Understanding Collaboration Success in Context of Cognitive and Social Presence

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Abstract

Collaboration and the success of collaborative efforts has been the focus of much information systems research. Recent measures of collaboration success include effectiveness, efficiency, productivity, commitment, satisfaction with the process, and satisfaction with the outcome. While the possible antecedents of collaboration success are many and varied, we suggest that constructs from the e-learning literature, that evolved independently from the information systems collaboration literature, can be used to explain differences in perceived collaboration success. Results from a recent exploratory study demonstrate that cognitive presence and social presence explain a large amount of the variance of different collaboration success metrics.

1. Introduction

The emergence of new technologies and a convergence on the Internet as a productivity tool has given birth to a grass-roots collaboration effort that has spread into many organizations. This form of collaboration looks very different from the collaboration efforts of the past. Previously, much of the information systems collaboration literature had focused on groupware facilitated, synchronous, face-to-face (FTF) environments [1], with success often based on satisfaction with the collaborative process or the outcome of the collaborative effort [2]. While collaboration as a research topic continues to enjoy significant coverage in the information systems literature [3], this specific form of collaboration has never broken out of its niche positioning to achieve widespread implementation in the day-to-day activities of many organizations [4].

Instead, today's emerging collaborative systems often lack explicit process structure needed to create collaborative artifacts or reach collaborative solutions, or simply address a very narrow aspect of the collaborative endeavor. Several technologies (such as discussion groups, forums, instant messaging, and wikis [5]) have emerged and have been adopted at organizations in order to share a wide variety of information between individuals and groups. While many tend to lump all collaboration technologies into a single grouping, more accurately these tools can be seen as lying on a continuum of complexity in terms of the collaboration supported [6]. Where the aforementioned groupware tools are designed to support complicated products and processes, these new tools tend to support unstructured use and generally excel in more simple information sharing tasks.

Indeed, most of the collaborative technologies that are being widely adopted are not structured in a way to support highly complex group collaboration. Thus, lessons from the information systems collaboration literature do not necessarily directly translate to these new technologies. However, insights, may be drawn from other disciplines that are either related to collaboration or provide support for it. Two examples of these supporting disciplines are human communication and education. In education, for example, e-learning literature investigates how participants use analogous technologies to support distributed, asynchronous learning with minimal input from a facilitator/moderator (i.e., the instructor).
This paper outlines the investigation of constructs adapted from the e-learning literature with respect to collaboration. Specifically, we look at cognitive presence and social presence and their ability to explain a large amount of the variance in measures of collaborative success. Cognitive and social presence may provide an additional avenue for examining the success of collaborative efforts and tools. To achieve these ends, a collaborative system for e-learning was developed and deployed in an exploratory study in order to assess the system's impact on collaboration and e-learning success.

The paper is organized as follows. Section 2 discusses the related work from the collaboration literature as well as the e-learning literature. Section 3 presents the integrated collaboration research model. Section 4 discusses the methodology followed in conducting an exploratory study to test the integrated model; followed by results and discussion in Section 5. Section 6 concludes by summarizing the contributions of the paper, some limitations and prospects for future work.

2. Related Work

2.1. Collaboration Success

Collaboration success factors have been extensively studied in the information systems collaboration literature. We propose that success factors are much richer than just satisfaction with the collaborative effort or satisfaction with whomever is facilitating the discussion. Success of a collaborative effort may be assessed from multiple dimensions. Duivenvoorde, Kolfschoten, Briggs, and de Vreede [7] recently reported a metaanalysis of collaboration outcomes described in several research studies to propose the following key dimensions for measuring successful collaboration from a participant perspective: group effectiveness, group efficiency, group productivity, commitment of resources, and satisfaction with process and outcome.

Though these measures are still based on user perception, they attempt to quantify collaboration success in a more fine-grained and objective fashion. Effectiveness and efficiency are typical dimensions measured to assess a given process. In this case they are extended to the group in order to better align with the goals of collaboration. Group productivity, in this context, is closely related to effectiveness in that it is a measure of the balance between resources expended and the results achieved. The commitment of resources is intended to gauge the investment that the participants make to the collaborative effort. Finally, participant satisfaction is used, as with more traditional groupware studies, to evaluate the participants’ emotional estimation of the value of the collaboration.

2.2. Antecedents of Collaboration Success

There are, of course, a number of factors that precede collaboration success. Considerable research has been conducted to examine the antecedents of success in both laboratory and field work studies. Substantial work has been performed to consolidate this research into one framework [1, 8-9]. This four-factor framework categorizes the antecedents of collaborative success into four areas: contextual factors, intervening factors, adaptation factors, and outcome factors. This framework provides a mechanism for categorizing and summarizing research on collaboration characteristics and success.

Contextual factors include elements such as the environment within which the collaborative effort is performed. For example, the mode of interaction, group size, and whether a facilitator is present are contextual factors.

As the collaborative engagement proceeds, additional factors influence the interaction (e.g., session length, order of activities, number of collaborative sessions). These intervening factors lead to adaptation of the collaborative process. Adaptation includes such things as procedures, norms, and resources the group develops during execution of the collaborative tasks.

Lastly, the outcome factors are the resultant goals or outputs from the collaborative process. Many collaboration success metrics attempt to assess these outcome factors.

Within these four factors, Fjermestad and Hiltz [9] found several characteristics of successful and unsuccessful group support systems (GSS) implementations. The antecedents of successful collaborative work include the use of a facilitator (contextual factor), specific training on the collaborative technology (intervening), and high levels of trust among the group (outcome factor). These characteristics of the collaborative effort were found to correlate with collaboration success and come from different factors in the four factors model.

2.3. Distributed, Collaborative Learning

With distance and online learning environments becoming an integral part of educational systems, the use of information technologies in general, and collaboration technologies in particular has received significant attention from educators and tool developers [10-11]. Research in the field of education
has focused on distributed, computer-mediated communication (CMC)-based education. We posit that many similarities exist between CMC learning and collaborative efforts. For example, collaborative learning tools aid the participants in creating knowledge by enabling interaction and discourse with peers and instructors [12]. In this manner, “[l]earning will be seen as more socially shared, active, and interactive than in the past” [13]. The online learning is executed by way of collaborative functions and features of the CMC technology.

Garrison, Anderson, and Archer [14] have proposed the community of inquiry model (see Figure 1) as a way to characterize and investigate the online educational experience. This model posits that there are three requisite components of an educational experience that are shared by the students and the instructor: social, cognitive, and teaching presence. It is the interaction of these three elements that creates an effective learning environment [14-15]. We posit that these three presences are not only components of online learning environments but also of collaborative efforts.

Cognitive presence is arguably the most important of the three as it is the most fundamental to educational and collaborative success. Garrison et al. [14] define this term as the participants being able "to construct meaning through sustained communication." Cognitive presence refers to the inquiry and dialogue that accompany the interactive learning and sharing processes. In a learning community, participants are able to ask questions, provide insights, and resolve unknown or unclear concepts as part of the learning process. Similar interaction is found in collaborative environments, where participants exchange and refine information critical to the task at hand. Indicators of cognitive presence include such things as identifying key issues, synthesizing ideas, resolving problems, and so forth.

Social presence refers to the participants projecting themselves socially and affectively in the community. Social presence provides the participants the ability to present themselves as unique individuals, enhancing the interpersonal dimensions of collaboration. This dimension provides support for the cognitive presences by enabling group cohesion. Social presence impacts the motivation of the participants to be actively involved in the collaborative processes. Indicators of social presence include such things as asking questions and sustaining discussion.

The last element in the community of inquiry model is teaching presence. This presence encompasses two main objectives. First, the subject matter and content to be discussed must be selected. Second, the discussion must be facilitated. Like social presence, teaching presence is a supportive mechanism that facilitates the cognitive processes involved with learning [14]. Our research model focuses on cognitive and social presence as antecedents of collaboration success. In certain situations, the process structure afforded by the collaborative feature set largely achieves the same goals as the facilitators' tailoring of the collaborative processes. Here we do not include teaching presence as a construct in our overall model because the subject matter and content for the experiment was selected by the researchers and no instructor was involved in facilitating the discussion between the participants. However, future research could examine the impact of teaching presence on collaboration success.

3. Integrated Collaboration Research Model

In education research, the presences in the community of inquiry model constitute areas of focus that determine the success of an educational transaction. We posit that the cognitive and social presences also determine the success of other collaborative efforts. To examine the relationship between the presences and collaborative success, we propose a model that bridges the e-learning literature and the information systems collaboration literature.

A premise of past research is that certain collaborative characteristics or factors, if correctly appropriated, will lead to collaborative success. As previously outlined, the cognitive presence and social...
presence constructs encapsulate the critical components of an online, distributed environment. We posit that these constructs mediate the relationship between collaborative characteristics and success factors (see Figure 2).

Figure 2. Integrated Collaboration E-learning Model

In this research paper, one premise is that the collaborative characteristics or factors impact cognitive presence. For example, Meservy et al. [16] argued that specific characteristics of the collaborative tool, such as the ability to rate, tag, and filter discourse of other participants, impacts perceptions of cognitive presence. Users are actively involved in evaluating concepts, enhancing the cognitive presence by focusing participants' attention on specific content.

Premise 1: Collaborative factors impact cognitive presence.

Another premise is that the choice of collaborative factors impacts social presence by either supporting or hindering discourse and interaction with collaborative peers. For example, certain collaborative tools enable participants to more easily evaluate, tag, filter, and identify relevant discourse and highlight comments and concepts that are valued by the collaborative group. This enhancement in supporting discourse is assumed to lead to an increased sense of community and ultimately improved ratings of social presence.

Premise 2: Collaborative factors impact social presence.

4. Research Hypotheses

This paper examines the relationship between social and cognitive presence with collaborative success factors. Duivenvoorde et al. [7] synthesized several collaboration research studies and proposed the following key dimensions for measuring successful collaboration from a participant perspective: effectiveness, efficiency, productivity, commitment, satisfaction with process and outcome. We posit that these success factors are influenced by cognitive and social presence.

Group effectiveness is the extent to which the resultant collaborative outcome meets the intended goal or outcome. Participants' expectations and the value attributed to collaborative effort are likely to drive their perceptions of effectiveness. It is useful to thus measure intended results as well as expected results [7]. It is hypothesized that individuals who are cognitively involved in the collaborative task by identifying and synthesizing issues and resolving problems will perceive that the group's efforts were successful. Additionally, an individual who indicates high social presence by asking questions and sustaining discussions will be likely perceive the collaborative efforts as successful.

H1a: Cognitive presence positively impacts group effectiveness.
H1b: Social presence positively impacts group effectiveness.

Group efficiency, from a participant's perspective, is the extent to which the resultant net usage of resources meets the expected expense of resources. Resources could be in any form such as time, effort, attention, knowledge, and even physical resources such as money or infrastructure facilities [7]. Individuals indicating high cognitive and social presence are also expected to display high levels of perceived group efficiency.

H2a: Cognitive presence positively impacts group efficiency.
H2b: Social presence positively impacts group efficiency.

Group productivity measures participants' perceptions of the extent to which the expense of resources are commensurate with the quality of results derived from the effort. This balance between time and effort expended and the quality of results is an important success factor, distinct from group efficiency and effectiveness [7]. Similar to group effectiveness and group efficiency, social and cognitive presence are hypothesized to positively impact the perceived group productivity.

H3a: Cognitive presence positively impacts group productivity.
H3b: Social presence positively impacts group productivity.
Commitment of resources to the group goal is the willingness of the participants to expend resources such as time and effort to achieve group goal [17]. It also considers the motivation to participate as well as the extent to which participants have a stake in the collaborative goal and their perceived importance of the collaborative effort [7]. Those individuals who expend time and energy to be cognitively involved by identifying key issues, synthesizing ideas, and resolving problems would be expected to display a higher level of commitment than those who do not. Additionally, social aspects of collaborative systems, such as the ability to interact with others and receive feedback from other group members, are expected to impact the commitment toward the group goal.

H4a: Cognitive presence positively impacts commitment.
H4b: Social presence positively impacts commitment.

Participant satisfaction can be measured with respect to the collaborative process as well as the outcome of the process [7]. Emotional satisfaction is implied here, which is a manifestation of a response resulting from a perceived shift in yield with regards to personal goals [18]. A related notion is that of judgmental satisfaction which results from a individual cost-benefit analysis of expending resources with respect to the results and is measured through perceptions of group productivity, effectiveness, and efficiency [7]. An interesting finding reported is that participants reporting higher values of satisfaction with the collaborative outcome have a tendency to report higher values of satisfaction with the process [2]. It is hypothesized that higher levels of cognitive presence and social presence impact both the satisfaction with the collaborative process as well as the satisfaction with the outcome of the collaborative effort.

H5a: Cognitive presence positively impacts satisfaction with the process.
H5b: Social presence positively impacts satisfaction with the process.

H6a: Cognitive presence positively impacts satisfaction with the outcome.
H6b: Social presence positively impacts satisfaction with the outcome.

5. Methodology

In order to test our research model, we conducted an online collaborative activity wherein participants read an article and then engaged in a discussion surrounding specific aspects of the article. Subsequently, participants were administered a survey to assess cognitive and social presence experienced during the collaborative activity as well as collaboration success metrics. Partial least squares (PLS) was then used to assess the measurement model and also the structural model for our research hypotheses.

Participants were drawn from Information Systems courses at two U.S. universities, one in the mid-south and another in the mid-west. Motivation was provided through two different mechanisms: 1) extra credit from the instructor of the class, and/or 2) a drawing to receive one of twenty gift certificates (ranging from $10-$25 in value) for local area restaurants. Chances for the drawings were awarded proportionally based on the amount of participation throughout the collaborative activity which lasted several days. Prospective participants were contacted via email with details of the study, benefits and risks. Ultimately, sixty-six students initiated the task and twenty-four participants completed the study and the final survey.

For the collaborative activity, participants logged into an artifact-based collaborative system [16] and were assigned to read, discuss and evaluate an article about computer security. This collaborative system was designed to be used to improve distributed, asynchronous collaborative learning by improving the sharing of ideas and comments related to a specific artifact (i.e., article or topic). Major portions of the system were divided into separate web pages which were arranged as "tabs" at the top of the page. In this way, users could easily switch between understanding what they were asked to do (instructions), viewing the article, carrying on an interactive discussion, and viewing how others perceived their contributions (rankings). For more information about the system see [16].

Participants were informed that the goal of the exercise was to develop a deeper understanding about some of the risks of security, costs of preventative actions, and the impact of security breaches. They were also provided with training on how to post and evaluate messages. This topic was selected as it was relevant to the coursework of the student but was also of general interest. The level of task difficulty was intended to foster collaborative learning while being able to be completed in the designated time. Participants were urged to participate in online discussions with other subjects. The discussion was seeded with specific questions intended to encourage collaborative discourse and active learning.
Users were asked to logon to the system once per day for one week to contribute to the discussion. They were given the expectation that the task should take one hour of cumulative effort. Upon completion of the task, the users were directed to complete a survey that sought to assess cognitive and social presences and also evaluate satisfaction with process and outcome, efficiency, effectiveness, commitment and productivity. The survey utilized questions from two previously validated survey instruments [7, 19], which were adapted for the distributed, asynchronous context of this study. The adapted survey instrument is provided in Appendix A.

6. Results and Discussion

Partial least squares (PLS) was the data analysis technique used for his study. Given that PLS is better suited for exploratory studies where the theory is under development, and can work for small sample sizes with minimal distributional assumptions [20], it was considered the analysis technique of choice for this study. SmartPLS [21] was used as the software for conducting PLS analysis.

Throughout the analysis, we followed the recommendations of Straub [22] and Straub, Boudreau, and Gefen [23] particularly as they apply to validity.

The questionnaire items were drawn from prior literature in the fields of e-learning and collaboration, thus attesting to the content validity of the instrument. Particularly, the instrument items related to the constructs of cognitive presence and social presence have been discussed by Garrison et al. [19], while those capturing collaboration success have been discussed by Duvenvoorde et al. [7]. The arguments presented therein attest to the representativeness of the measures of these constructs.

Next, construct validity, which relates to the operationalization or measurement between constructs, was considered. Factorial validity, which focuses on establishing the validity of latent constructs, is important in the context of PLS [24]. Establishing factorial validity implies testing that each indicator variable correlates strongly with a single construct, while correlating weakly or not correlating with other constructs. In PLS, it is assumed that each measurement item reflects only a single latent construct [25]. As such, unidimensionality is assumed to exist a priori. Two other components of factorial validity that capture certain aspects of the goodness of fit of the measurement model are convergent validity and discriminant validity [24]. Table 1 indicates the outer model loadings, along with the t-values. The t-values were estimated using a nonparametric bootstrapping procedure using 1000 samples [26]. The loadings for all constructs are significant at $\alpha = 0.05$ significance level and uniformly high (above 0.7) with a majority above 0.85, attesting to the convergent validity.

Table 1: Significance test of measurement item loadings

<table>
<thead>
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<th>Item Code</th>
<th>Item Loading</th>
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</tr>
</thead>
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<td>12.864</td>
</tr>
<tr>
<td>Cognitive-2</td>
<td>0.762</td>
<td>9.574</td>
</tr>
<tr>
<td>Cognitive-3</td>
<td>0.791</td>
<td>11.356</td>
</tr>
<tr>
<td>Cognitive-4</td>
<td>0.872</td>
<td>15.727</td>
</tr>
<tr>
<td>Cognitive-5</td>
<td>0.916</td>
<td>13.465</td>
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<tr>
<td>Cognitive-6</td>
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<td>Cognitive-7</td>
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<td>Cognitive-8</td>
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<td>19.402</td>
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<tr>
<td>Social-1</td>
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<tr>
<td>Social-2</td>
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<td>14.036</td>
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<tr>
<td>Social-3</td>
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<td>Social-4</td>
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<td>11.797</td>
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<td>Social-5</td>
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<td>Social-6</td>
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<td>Effect-5</td>
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<td>Efficiency-3</td>
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<td>Efficiency-4</td>
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<td>17.549</td>
</tr>
<tr>
<td>Productivity-1</td>
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<td>Productivity-2</td>
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<td>Productivity-3</td>
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<td>SatAct-5</td>
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<td>20.256</td>
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<td>SatOut-2</td>
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<td>25.813</td>
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<td>SatOut-3</td>
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<td>8.802</td>
</tr>
<tr>
<td>SatOut-4</td>
<td>0.922</td>
<td>19.553</td>
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Table 2: Square root of AVE scores and correlation of latent variables

<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Cognitive</td>
<td>0.873</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social</td>
<td>0.778</td>
<td>0.004</td>
<td></td>
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<td></td>
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<tr>
<td>Effect</td>
<td>0.675</td>
<td>0.575</td>
<td>0.882</td>
<td></td>
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<tr>
<td>Efficiency</td>
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<td>0.572</td>
<td>0.737</td>
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<tr>
<td>Productivity</td>
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<td>0.549</td>
<td>0.880</td>
<td>0.916</td>
<td>0.902</td>
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<td></td>
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<tr>
<td>Commit</td>
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<td>0.411</td>
<td>0.690</td>
<td>0.600</td>
<td>0.087</td>
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<td>SatAct</td>
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<td>0.739</td>
<td>0.693</td>
<td>0.759</td>
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<td>SatOut</td>
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<td>0.890</td>
<td>0.742</td>
<td>0.847</td>
<td>0.527</td>
<td>0.801</td>
<td>0.911</td>
</tr>
</tbody>
</table>

Table 2 shows the average variance extracted (AVE) analysis for assessing discriminant validity. To establish discriminant validity, it is recommended that the square root of the AVE of each latent construct should be greater than any correlation between this latent construct and any other latent construct [20]. This indicates that more variance is shared between the latent construct and its indicators than with another latent construct representing a different set of indicators. This holds true in this study with a couple of exceptions.

Table 3: Summary of results for the inner model constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>Code</th>
<th>Cronbach’s α</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Presence</td>
<td>Cognitive</td>
<td>0.955</td>
<td>0.962</td>
<td>0.762</td>
</tr>
<tr>
<td>Social Presence</td>
<td>Social</td>
<td>0.891</td>
<td>0.916</td>
<td>0.647</td>
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<tr>
<td>Collaboration Effectiveness</td>
<td>Effect</td>
<td>0.929</td>
<td>0.946</td>
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<td>Collaboration Efficiency</td>
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<td>0.721</td>
</tr>
<tr>
<td>Collaboration Productivity</td>
<td>Productivity</td>
<td>0.943</td>
<td>0.956</td>
<td>0.814</td>
</tr>
<tr>
<td>Collaboration Commitment</td>
<td>Commit</td>
<td>0.902</td>
<td>0.931</td>
<td>0.772</td>
</tr>
<tr>
<td>Satisfaction with Collaboration Process</td>
<td>SatAct</td>
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<td>0.953</td>
<td>0.836</td>
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<tr>
<td>Satisfaction with Collaboration Outcome</td>
<td>SatOut</td>
<td>0.949</td>
<td>0.961</td>
<td>0.830</td>
</tr>
</tbody>
</table>

Table 3 summarizes the results for the structural model constructs. Cronbach’s α is used as a measure of internal consistency and values exceeding 0.7 are recommended as a rule of thumb. All constructs fair well on this criterion. Composite reliability is considered a closer approximation of reliability under the assumption that the parameter estimates are accurate. The results show composite reliability (CR) exceeding 0.8 as recommended [23]. AVE, which can also be considered as a measure of reliability, tends to be more conservative than composite reliability. The results indicate AVE to exceed the recommended 0.5 value, implying 50% or greater variance in each construct is being accounted for [23]. Together, these statistics attest to the reliability of the instrument.

Figure 3 illustrates the structural model with the $R^2$ value for each of the endogenous constructs. The exogenous constructs, cognitive presence and social presence, are seen to account for 36.1% to 47.6% variation in the endogenous constructs (collaboration success factors), indicating a fairly strong effect overall.

![Figure 3: PLS results for the structural model](image-url)

The path coefficients (similar to standardized coefficients in regression analysis) for this inner model are shown along with their respective t-values ($p$-value $< 0.05$) in the parentheses. The significant paths are shown with solid lines, while those not
deemed statistically significant are shown with dashed lines. Most of the hypotheses were supported although a few hypotheses did not turn out to be statistically significant. Counter to our expectations, cognitive presence did not positively impact perceived participant commitment. The structural model also shows that social presence does not significantly impact perceived effectiveness and productivity. It can be rationalized that participants enjoying more social presence in the collaborative environment perceive having less focus on tangible outcomes, leading to decreased perceived productivity and effectiveness. This also ties in with the result that social presence does not significantly impact perceived satisfaction with outcomes. Participants enjoying heightened social presence may not necessarily feel more productive and are likely to perceive less satisfaction with the outcomes. Detailed investigation is certainly deemed necessary to further our understanding in this direction. Also, it is acknowledged that the study is exploratory in nature, and the small sample size may have attributed to reduced power of statistical inference.

7. Conclusions

This paper discusses collaboration from the perspective of the distributed, collaborative learning literature and the information systems collaboration literature. The primary contribution of this paper is the introduction and evaluation of a new research model that combines constructs from multiple disciplines. While there are many antecedents of collaboration success, we suggest that cognitive and social presence may mediate the impact of antecedents on collaboration success. At a minimum, these constructs provide yet another set of measurements for collaborative interactions. However, this study suggests that these constructs have additional implications. The previous analysis suggests that these constructs may help to explain variance in success metrics. The data collected from an extensive, distributive, asynchronous activity and survey and subsequent analysis demonstrates that cognitive presence and social presence impact success metrics differently. This is important for a few reasons:

1. These measures may be able to be used as surrogates for other success metrics. Additionally, they may be able to be used earlier in the collaborative process (i.e., the current state of the interaction can be assessed to inform process tailoring decisions).

2. Cognitive and social presence provide an enhanced understanding of why certain collaboration engagements succeed (i.e., certain contexts may impact cognitive and social presence which ultimately lead to success).

3. Understanding the relationship of cognitive and social presence on different success metrics makes designing technology-supported collaborative environments easier. Designing and including features to increase cognitive presence or social presence of group members in collaborative environments is a more concrete and tangible task than focusing on features that increase the more abstract success metrics (e.g., commitment, satisfaction with the process).

The collaboration community is expected to benefit from consideration of cognitive and social presence as mediating factors between collaborative factors and overall collaboration success metrics. However, there are a number of recognized limitations of the study. For example, while the context of the study (i.e., a distributed, asynchronous learning environment) is becoming more prevalent, it may not be representative of many collaborative environments and the results may not generalize. However, it is our belief that in many collaborative environments these relationships will continue to be significant. In this study, we did not focus on the antecedents of cognitive and social presence. While the presented model is parsimonious, it is likely that there are numerous antecedents that not only impact cognitive and social presence but that also may have a direct impact on the success metrics. Additionally, collaborative success metrics may directly impact each other (e.g., commitment may moderate or mediate satisfaction of the outcome). Further, in our study, constructs were perception based metrics. There are numerous additional approaches that could be utilized for capturing measures including automatically extracting metrics from the collaborative system (e.g., frequency of posting, distribution of posting/reading among subjects, relationship of posting contribution/reading to subject responses). Finally, the interactions studied in this paper primarily occur through the artifact (i.e., posting ideas, evaluating ideas). In contexts interactions may occur between participants through other channels.

This paper lays the foundation for future research work which needs to test contextual factors to see how they impact cognitive and social presence and develop additional collaborative feature sets that further promote cognitive and social presence.
8. References


Appendix A

Note: Codes are in parentheses in order to help reader to match survey instrument question with analysis above.

Survey of Online Learning and Collaboration

This instrument is designed to assess your experiences in online learning. The following questions will assist us in assessing your perceptions with regard to learning in an online environment. Your responses will be held in strict confidence and your identity will not be revealed to anyone other than the researchers in the project. Please complete
all pages of this questionnaire. This will take approximately 25-30 minutes.

Compared to previous face-to-face learning experiences, how would you rate your online learning experiences with the following?

Rating Scale: Much Better, Better, Same, Worse, Much Worse

Cognitive Presence (Cognitive)
1. Identifying key issues?
2. Stimulating your curiosity?
3. Identifying relevant new information?
4. Engaging in exchange of ideas?
5. Synthesizing ideas?
6. Resolving problems?
7. Understanding ideas or concepts?
8. Applying ideas or concepts?

Social Presence (Social)
1. Expressing your emotions?
2. Being open? (i.e. disclosing your personality)
3. Asking questions?
4. Responding to others’ comments?
5. Sustaining discussion?
6. Feeling part of the class community?
7. Referring to others by name?

Overall, how would you rate your online learning experience with the following?

The following questions use a 7-point likert scale ranging from 1 - Strongly disagree to 7 - Strongly agree:

Satisfaction with the process (SatAct)
1. I feel satisfied with the way in which this learning exercise was conducted.
2. I feel good about this learning exercise's process.
3. I liked the way this learning exercise progressed.
4. I feel satisfied with the activities used in this learning exercise.
5. I feel satisfied about the way we carried out the activities in this learning exercise.

Satisfaction with the outcome (SatOut)
1. I liked the outcome of this learning exercise
2. I feel satisfied with the things we achieved through this learning exercise.
3. When the learning exercise was over, I felt satisfied with the results.
4. Our accomplishments today give me a feeling of satisfaction.
5. I am happy with the results of this learning exercise.

Commitment (Commitment)
1. I support the goal of this learning exercise as it was presented in the introduction.
2. I had a stake in achieving the goal of this learning exercise as it was presented in the introduction.
3. I was motivated to contribute to this learning exercise.
4. I was willing to put my time and effort into this learning exercise.
5. I found this learning exercise important.

Efficiency (Efficiency)
1. I found the learning exercise worth the time and effort.
2. The time and effort requested from me was reasonable.
3. I was able to contribute relevant knowledge & experience I had to the learning exercise.
4. The time and effort I spend in the learning exercise was what I expected.
5. My input was justified.

Effectiveness (Effectiveness)
1. The result of the learning exercise had the quality I expected.
2. What we achieved in this learning exercise met my expectations.
3. We achieved what we intended.
4. The result has the quality intended.
5. The result was as I hoped.

Productivity (Productivity)
1. The input asked from me was in balance with the results.
2. The result was not a waste of my time and effort.
3. What we achieved was worth the time and effort.
4. The quality of the results is in balance with the time and effort asked from me.
5. The quality of the results justifies my input.