each other socially in a context unrelated to the assigned task such as discussing what they did over the weekend; session three .9506, session four .9942).  Because a given message could be broken down into several, disparate subject-verb fragments, the categories were assigned in a mutually exclusive fashion.  All coding values were nominally rated (no attempt was made to assess the degree to which a category applied).  Observed consensus was gathered by two methods.  First, because consensus is positively related to higher involvement of all team members than in dominance, groups were measured on the percentage of chat participation by each group member.  The second method relates directly to the chat coding measures that looked for messages indicating agreement.

To assess externally-judged quality all papers were exported into a generic HTML format.  All names and group identifiers were removed and an unidentifiable code was placed on each paper to ultimately identify the group.  Papers were judged by five external judges who had been trained on how to assess the papers.  However, two judges were dropped from the judge pool because they were inconsistent in their measures; the remaining three judges had an interrater reliability of 0.77.

4.0 Results

Intracorrelation tests indicated that perceived quality, perceived strength of interpersonal relationships, and perceived heterogeneity were relatively uncorrelated, and thus, these three measures were analyzed on the individual level, while all other measures were analyzed on the group level, using a between-groups independent variables analysis [66].  This analysis is more conservative than ANOVA as it corrects for the existence of strong intraclass correlations, where ANOVA does not make this correction [66].  In addition, an adjustment was made to test all data at α=.10 to reflect the increased power of the one-tailed hypotheses.

Because of the large number of hypotheses, this section highlights the significant results from the statistical analysis (Table 5).  H4b was partially supported because Collaboratus groups showed more disagreement and less conformance.  H1a was fully supported in that Collaboratus groups would produce higher document lengths.  H1b was supported that Collaboratus groups would have more participation / involvement.  H2b was supported that Collaboratus groups would produce documents of higher quality, as judged by external judges.  H6b was supported that Collaboratus groups would have higher quality of observed interpersonal relationships in terms of socialization and positive support.  Finally, H8 was supported that Collaboratus groups would engage in more simultaneous work than Word groups.

5.0 Discussion

Given the results outlined in Table 5, under these experimental conditions Collaboratus groups will produce significantly more consensus, higher document lengths, more participation, higher quality documents, better relationships, and engage in more simultaneous work than Word groups.  Clearly it is notable that not only were Collaboratus groups more efficient and produced higher quality documents, but also Collaboratus groups displayed more consensus and stronger social relationships.  The factors of high consensus and strong relationships could partially account for the increased quality and efficiency.  Conversely, increased efficiency and quality provided more time for Collaboratus groups to socialize and provide supportive messages.  Such increased consensus and stronger social relationships may be pivotal to successful community development efforts, especially in highly politicized environments.

Several shortcomings of this study need to be improved upon in future studies.  In particular, the perceived measures were largely disappointing in their effect sizes (except for agreement and satisfaction).  Thus, adjustments to the scales and underlying theoretical constructs of the perceived measures need to be improved.  The observed DV’s were much more accurate and insightful in distinguishing satisfaction,
Table 5: Results of Experimental Hypotheses Testing

<table>
<thead>
<tr>
<th>Hyp.</th>
<th>DV</th>
<th>Control Mean (sd)</th>
<th>Treat Mean (sd)</th>
<th>Correct direction?</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a</td>
<td>Chat length session 3</td>
<td>450.43 (248.55)</td>
<td>476.74 (93.71)</td>
<td>Yes</td>
<td>0.09</td>
</tr>
<tr>
<td>H1b</td>
<td>Chat length session 4</td>
<td>360.38 (140.91)</td>
<td>617.37 (256.16)</td>
<td>Yes</td>
<td>5.27*</td>
</tr>
<tr>
<td>H2a</td>
<td>Perceived quality</td>
<td>5.710 (.368)</td>
<td>5.849 (.543)</td>
<td>Yes</td>
<td>0.56*</td>
</tr>
<tr>
<td>H2b</td>
<td>Externally Judged quality</td>
<td>3.475 (6.464)</td>
<td>4.445 (8.826)</td>
<td>Yes</td>
<td>6.58*</td>
</tr>
<tr>
<td>H3a</td>
<td>Perceived satisfaction</td>
<td>5.423 (.583)</td>
<td>5.285 (1.309)</td>
<td>No</td>
<td>0.08</td>
</tr>
<tr>
<td>H3b</td>
<td>Observed dissatisfaction session 3</td>
<td>3.643 (4.741)</td>
<td>2.605 (2.264)</td>
<td>Yes</td>
<td>0.16</td>
</tr>
<tr>
<td>H3b</td>
<td>Observed dissatisfaction session 4</td>
<td>2.06 (1.10)</td>
<td>1.79 (1.64)</td>
<td>Yes</td>
<td>0.08</td>
</tr>
<tr>
<td>H4a</td>
<td>Perceived agreement</td>
<td>5.85 (.30)</td>
<td>5.54 (.77)</td>
<td>No</td>
<td>1.27</td>
</tr>
<tr>
<td>H4b</td>
<td>Observed agreement (positive) session 3</td>
<td>3.79 (3.92)</td>
<td>6.34 (3.35)</td>
<td>Yes</td>
<td>1.58</td>
</tr>
<tr>
<td>H4b</td>
<td>Observed agreement (negative) session 4</td>
<td>3.94 (2.47)</td>
<td>4.58 (3.11)</td>
<td>Yes</td>
<td>0.21</td>
</tr>
<tr>
<td>H4b</td>
<td>Observed agreement (positive) session 4</td>
<td>4.94 (4.12)</td>
<td>6.47 (6.55)</td>
<td>Yes</td>
<td>0.27</td>
</tr>
<tr>
<td>H5</td>
<td>Perceived participation</td>
<td>5.859 (.442)</td>
<td>5.811 (.7725)</td>
<td>No</td>
<td>0.02</td>
</tr>
<tr>
<td>H6a</td>
<td>Perceived interpersonal (relationship)</td>
<td>2.750 (1.431)</td>
<td>3.547 (.916)</td>
<td>Yes</td>
<td>2.66*</td>
</tr>
<tr>
<td>H6a</td>
<td>Perceived interpersonal (respect)</td>
<td>6.094 (2.733)</td>
<td>5.685 (1.091)</td>
<td>No</td>
<td>1.17</td>
</tr>
<tr>
<td>H6a</td>
<td>Perceived interpersonal (post-test increase)</td>
<td>.96 (.88)</td>
<td>1.56 (1.09)</td>
<td>Yes</td>
<td>2.67*</td>
</tr>
<tr>
<td>H6b</td>
<td>Observed interpersonal (socialization) session 3</td>
<td>2.00 (2.95)</td>
<td>1.18 (2.06)</td>
<td>No</td>
<td>0.25</td>
</tr>
<tr>
<td>H6b</td>
<td>Observed interpersonal (socialization) session 4</td>
<td>1.250 (2.642)</td>
<td>23.842 (30.023)</td>
<td>Yes</td>
<td>4.41*</td>
</tr>
<tr>
<td>H6b</td>
<td>Observed interpersonal (positive support) session 3</td>
<td>7.643 (4.881)</td>
<td>14.895 (4.624)</td>
<td>Yes</td>
<td>7.17*</td>
</tr>
<tr>
<td>H6b</td>
<td>Observed interpersonal (negative) session 3</td>
<td>1.000 (.300)</td>
<td>.474 (.589)</td>
<td>Yes</td>
<td>4.37*</td>
</tr>
<tr>
<td>H6b</td>
<td>Observed interpersonal (positive support) session 4</td>
<td>7.063 (3.174)</td>
<td>14.816 (4.688)</td>
<td>Yes</td>
<td>12.17*</td>
</tr>
<tr>
<td>H6b</td>
<td>Observed interpersonal (negative) session 4</td>
<td>.31 (.36)</td>
<td>.39 (.46)</td>
<td>Yes</td>
<td>0.20</td>
</tr>
<tr>
<td>H7</td>
<td>Coordination messages session 3</td>
<td>45.357 (13.309)</td>
<td>31.079 (13.309)</td>
<td>Yes</td>
<td>1.23</td>
</tr>
<tr>
<td>H7</td>
<td>Coordination messages session 4</td>
<td>33.58 (15.85)</td>
<td>26.84 (16.92)</td>
<td>Yes</td>
<td>0.47</td>
</tr>
<tr>
<td>H8</td>
<td>Simultaneous work</td>
<td>4.06 (1.83)</td>
<td>5.53 (1.30)</td>
<td>Yes</td>
<td>7.72*</td>
</tr>
</tbody>
</table>

+ This was tested on individual-level where F-test was F(1,40) = 2.84 (power ranging from .78 to .98); Group-level F-test was F(1,12) = 3.18 (power ranging from .35 to .65). * Signifies significant tests.

frustration, agreement, and socialization than the perceived DV’s. Thus, more work should be conducted to improve the message coding generalizability and to extend it to other constructs. Other measures that could be included in the future include learning and quality of communication. While the measure of heterogeneity appeared to show promising results in explaining the differences amongst group outcomes, heterogeneity needs to be further expanded into a multi-dimensional construct accounting for differences such as background, culture, ethnicity, race, and status. Additionally, the power of the future experimental studies needs to be increased by including more groups. Moreover, this study does not determine which affordances or features of Collaboratus are responsible for particular outcomes. In this light, future research comparing different versions and features of Collaboratus would provide valuable insight. Furthermore, although the writing task involved integration between group members, it was not as highly integrative as more complex community development efforts tend to be (e.g., grant writing, policy creation). Thus, a wide array of writing tasks need to be studied in the future. Likewise, a more diverse array of participants should be examined, such as professionals and academic writers as well as community members who are perhaps not quite as literate as college students. Moreover, field studies with actual community development efforts would prove to be highly insightful. Finally, in terms of future experiments it would be useful to look at different combinations of heterogeneity, brainstorming, task choice, task structure, and general CW processes, to assess the most ideal combinations for distributed CW.

In closing we would like to particularly acknowledge Dr. Queen Esther Booker for her invaluable help with this research, as well as Dr. Judee Burgoon for her insightful review. We also would like to thank the staff at CMI and particularly Dr. James Lee and Dr. Conan Albrecht for their development efforts.

References


