Scaffolding Solutions to Business Problems: Trust Development as a Learning Process

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ABSTRACT

Teams whose interactions are mediated entirely via internet-based communication, virtual teams, are becoming commonplace in businesses. Although trust has been identified as key for virtual teams to work effectively, researchers have not developed scalable methods that consistently promote trust. This study examines the formation of trust perceptions, which is inherently a learning process. Strategies employed to promote more traditional definitions of learning can be used to promote trust development. In this paper, the authors investigate how a strategy of modifying the design of the communication system for virtual teams can be used to promote perceptions related to trust. The authors conduct an experiment to examine the impact of a template-driven messaging system to scaffold the development of the three antecedents of trust—integrity, benevolence, and ability—within a virtual team environment and communication activity. The study shows that participants who used the template-driven messaging system perceived their team members as having a higher level of ability than those who used the regular system. Moreover, users of the template-driven environment authored more messages and read a greater percentage of the messages, suggesting that messaging scaffolds were successful in improving the flow of information and fostering an environment favorable to trust development.

Keywords: Collaborative Computing, E-Learning, Scaffolding, Trust, Virtual Teams

INTRODUCTION

Electronically mediated communication promises to continue to grow in overall volume and importance. It is not surprising that the challenge of creating environments in which virtual teams can flourish and perform effectively has caught attention in both industry and academia. As the steady growth of temporary and distributed work combines with advances in the capabilities of Internet-based tools, virtual teams are likely to become more important in the future (Te’eni, 2001). Given that virtual teams interact entirely via computer-based systems, part of the solution to the problem of building a more effective virtual organization might lie in the design of the information systems these teams utilize. Well-designed communication support tools that affect not only the way in which a
message is delivered but also the message itself can play a central role in creating an effective virtual team environment. In addition to drawing upon the existing body of literature in IS, one strategy for advancing our understanding of how to facilitate trust development in computer-mediated teams is to draw upon the strategy of scaffolding, which has been used successfully in other disciplines. The theoretical foundations of scaffolding provide a lens through which works previously conceptualized as separate areas, trust development and learning, can be viewed as jointly grappling with the same issue.

The purpose of this paper is to introduce the novel perspective that trust formation within groups is inherently a learning process. To illustrate the utility of this perspective we present the results of a study designed to investigate the impact of a system based on this perspective. The study involves the use of a template-driven asynchronous communication support tool designed to promote the antecedents of trust within virtual teams, thus providing useful information to software developers regarding their design of future communication support systems. We next review the theoretical foundations of learning and trust development that underlie the design of a new computer-based communication support system and advance a research model and hypotheses. We then report on an empirical study examining the effectiveness of this new communication tool. The paper concludes with the discussion, implications, limitations and future directions for research in this area.

**Scaffolding**

A scaffold can be conceptualized as any tool, procedure or aspect of the environment specifically engineered to assist an individual or group in performing a task for which they would otherwise be unprepared (Laffey, Tupper, Wedman, & Musser, 1998). Traditionally, scaffolds have taken the form of prompts designed to guide someone through a process. Scaffolding has been a popular learning support strategy in the field of education. For example, with the phonics approach to reading instruction (Snow, Burns, & Griffin, 1999) when a student struggles to read a word, the teacher might query him or her to slowly sound out the syllables in the word. If the student continues to struggle, the teacher might then cover up part of the word and ask the student to pronounce the first syllable. The act of questioning the student would be a discourse-based scaffold, whereas the act of covering up part of the word would be a physical scaffold. Other examples of physical scaffolds include cue cards (Scardamalia et al., 1984) and short skis used in teaching downhill skiing (Burton, Brown, & Fischer, 1984).

The theoretical foundations of scaffolding lie in multiple areas but primarily in Lev Vygotsky’s work (Vygotsky, 1978). Vygotsky was a Russian cultural-historical psychologist who proposed a social development theory of learning. An important element of this theory is that learning happens through visible cultural interactions which are mediated by language and symbols. For Vygotsky, all learning happens first on a social plane and then on a psychological plane. The exact nature of the internalization process is still widely debated. To understand conceptual development in formal settings he introduced the concepts of the Zone of Current Development (ZCD) and the Zone of Proximal Development (ZPD) (see Figure 1). Activities that one can successfully complete without outside assistance are said to be inside the ZCD.

*The distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers is the ZPD (Vygotsky, 1978, p. 86).*

Instructors at all levels, but particularly at the lower grade levels, use the ZCD and ZPD concepts as a framework for interpreting their role and the role of a learner’s peers in promoting a child’s cognitive, social and cultural development. Instructors can frame their work as one of creating situations or interactions that allow
a child to increase their range of skills until the set of activities they are able to complete on their own, those in the ZCD, include those that they can currently only accomplish with assistance, those in the ZPD. In this model, the ZCD and ZPD are constantly in flux and ever expanding. As discussed earlier, one strategy that instructors use is to scaffold a child’s activity through dialogue or physical scaffolds. For a full examination and critique of Vygotsky’s theory, see Wertsch (1985).

Educational technologists have carried this concept of scaffolding into the realm of software design. Scaffolding in this context is often designed to support one of three broad categories: process management, sense making or articulation (Quintana et al., 2002). Process management scaffolds support learners’ need to navigate through their work. Examples of these scaffolds can include process maps designed to structure a complex task by restricting the options a learner has at any one point in the process and automatizing the organization of work products, which frees up the learner’s cognitive resources to focus on more meaningful activities. Sense-making scaffolds support learners in organizing, analyzing and making sense of their work. These types of scaffolds include multiple views of the same information or the ability to collaboratively create views of shared information. Articulation scaffolds support users in their efforts to express their understanding of the work they have conducted. Examples include partially completed documents and reminders to make notes at critical points in the process.

Educational technologists have developed many systems to scaffold domain-specific conversations (e.g., scientific process, inquiry-based learning, etc.) and problem solving (e.g. KIE (Bell & Linn, 2000), CaMILE (Guzdial et al., 1996). Many of these systems have graphical interfaces that “utilize node-link graphs representing argumentation or evidential relationships between assertions” (Suthers & Hundhausen, 2001) and provide users with a visual representation of the conversation or process. These systems have been successful in helping students complete processes that they would not otherwise have been able to complete (Scardamalia & Bereiter, 1994). Next we discuss how researchers in the IS field have grappled with providing process support to novices, without the benefit of the unifying framework or theoretical underpinning that a scaffolding perspective provides.

Systems similar to those developed by educational technologists have been proposed to support decision processes in business set-
tings (Bui, Bodart, & Ma, 1998). In this line of research, Hilmer and Dennis (2001) created a synchronous decision support system to support attention-focusing and decision-making that required participants to label outgoing and incoming messages. The results were that labeling only outgoing messages did not help users attend to information or improve decision quality. However, the users who were required to label incoming messages showed increased attention to information and improved decision quality. By providing support for a task, scaffolds often restrict the learner’s options. This introduces the problem of knowing when to provide support, what kind of support to provide and when to begin fading the support/restrictions. An issue that complicates the decision of when to provide what type of support is that different users view the same set of scaffolds differently in terms of their restrictiveness (Silver, 1988).

In addition to supporting decision making, message labels have been proposed to support more general types of coordination. Malone et al. (Malone, Lai, & Fry, 1995) developed a set of semi-structured message templates and found them to be “surprisingly helpful” in designing a variety of computer-based communication and coordination systems. Specifically, Malone et al. (1997) conclude that semi-structured messages can serve as aids for composing messages to be sent, selecting, sorting, and prioritizing messages that are received, responding automatically to some messages and suggesting likely responses to other messages. The Coordinator (Winograd, 1987) was another system that adopted message templates to facilitate communication. Coordinator users were provided options for opening a conversation. Their first step in initiating a conversation was to choose a label for their message (Request, Offer, Answer, etc.). A user who chose the “Request” message type was then presented with a semi-structured message template designed to scaffold them through the process of creating a good “Request.” Each message type had an associated template to scaffold a user’s communication efforts.

The systems mentioned above focused on either general information process support or support for decision making. The conceptualization of scaffolding put forth in this paper goes beyond how it has been employed by educational technologists or IS researchers. IS researchers have used scaffolds to support information processing and task related communications (Malone et al., 1995). Educational technologists have used scaffolds to support students’ problem solving and inquiry (Pea, 2004; Quintana et al., 2002).

This paper contends that message templates can act as scaffolds and be used to support social interactions in computer-mediated collaborative work environments. Because trust has been found to be beneficial to team interactions, it was selected as the focus of this study.

Trust

Research has identified trust as a key element of effective virtual teams (Jarvenpaa, Shaw, & Staples, 2004; Te’eni, 2001). Hence, the question of how managers can and should promote trust within virtual teams is of immense interest, both from a theoretical and practical perspectives. A large and expanding body of literature demonstrates the importance of trust in facilitating cooperation (Mayer, Davis, & Schoorman, 1995), communication (Dore, 1983); (Ebner & Krcmar, 2005), leadership (Atwater, 1988), self-managed work teams (Claus, 2004), improving an organization’s ability to adapt to complexity and change (McAllister, 1995), and collaborative learning, knowledge sharing and creative problem solving (Argyris, 1999).

Most models of trust, including that of Mayer et al. (Mayer et al., 1995), have assumed that trust develops gradually over time. However, Meyerson et al. (1996) argued that trust in temporary teams develops from different sources than trust in permanent teams, because temporary systems exhibit behavior that presupposes trust, yet traditional sources of trust, such as familiarity, shared experience, reciprocal disclosure, threats and deterrents, fulfilled promises, and demonstrations of non-
exploitation of vulnerability, are not obvious in such systems. Rather than using specific information about character, temporary team members primarily base their trust on categorical and action-based data that can be assessed quickly but not necessarily accurately. Meyerson et al. (1996) termed the type of quick-formed trust in temporary teams “swift trust.” Prior to the concept of “swift trust” there was no explanation for the presence of trusting behaviors in temporary face-to-face or virtual teams. Since the concept of swift trust offers an explanation for the presence of trusting behaviors in virtual teams that traditional theories of trust cannot explain, it has been helpful in explaining findings from trust research with virtual teams. The presence of “swift trust” has since been used by many researchers to explain the trusting behaviors found early on in virtual teams (Aubrey & Kesley, 2003; Coppola, Hiltz, & Rotter, 2004).

Mayer et al. (1995) defined trust as “the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control the other party” (p. 712). This definition has been adopted by others researching trust in virtual teams (Jarvenpaa & Leidner, 1999) and is also adopted by this study. The Mayer et al. (1995) trust model defines the antecedents of trust as perceived ability, benevolence, integrity and the trustor’s propensity to trust. Similar constructs (Benevolence, Competence, Honesty and Predictability) have been included in other models of trust as directly influencing trustworthiness perceptions/trusting intentions (McKnight, Cummings, & Chervany, 1998). Mayer et al.’s (1995) model of trust in virtual teams does not include the concept of swift trust. Jarvenpaa et al. (1998) proposed modifying Mayer et al.’s (1995) model to include the construct of swift trust (see Figure 2).

By definition, virtual teams are typically temporary in nature (Maznevski & Chudoba, 2000), and the team members rarely see each other in person, but instead interact primarily through the use of computer-mediated communication technologies. Because organizations might find it difficult to develop trust between team members who rarely meet (Handy, 1995), communication will play a greater role in promoting not only task-oriented goals, but also relationship-oriented goals (Chidambaram, 1996; Te’eni, 2001).

Supporting Trust Development

In a comprehensive experimental study designed to shed light on communication patterns of high-trusting virtual teams, Jarvenpaa et al. (1998) asked 75 virtual teams with four to six members per team to communicate online and complete several assigned tasks over an eight week period, including initial trust-building exercises (Jarvenpaa et al., 1998). The results showed that the team-building exercises at the beginning of the experiment had a positive effect on perceived ability, integrity and benevolence of fellow team mates, and that team members’ own propensity to trust had a significant, unchanging effect on trust. Their findings included recommendations for strategies that virtual teams might employ to reinforce trust, for instance proactive behavior, empathetic task communication, positive tone, rotating team leadership, task goal clarity, role division, time management, and frequent interaction with acknowledged and detailed responses to prior messages.

Tan et al. (Tan, Wei, Huang, & Ng, 2000) built on the work of Jarvenpaa et al. (1998) and successfully employed a dialogue technique to enhance relationship development in virtual teams. In this study, students moved through three distinct phases of communicating via email. In the first phase, small talk, students were asked to provide background information and share jokes. Following that was the infinite container phase, where they listed what they considered good communication practices and reflected on past experiences that led them to hold these opinions. In the last phase, last generation, they compiled a list of best practices for team communication that they then used to facilitate their upcoming work. Groups that
used this technique reported a higher level of relationship development and satisfaction with the team’s decision. Tan et al. (2000) did not measure trust directly; rather, they measured cohesion and collaboration, which Beranek (2000) found to be highly correlated with trust. The team-building exercises employed by Jarvenpaa et al. (1998) and the dialogue technique followed by students in Tan et al.’s (2000) study were conducted separate from and prior to the main work task, much like training. It may not be practical in today’s work context where virtual teams are dynamically assembled and disassembled to ask that workers take time out to practice the types of trust-building exercises that Jarvenpaa et al. (1998) and Tan et al. (2000) found to be helpful in supporting the development of trust. The authors of this study propose that it is possible to modify a communication support system to scaffold the development of the types of communication patterns that Jarvenpaa et al. (1998) found in high-trusting teams.

**Trust-Related Scaffolds**

Instead of using trust-building exercises prior to team interaction like the studies discussed above, an alternative method is to design communication supports into a communication support system. In 2007, Remidez, Stam and Laffey described a Web-based template-driven asynchronous communication support system that allows researchers to scaffold the communication process. The scaffolds consisted of message notifications, messaging templates, message structure restrictions and message labels. From a Vygotskian perspective, these features represent the way a knowledgeable worker would act and support the novice at this higher level of performance without frequent errors or frustrations. Over time and with usage, the novice comes to understand the implications of this way of working through being effective and having positive results in the community and then starts to internalize these ways of working. Thus, by being helped to act trustworthy, the novice comes to understand being trustworthy and the basis for trust-promoting communication. The features of this system were designed to work in concert to scaffold trust engendering communication behavior and patterns. Conceptually it is not any single function that leads to trust, but rather how the novice uses an array of functions to achieve the desired effect. Next, we summarize the aspects of the system used in this study.

The message templates are the most noticeable form of support provided in this system. Prior to authoring a message the system

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**Figure 2. A Model of Trust in a Global Virtual Teams (adapted from Jarvenpaa et al., 1998)**

![Diagram of trust model](image-url)
prompted authors to select from one of seven message types (Introduction, Getting Started, Communication Issues, Time Management/Milestones, Feedback, Issue/Conflict, and Task Completion). Each message type was accompanied by a unique description and content suggestions, which were displayed on the selection screen and on the authoring screen. For all but the “Introduction” message type, the input field was a single input field like one would find in most discussion boards. In addition to the description and some content suggestions, the authoring screen associated with the “Introduction” message type was a multipart form. The form included a series of prompts designed to elicit message content Jarvenpaa et al. (1998, 1999) found in the initial communication of high-trusting teams. The prompts were designed to elicit information about a team member’s background, abilities, planned communication patterns, availability and dedication to the project.

The label associated with the template used to create a message was displayed in both the index view of all the messages and when an individual message was displayed. The primary purpose of this feature was to expedite the communication process by facilitating the retrieval of relevant messages. For example, if users were not interested in viewing messages about getting started they could simply not open messages labeled “Getting Started.” A side benefit of the message labels was that correctly labeling a message was a task that other team members could judge as successful or not.

Message notifications and sequencing constraints were additional forms of support. The notifications consisted of each team member receiving an email copy of new messages posted to the group’s discussion board. This feature was designed to raise awareness of the team’s activity or lack of activity. Sequencing constraints consisted of restrictions placed on the order in which some messages could be posted. For example, users could not start a conversation thread with a “Feedback” message type. This message type was specifically designed to reply to an existing message and would not have made sense as the root message of a conversation thread. Another restriction was related to the “Conflict” message type. The options for replying to a “Conflict” message type were limited to “Communication Issues,” “Feedback”, and “Conflict.”

This study adopted the Jarvenpaa et al. (1998) trust model, which defines the antecedents of trust as perceived integrity, ability, benevolence, and the trustor’s propensity to trust. Integrity is the degree to which one adheres to a set of principles (such as work/study habits) thought to make one dependable and reliable. Questions thought to measure perceptions of integrity related to display of solid work ethic, commitment to the project and completing promised activities. Three of the seven message types included prompts related to integrity. The first message type participants encountered was the “Introduction” message type and it included prompts to address how frequently the team members planned to communicate and to discuss any times they were not going to be available. The “Communication Issues” message type encouraged discussion of both frequency and communication strategies participants planned to use. The “Time Management/Milestones” prompted participants to set deadlines for completing tasks. Any commitments made through these templates could be easily monitored through email notifications sent by the system every time a message was posted to the group’s discussion board, which could be motivation in itself to act with integrity. These features support the position that the system would result in higher levels of perceived integrity.

H1: Virtual team members who use the template-driven messaging system will report higher levels of perceived integrity than those that use the non-template driven messaging system.

Another antecedent of trust is ability, which is defined as the skills that enable a trustee to be perceived as competent within a certain domain. The scale that measures ability asks questions about the other team members’ specialized
capabilities, capability of performing their assigned task and general skills. The “Introduction” message type specifically addressed the issue of ability by prompting participants to discuss any skills they had that might help the team solve the problem. The “Getting Started” message type encouraged participants to share their understanding of the goals, which would be a means of judging someone’s ability to understand the problem. Choosing the correct message template type for the specific content which users wanted to author was a task inherent to system use. Template labels were displayed next to the message subject line and were designed to facilitate quick access to the desired content. If a participant mislabeled their message this could be seen as a reflection on their ability as it relates to trustworthiness. The prompts to discuss ability along with the inherent test of ability led us to believe that participants using the scaffolds would perceive their team members as more able.

H2: Virtual team members who use the template-driven messaging system will report higher levels of perceived ability than those that use the non-template driven messaging system.

Benevolence is the extent to which one is believed to feel interpersonal care and concern. The scale items used to measure benevolence inquire about the project’s importance to the team members, other team members’ concerns about team’s concerns, and willingness to help the team perform. Four of the seven message types included descriptions that emphasized expressing enthusiasm (Introduction, Getting Started, Communication Issues and Feedback). Types of statements encouraged included: “I am looking forward to working with you all” and “I like this group.” Expressions of these types of statements could lead to participants perceiving their team members as more caring, which leads us to our third hypothesis.

H3: Virtual team members who use the template-driven messaging system will report higher levels of perceived benevolence than those that use the non-template driven messaging system.

In order to understand how information systems might be designed to help promote relationship development in virtual teams, it is useful investigate how these system might be impact behaviors related to trust development. Hart and Saunders (1997) and Nelson and Cooprider (1996) found that mutual trust facilitates a more productive flow of information. It has not been established if trust is a prerequisite for an increase in information flow. Viewing and authoring messages are types of information exchange activities in a virtual team setting. This leads us to our fourth and fifth hypotheses.

H4: Virtual team members who use the template-driven messaging system will author more messages than those that use the non-template driven messaging system.

H5: Virtual team members who use the template-driven messaging system will view a higher percent of the messages available than those that use the non-template driven messaging system.

Underlying these hypotheses are two driving research questions. First, do users of a template-driven asynchronous communication support tool report higher levels of perceived ability, integrity and/or benevolence of the team than users of the non-template-driven asynchronous communication support tool? Second, do users of a template-driven asynchronous communication support tool experience an increase in information flow? The answer to these questions is relevant to those designing new information systems, because they might be able to embed trust promoting features into their systems. In addition, it has implications
for those using and managing the use of existing information systems. If a system’s design can boost perceptions of the antecedents of trust, the logical opposite is that the design of existing information systems could be hampering the development these and other dimensions of users’ relationships. This possibility is discussed further below.

**METHOD**

The experiment involved 40 subjects, all of them MBA students at a large mid-western university. Participants were assigned randomly to five member teams, and teams were randomly assigned to treatments. As result, we had equal numbers in each group and in each treatment; with no dropouts. A team size of about five has previously been employed in related studies (Tan et al., 2000). Earlier field tests of the study approaches in another academic unit at the same university were used to fine-tune the experiment.

The problem that participants solved was a modified version of a classic survival problem, in which they were required to jointly rank fifteen items in importance for surviving in a mountainous region after a plane crash (Turk, 2002). To enhance the complexity of the decision problem and the need for each team member to exchange information, five derivations of the original scenario were created, each scenario missing 10% of the descriptive information and 10% of the available survival items; however, none of the scenarios contained conflicting or incorrect information. Thus, the team members had to pool their information and develop a team ranking.

The control group used a standard, hierarchically-formatted, asynchronous discussion board, while the treatment group used a hierarchically-formatted, template-driven discussion board application that employed templates designed to support them in taking actions characteristic of high trusting teams. The process for creating a template-driven message involved four screens and a structured interaction. Depending on the nature of the message, the user was guided through a specific series of steps and choices, and was prompted for certain types of information and given suggestions on how to proceed.

*Figure 3. Research model*
Each participant received instructions via e-mail about how to access the system. Users of the template-driven discussion board received a description of each template, including suggestions of statements users might include in their messages. Users of the regular discussion board received neither directions nor suggestions. For a complete description of the templates and how they appeared to the participants, refer to Remidez, et al. (2007). At the end of the allotted work time, three weeks from the start, participants filled out the final post-test questionnaire.

The entire study lasted five weeks: an initial pre-test was followed by three weeks of participant interaction, and a post-test. After the initial face-to-face introduction of the experiment, all additional directions and information were handled through e-mail. After receiving the problem description and a list of their team members, participants were asked to complete a pre-test questionnaire of the instruments, in order to account for the possibility that they might have known their teammates by name and have formed opinions about them outside the context of this experiment. In addition, the pre-test questionnaire measured the presence of any imported trust.

The data were collected to examine main treatment effects and included the results of questionnaires administered before and after the experimental use of the discussion board. The SPSS statistical package (Norusis, 2004) was used to conduct the analysis. The questionnaires were the same as those developed and used by Jarvenpaa et al. (1998). This enabled us to analyze the main effects using an analysis of covariance (ANCOVA) (Girden, 1992), with message organization as an independent variable, three trust-related dependent variables: ability, benevolence, integrity and two activity related variables. Message organization had two levels, template-driven and non-template-driven. The template-driven treatment incorporated the message templates described above. These templates were designed to encourage users to communicate in ways that support trust formation in virtual teams.

The antecedents of trust (ability, benevolence and integrity) (Mayer et al., 1995), were measured using the scales in Table 2, developed, tested and adapted for use in virtual team settings by Jarvenpaa et al. (1998), based on the work of Schoorman et al. (1996), Mayer et al. (1995), and Meyerson, Weick, and Kramer (1996). This facilitated the testing of our hypotheses H₁ – H₃ using instruments that have been validated and used in previous studies conducted under conditions similar to this study. All questions were measured on a five-point scale, ranging from 1 (to no extent) to 5 (to a great extent). The scales were used to establish pretreatment values and ensure homogeneity between the treatment and control groups on the variables prior to the treatment. Establishing this initial value was especially important because the context of the project allowed for participants to have had interactions prior to the experiment.

Table 1. Characteristics of high trusting teams and template titles

<table>
<thead>
<tr>
<th>Characteristics of High Trusting Teams¹</th>
<th>Templates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive initial interactions</td>
<td>Introduction</td>
</tr>
<tr>
<td>Early starters</td>
<td>Getting Started</td>
</tr>
<tr>
<td>Discussed communication plans</td>
<td>Communication Issues</td>
</tr>
<tr>
<td>Time and goal oriented</td>
<td>Time management/ Milestones</td>
</tr>
<tr>
<td>Provided robust feedback</td>
<td>Feedback</td>
</tr>
<tr>
<td>Addressed and managed conflict</td>
<td>Issue/Conflict</td>
</tr>
<tr>
<td>Task oriented</td>
<td>Task completion/ Questions</td>
</tr>
</tbody>
</table>

¹: Findings by Jarvenpaa et al. (1998)
The validity of this initial value is consistent with the model of team members importing trust that was proposed by Mayer et al. (1995), and with the research design of others (Tan et al., 2000; Jarvenpaa et al., 1998).

RESULTS

Prior to the analysis, the data were screened extensively. Descriptive statistics were inspected to ensure that all continuous variables were within plausible ranges and that all means and standard deviations were reasonable, given this data set. Although no participants dropped out of the exercise during the experiment, two participants completed the pre-test questionnaire but failed to complete the post-test questionnaire. As these participants were from a different treatment, and participated in all other aspects of the experiment, their post-test scores were replaced with the means from their respective treatment group. An initial analysis indicated no substantial effect on the results of this study by including or excluding these two participants. In a separate case, one participant failed to complete an item on one of the subscales, and the value was replaced by the treatment group’s mean, again with no substantial effect.

As part of the screening process and in anticipation of a multiple analysis of covariance (MANCOVA), bivariate correlations were computed for the three trust-related variables, ability, benevolence and integrity. Table 3 shows that all of the scales measuring the antecedents of trust constructs were significantly correlated, which is consistent with the findings in Jarvenpaa et al. (1998), but requires that additional steps be taken prior to conducting the statistical analyses required for our study. Since highly correlated dependent variables are not acceptable when conducting a MANCOVA analysis, separate analyses of covariance procedures were employed.

Following the remedy recommended by (Tabachnik & Fidell, 2007), three new composite variables were created to serve as covariates – one combining the integrity and benevolence scores, another combining the integrity and ability scores and a third which combined the ability and benevolence scores. In all, the augmented ANCOVA model has three questionnaire-based variables: ability, benevolence, integrity, and the three composite variables that serve as co-variates, ability+benevolence, ability+integrity and integrity+benevolence.

To facilitate an ANCOVA using the results from the pre- and post-treatment questionnaires, scores on the pre-test were subtracted from scores on the post-test to produce a final score. We chose this approach to account for participants being enrolled in the same course and having already formed perceptions about the ability, integrity, and benevolence of their class members as a whole. The independent variable is a 0-1 binary variable reflecting the type of communication support (template or regular).

The inclusion of the composite variables allows for the use of ANCOVA to examine the impact on an individual antecedent of trust (e.g., ability), while controlling for the other two (e.g., integrity and benevolence). In addition to the ANCOVA model and analysis, ANOVA analyses were conducted to measure the degree to which the flow of information increased as a result of the experiment, using the number of messages authored and the percentage of available messages viewed.

A further exploratory analysis was performed to verify that the composite variables satisfied the assumptions for a valid ANCOVA analysis. Although it is common practice to minimize the importance of ensuring the data distributions conform to the normality assumptions that underpin analysis of variance procedures, this study took the approach of ensuring normality assumptions were met prior to conducting the analysis. To satisfy these assumptions, all variables except benevolence required a transformation, either because of skewness and kurtosis scores outside the range of plus or minus two, or because of outliers. See Table 4 for details on the transformations. Two composite covariate variables required minor calibration in addition to the transformation.
Shapiro-Wilk tests, Q-Q probability plots, histograms, stem-and-leaf plots, box plots and general descriptive statistics revealed that all transformed and calibrated variables approximately followed a normal distribution, with homogeneous variance-covariances. Scatter plots did not reveal significant nonlinear relationships between each covariate and dependent variable. Cronbach alpha scores calculated for each combination show reliability scores of above .86, well above the acceptable limit of .80 (Tabachnik & Fidell, 2007).

Table 2. Jarvenpaa et al. (1998) Instruments adapted to our experiment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability</td>
<td>The other team members have much knowledge about the work that needs to be done. The other team members seem to be successful in the activities they undertake. I feel confident about the other team members’ skills. The other team members have specialized capabilities that can increase our performance. The other team members are well qualified. The other team members are very capable of performing their tasks.</td>
</tr>
<tr>
<td>Benevolence</td>
<td>The outcomes of this project are very important to the other team members. The other team members would not knowingly do anything to disrupt or slow down the project. The other team members are concerned about what is important to the team. The other team members will do everything within their capacity to help the team perform.</td>
</tr>
<tr>
<td>Integrity</td>
<td>The other team members display a solid work ethic. The other team members try hard to be fair in dealing with one another. I like the work values of the members on this team. The other team members are strongly committed to the project. The other team members do not behave in a consistent manner-In general, I am not sure whether they are going to do what they promise or not.</td>
</tr>
</tbody>
</table>

Table 3. Correlations for trust-related variables

<table>
<thead>
<tr>
<th>Post – Pre</th>
<th>Pearson Correlation</th>
<th>Sig (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benevolence</td>
<td>1</td>
<td>.346**</td>
<td>40</td>
</tr>
<tr>
<td>Ability</td>
<td>.029</td>
<td>.465**</td>
<td>40</td>
</tr>
<tr>
<td>Integrity</td>
<td>.718**</td>
<td>1</td>
<td>40</td>
</tr>
</tbody>
</table>

Shapiro-Wilk tests, Q-Q probability plots, histograms, stem-and-leaf plots, box plots and general descriptive statistics revealed that all transformed and calibrated variables approximately followed a normal distribution, with homogeneous variance-covariances. Scatter plots did not reveal significant nonlinear relationships between each covariate and dependent variable. Cronbach alpha scores calculated for each combination show reliability scores of above .86, well above the acceptable limit of .80 (Tabachnik & Fidell, 2007).
The results of testing hypotheses H1 – H3 are given in Tables 5-7. The first research question relates to the extent to which a template-driven discussion board affects the development of perceptions related to the antecedents of trust in virtual teams. After controlling for perceptions of ability and benevolence, there was no significant difference in perception of team members’ integrity (α=.05) between those who used the template-driven discussion board and those who used the regular discussion board, so that H1 cannot be supported (see Table 5). Similarly, we conclude that H3 cannot be supported at the α=.05 level. After controlling for perceptions of ability and integrity, no significant difference in the perception of team members’ benevolence was found (see Table 7). However, Table 6 shows that, after controlling for perceptions of integrity and benevolence, the template-driven discussion board users perceived their team members’ ability to be significantly higher than those using the regular discussion board, so that H2 is supported at the α=.05 level. The partial η² of .104 indicates that the treatment explains 10.4% of the variance of the perceptions of ability.

The second research question, explored the extent to which message templates influence the free flow of information. ANOVA procedures were used to test for differences between the groups in the number of messages authored and viewed by each participant. Tables 8 and 9 presents the test results for the corresponding hypotheses H4 and H5. Table 8 reveals that members of the template groups authored significantly more messages than their counterparts in the control groups (p-value=.015; η² =.146), while Table 9 shows that members of the template groups also viewed a higher percentage of the messages that were available to them (p-value=.019; η² = .137).

DISCUSSION AND IMPLICATIONS

The experiment revealed that users of the template-based discussion board developed a higher level of perceived ability in their team than did users of the regular discussion board. However, template-based discussion board users did not report higher levels of integrity and benevolence (H1, H3). Thus, using the model of Jarvenpaa et al. (1998), the results are mixed, with one of the three antecedents of trust, ability, significant. However, template users authored more messages and viewed a higher percentage of the messages available to them than members of the control groups, indicating an increased flow of information associated with the use of templates.

In summary, as the use of temporary virtual teams continues to grow rapidly, managers depending on virtual teamwork face a unique set of challenges. Knowing the factors that are likely to facilitate optimal productivity by virtual teams is a key ingredient for success. Fortunately, researchers have identified trust

<table>
<thead>
<tr>
<th>Variable transformations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>Ability</td>
</tr>
<tr>
<td>Integrity</td>
</tr>
<tr>
<td>Benevolence</td>
</tr>
<tr>
<td>Ability + Benevolence</td>
</tr>
<tr>
<td>Ability + Integrity¹</td>
</tr>
<tr>
<td>Percentage of messages available viewed</td>
</tr>
<tr>
<td>Messages Authored</td>
</tr>
</tbody>
</table>

¹ Required additional adjustments for outliers to meet normality assumptions.
Table 5. ANCOVA test results for $H_1$ (ability)

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model Intercept</td>
<td>8533.302$^b$</td>
<td>2</td>
<td>4266.651</td>
<td>13.819</td>
<td>.000</td>
<td>.428</td>
<td>27.637</td>
<td>.997</td>
</tr>
<tr>
<td>BENEVOLENCE+ABILITY TREATMENT</td>
<td>8419.957</td>
<td>1</td>
<td>96.035</td>
<td>.311</td>
<td>.580</td>
<td>.008</td>
<td>.311</td>
<td>.084</td>
</tr>
<tr>
<td>Error</td>
<td>11424.076</td>
<td>37</td>
<td>871.256</td>
<td>27.270</td>
<td>.000</td>
<td>.424</td>
<td>27.270</td>
<td>.999</td>
</tr>
<tr>
<td>Total</td>
<td>100119.556</td>
<td>40</td>
<td>308.759</td>
<td>2.822</td>
<td>.101</td>
<td>.071</td>
<td>2.822</td>
<td>.373</td>
</tr>
</tbody>
</table>

Corrected Total

- a. Computed using alpha = .05
- b. R Squared = .428 (Adjusted R Squared = .397)

Table 6. ANCOVA test results for $H_2$ (integrity)

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model Intercept</td>
<td>4.083$^b$</td>
<td>2</td>
<td>2.042</td>
<td>6.901</td>
<td>.003</td>
<td>.272</td>
<td>13.803</td>
<td>.901</td>
</tr>
<tr>
<td>BENEVOLENCE+INTEGRITY TREATMENT</td>
<td>310.547</td>
<td>1</td>
<td>310.547</td>
<td>1049.823</td>
<td>.000</td>
<td>.966</td>
<td>1049.823</td>
<td>1.000</td>
</tr>
<tr>
<td>Error</td>
<td>1.265</td>
<td>1</td>
<td>3.119</td>
<td>10.543</td>
<td>.002</td>
<td>.222</td>
<td>10.543</td>
<td>.885</td>
</tr>
<tr>
<td>Total</td>
<td>327.000</td>
<td>37</td>
<td>1.265</td>
<td>4.275</td>
<td>.046</td>
<td>.104</td>
<td>4.275</td>
<td>.522</td>
</tr>
<tr>
<td>Corrected Total</td>
<td>15.028</td>
<td>39</td>
<td>.296</td>
<td>.296</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- a. Computed using alpha = .05
- b. R Squared = .272 (Adjusted R Squared = .232)

Table 7. ANCOVA test results for $H_3$ (benevolence)

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model Intercept</td>
<td>70.467$^b$</td>
<td>2</td>
<td>35.233</td>
<td>8.404</td>
<td>.001</td>
<td>.312</td>
<td>16.808</td>
<td>.950</td>
</tr>
<tr>
<td>ABILITY+INTEGRITY TREATMENT</td>
<td>68.159</td>
<td>1</td>
<td>68.159</td>
<td>16.257</td>
<td>.000</td>
<td>.305</td>
<td>16.257</td>
<td>.975</td>
</tr>
<tr>
<td>Error</td>
<td>67.915</td>
<td>1</td>
<td>67.915</td>
<td>16.199</td>
<td>.000</td>
<td>.305</td>
<td>16.199</td>
<td>.975</td>
</tr>
<tr>
<td>Total</td>
<td>155.123</td>
<td>37</td>
<td>6.860</td>
<td>1.636</td>
<td>.209</td>
<td>.042</td>
<td>1.636</td>
<td>.238</td>
</tr>
<tr>
<td>Corrected Total</td>
<td>226.011</td>
<td>40</td>
<td>4.193</td>
<td>.423</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- a. Computed using alpha = .05
- b. R Squared = .312 (Adjusted R Squared = .275)

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as a key ingredient necessary for virtual teams to overcome common obstacles. Given that, by definition, virtual teams interact almost entirely via information systems, designers face the problem of how to design these systems to support it. This study took the perspective that supporting trust development could be accomplished by viewing trust development as a learning process. Specifically, it adopted a strategy of scaffolding that is derived from Vygotsky’s (1978) theory of mental development.

Our experiment suggests that perceptions related to trust development can be enhanced by the computer-based communication tools used by the virtual team. This study employed discussion board templates that exploited elements of previous models developed by Mayer et al. (1995) and Jarvenpaa et al. (1998). Although the evidence is mixed, there certainly appears to be substantial evidence that the template scaffolds supported relationship development, as measured by the trust-related scales, and a freer flow of information. In addition to taking a trust-development-as-learning perspective, this study is unique in that its goal was to promote change in the affective domain, compared to previous studies, which had goals of supporting information processing, decision making or cognitive change. Since modifying the communication tool is a complex undertaking,
it is rare to find an experiment that studies the impact of manipulating the characteristics of the tool itself. Yet, that is exactly what was done—customized templates were developed.

Although not an primary objective of the study, this is the first study to offer empirical evidence that an increase in perceptions related to trust in virtual teams is associated with an increase in participation. Similar relationships had been identified in co-located teams, but no previous study has offered evidence of relationships existing in virtual teams.

**Limitations**

The current study has several limitations. The duration of the study was three weeks; a longer interaction time might have affected the team members’ relationships differently. The participants represent a convenience sample consisting of graduate students at a major Midwestern university. The limited number of participants prevented more robust statistical procedures from being employed. The study did not examine how trust developed over time, nor the impact of the antecedents of trust on overall trustworthiness. Additional experiments using different sample populations are needed. Between-subject contamination is possible because participants were physically located at the same institution. However, participants were urged not to communicate in any way other than via the discussion board; moreover, the relative isolation and short duration of the experiment may have helped to limit undesirable interaction between participants. Finally, there were not enough teams to statistically compare the decision quality of treatment and non-treatment teams.

**FUTURE RESEARCH**

Further research is encouraged to confirm and explore the results of this study. For example, although this study found that templates could influence the development of an antecedent of trust and participation, this study should be repeated with larger and different samples to confirm that there was nothing unique about this sample that led to these results. It could be that the results of this study can be attributed to just one of the dimensions of the scaffolds or to some combination of the dimensions. Future research should attempt to delineate the impact of each of the dimensions of the scaffold discussed as well as the impact of various combinations of these dimensions. Decision quality and the use of templates by the different genders are both issues that should be examined. In addition, other types of scaffolds should be explored.

An example of another set of scaffolds that could be explored would be a set of message templates based on the dialogue technique successfully employed by Tan et al. (2000). In that study, students were directed to segment their conversation such that the early stages of the conversation were focused on relationship building and then progressing to focusing on the task. Tan et al.’s (2000) study successfully used the PINE email application, which does not support message templates and provides a very minimal graphical interface. Combining the dialogue technique employed in their study with message templates is an interesting area for future research.

Research into how tool design and use affects other aspects of virtual team members’ relationships, beyond trust, could assist practitioners in the management and selection of information technologies to meet an organization’s goals. One example of such research is the work of Thomas Erickson and his colleagues at IBM (Erickson & Kellogg, 2003). They have adopted the perspective that personal computers are fundamentally social tools and that making users’ activity within the system visible supports coherent and productive communication. One approach Erickson and his colleagues have adopted to making workers’ activity visible is to use visual cues, or social proxies, to represent user activity within a system. They have measured the effects of various social proxies on communication, collaboration, and participation within IBM teams using Babble, a chat-like application. Because trust has been shown to be important to virtual teams, one suggestion...
for future research is to examine the impact of various social proxy mechanisms on trust.

The study of the impact of tool design on the communication process is in its early stages. Through continued research and dialogue, the dimensions of communication tools and a common description for how those dimensions can be manipulated can be identified. These definitions then could be used to compare various studies and to guide the research and design of better tools.

CONCLUSION

The study introduces a new theoretical perspective for viewing trust development as a learning process rooted in cultural development. It provides an example for how this perspective can translate into system design elements. Future researchers investigating trust development in virtual teams should be attuned to the potential impact that the design of a system that mediates interactions could be having on the team’s development.

Previous studies of trust in virtual teams have examined how trust develops in virtual teams and the communication characteristics of high-trusting virtual teams. This is the first study to build on these studies by manipulating the design of the communication tool. The results indicate that the tool design impacted the development of an antecedent to trust and messaging activity in a virtual team setting. These findings should be encouraging for tool designers, educators, and managers of virtual teams.

REFERENCES


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