

The Light and Dark Side of Online Teams in Higher Education

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Abstract

Students and faculty are grappling with learning teams in the online environment: more than half of all higher education organizations offer online courses (Hoffman, P., 2006). The availability of online coursework as a convenient alternative for traditional face-to-face classes has been increasing as colleges, universities, and especially students recognize the advantages of learning from home. As online course developers try to replicate the best practices of traditional classrooms, the asynchronous technology of the Internet has added great capability while also increasing the confusion that distance in space and time can add to the learning process.

The purpose of this paper is to provide a literature review of the research on classroom teams and online teams to identify possible avenues for further research in the area. The paper first looks at the research on traditional classroom-based teams and online teams. It then examines the theoretical basis for some of the issues identified in the research, communication theory and the impact of technology. It concludes with a summary of some of the commonly identified variables that warrant further research.

Key words: Distance education, online learning, higher education, educational technology, teaching methods & styles, research & development, teams, virtual teamwork.

The availability of online classes as a convenient alternative for traditional face-to-face classes has been increasing exponentially as colleges, universities, and especially students recognize the advantages of learning from home: reduced travel time, fuel use, and facilities use, and increased flexibility in study time, to name a few. As online course developers try to replicate the best practices of traditional classrooms, the asynchronous technology of the Internet has added great capability while also increasing the “fog and friction” (i.e., confusion) that distance in space and time can add to the learning process (Kiesling, 2001) In traditional classrooms, for example, the use of student teams is one instructional strategy that has seen increased use as research over the last thirty years has shown its effectiveness in increasing student learning (Michaelsen, Knight, & Fink, 2004). Transforming student team activities for use in online courses has been possible for some time in various learning management systems, but there is some evidence that the asynchronous nature of online learning may be adding or exacerbating challenges that students may or may not experience in the classroom. Since the development of online courses is a relatively new phenomenon, however, there is little research on the issues surrounding online student teams. The purpose of this paper is to provide a literature review of the research on classroom teams and online teams to identify possible avenues for further research in the area. The paper first looks at the research on traditional classroom-based teams and online teams. It then examines the theoretical basis for some of the issues identified in the research, communication theory and the impact of technology. It concludes with a summary of some of the commonly identified variables that warrant further research.

Classroom-based teams

The first research on academic team-based learning occurred in the University of Oklahoma in the late 1970s (Michaelsen, et al., 2004). Michaelsen, et al. found that he was able to turn a potentially negative situation,

larger class sizes, into an enhanced setting for learning by using teams. Teams, his research showed, seemed to learn more, take more responsibility for their learning, and have more fun. Goold, Augar & Farmer (2006) found that, even though on average students enjoyed working in teams in a classroom setting, most were less enthusiastic with working in a group in an online environment; however, the overall trend was that more students had positive opinions than negative opinions. Additionally, Walther (1996) suggested that in the virtual environment teams are able to adapt to the new environment and achieve high performance.

Other research uncovered characteristics of effective learning groups: effective groups tended to support each other, were held accountable both individually and as a group, worked on team skills in addition to content skills, and evaluated their teamwork (Barkley, Cross, & Major, 2005). A substantial number of research studies on cooperative or collaborative learning in the classroom showed positive results in academic, social, and emotional growth in student teams, from elementary to college-age students and from a wide range of ethnicities and abilities. Various meta-analyses also confirmed that team-based activities promoted learning. In one meta-analysis on students in higher education by Springer, Stanne, and Donovan (1999), the academic achievement of students in small groups was approximately one standard deviation higher (effect size = .51) than students in lecture-based classes, and students in those studies had more positive attitudes towards the course content.

A number of studies have examined what personality characteristics lend themselves to team effectiveness. In a meta-analysis of these studies (Peeters, Van Tuijl, Rutte, & Reymen, 2006) that addressed the effect of Big 5 personality types on professional and student team effectiveness, the study found that extraversion, emotional stability, and openness to experience were not significant factors in either professional or student teams; and though higher average levels in agreeableness and conscientiousness had a positive effect on professional team performance (and variability had a negative impact) those factors were “virtually absent in student teams” (p. 392). The study suggests that these two factors may be less significant in student teams because student teams work together for shorter timeframes and are not as dependent on one another (i.e., one conscientious student can usually complete the entire project, if need be.)

In a qualitative study by one of the authors (Grinnell, 2003), the added learning from using written reflection (i.e., structured debriefings) after team experiential activities was explored. Through written reflection, students increased learning in six variables (mental rehearsal, connections, transfer, emotional processing, relevance, and intent). The team development process during team experiential activities was far more fluid than might be indicated by Tuckman’s four stages of group development namely forming, storming, norming, and performing (1965). Satisfaction with achievement and team affiliation were affected by the level of disagreement during the team process and how that conflict was resolved.

Dysfunctional teams. Some early research, however, also indicated that student teams had a number of issues, including (1) dissatisfaction for all team members getting the same grade despite different levels of effort, (2) unequal concern between students over grades; and (3) difficulty with coordinating meeting times (Michaelsen, et al., 2004). Since those early observations, there has been little further research on dysfunctional classroom-based teams (Barkley, et al., 2005). Informal student survey results suggested that, in addition to positive effects of teamwork recognized by both students and instructors, negative aspects of student teams included: dominating students, “social loafers,” students who missed meetings and deadlines, students who disappeared for extended periods, teams digressing from the task, and teams that did not communicate well nor had clashing personality types.

Designing team-based instruction. Barkley, et al. described two basic approaches to designing classroom-based small group instruction (2005). Cooperative learning experiences were activities in which students worked on a common problem while the instructor managed the experience – the task, time, and resources; collaborative learning experiences were distinct from cooperative activities in that students and faculty worked on an issue or problem that might not have one correct answer, and in which knowledge was created by the group by consensus. Cooperative learning supported students learning to work together to find a single solution, while collaborative learning supported the development of independent thinkers and was particularly appropriate for college students. Five variables have been identified that build team cohesiveness when incorporated into team activities: (1) individual accountability, (2) close physical proximity, (3) tasks requiring interaction, (4) feedback, and (5) team rewards. Michaelsen et al. (2004) and Boyd and Bright (2007) recently illustrated how teamwork

using appreciative inquiry (AI) induces innovation and collaboration through participatory methods consistent with current concepts of community psychology. The authors suggested that AI begins with the premise that communities are centers of relatedness, and that the extension of strengths within communities invoke a reserve of capacity to reshape the images of community such that previously viewed challenges can be confronted in radically different ways (p. 2).

Online Teams

In an early qualitative study (Johnson, Johnson, S., Suriya, Yoon, Berrett, & LaFleur, 2002) exploring data collected from seven online student teams, cross-comparison between survey data and analysis of communications identified group development similar to Tuckman's forming, storming, norming, and performing stages of development; however, storming was only observed in two groups. Reasons for storming included several typical of traditional teams: disagreements, poor planning, variance in participation levels, and schedule conflicts. The researchers suggested these conflicts might have been exacerbated by the lack of non-verbal cues and the ease with which students could withdraw from participation. Conflicts, when they happened, had the effect of eroding trust, which was not regained within the timeframe of the team assignments.

Yoon (2006) examined online student team behaviors in seven online teams, categorizing the behaviors into three domains: Work, Social, and Management. In reviewing student behaviors over time, Yoon found that the majority of interactions in early weeks of a team project were aimed at social behaviors (42.6%), which he speculated "might indicate that virtual learning team members try hard to enhance the social presence in an online environment before focusing on work. The percentage of interactions focused on work increased over time to become the dominant behaviors (68.7%) by the end of the project. Management interactions were lowest, starting at 23% and dropping to 10.7% by the end of the project. He found two group development patterns: linear and adaptive. Two teams followed a linear progression (orientation, scheduling, exploration, work and decision, progress check and evaluation, refinement and formatting, and termination), while five teams followed an adaptive progression, retracing steps to readdress steps of the project. Those five teams had widely varying experiences: two had minor adjustments, one had a major mid-course correction, one had a major late correction creating stress, and dissatisfaction within the team, while the last had major corrections in all three-time segments measured, but had the greatest cohesion and consensus. Being a qualitative study, there were not enough groups to develop patterns or generalizations, but the wide range of adaptations could be indicative of key team issues that should be explored further.

Kirschner and Van Bruggen (2004), in an overview for a special issue on tools for online learning, concluded that positive online team learning experiences are a function of an effective pedagogy, relevant content, and a supportive learning community. By a supportive learning community, they meant communities that had developed group cohesion through "a process of affiliation, impression formation, and interpersonal attraction" (p. 137). The absence of any of those three elements would effectively disrupt the learning experience. Hakkinen (2004), in a summary of the findings in that same issue, described some of the challenges facing online learning teams that are exacerbated by the online environment. Successful learning teams were those that developed shared goals and focused joint attention on solving the task at hand, especially at "solution-critical times" (p. 202). The author suggested that, considering the lack of visual cues and the potential untimeliness of asynchronous communication, social presence and shared goals were much more difficult to establish in online student teams.

In a recent study (Grzeda, Haq, LeBrasseur, 2008), emphasized the importance of the team building process in their instructional design in order to alleviate the project-oriented assignments that do not promote team process skill development, a common complaint from business. While the overall number of positive comments exceeded negative ones, there were two areas of lopsided results when drilling down to the categories that might be indicative of problem areas for further exploration: Orientation/team directions (8 positive comments, 92 negative) and technology (9 positive, 91 negative). On the other hand, comments on team process (59 positive, 41 negative) and team effectiveness (78 positive, 22 negative), which were the focus of the study's instructional design, were very positive, indicating that the inclusion of teambuilding processes may contribute positively to the online learning experience.

Communication in online teams in higher education

By 2001, more than half of all schools in higher education had already given online courses (Hoffman, 2006). The question of what makes a good team is salient. Whereas personality attributes and performance outcomes are normally outside of a student team's control, communication is firmly placed in the center as a key mediating variable for successful online team learning. The communication literature substantiates that reliable communication and deepening disclosures lead to trust (Altman, & Taylor, 1973). However, this trust-building communication within teams appears elusive: only 20% of CEO's rate their top teams as "high performing" (The Bolton Group, 2005). Authors on the topic of online team communication quip that teamwork needs touch, indicating that proximity matters for effective team communication.

When attempting to understand the process of communication within higher-education online teams, it is crucial to comprehend the interpersonal relationships of the members. Communication plays the central role in the stability, maintenance, and processes that allow these relationships to function. Various theories inform communication in online learning teams. In addition, studies on online teams reveal key variables of interest.

Group communication theories. Group communication theoretical approaches inform communication in an online learning team. The most applicable theoretical approaches include structural, interactionist, exchange, systems, and developmental theories, as well as other perspectives.

1. The structural-functional perspective views communication in the team as a system of structural elements and therefore specifies their function in the maintenance of the system. This perspective emphasizes functional roles and the diversity of roles as being ideal for team functioning.
2. The interactionist theoretical perspective takes into account an individual's experience of the meaning of their environment. The emphasis in this perspective assumes that team members create and negotiate roles through online team interaction, rather than merely playing out culturally determined scripts (Burr, Leigh, Day, & Constantine, 1979).
3. The conflict perspective views team members as having constantly opposing viewpoints (Sprey, 1979). However, this perspective does not insist that viewpoints must always be opposing. Inter-group relations theory assumes that there is a psychological view of the team reality and a sociological view of the team reality. Team members must themselves represent social categories, while at the same time; beliefs about social categories take shape (Giles & Fitzpatrick, 1985).
4. The exchange theoretical perspective assumes that team members are constantly making trade-offs regarding social behavior with the team. If a team member sees a beneficial pay-off for a particular behavior, that individual will act in expectation of the reward. Equity theory is similar to exchange theory and explicitly states that what a team member puts in, they should get as much out. There is an emphasis on fairness and a sense of justice or equity in the team relationships.
5. A systems theoretical approach takes the perspective that a team member operates within a larger (team) system, which in turn operates within a larger higher education system (Senge, 1990). The interactions or transactional patterns lay the "track" for how to relate to one another during teamwork. Systems theory can be used to contrast functional vs. dysfunctional communication patterns within teams or between teams.
6. The developmental stages perspective focuses on the pattern over the formation process that teams take. The stages perspective can also be applied to relationship dissolution. By taking a stage-based perspective on group/team formation, team members can be more aligned with the prime directives of the crises or concerns inherent in that stage. Tuckman's (1965) four-stage group model is a developmental stages team approach. The developmental perspective can account for the key turning points or critical moments over the "lifecycle" of a team. The developmental perspective allows these key team turning points to be expected, planned for, and contextualized in meaningful ways for the members. This perspective can encompass social penetration theory, which has been validated in research that shows a gradual deepening in the exchange of information leading to a deeper felt trust among team members. The theory expanded from the simplistic progression view to encompass dialectical cycling of exchange and self-disclosure. In addition, this theoretical viewpoint allows for stages of dissolution within teams as well as for the transition period of team relationships ending.

7. Structuration theory (Giddens, 1976) is useful for analyzing team communication because it takes into account both structural and process elements of team relationship communication. The physical constraints of online teams necessitate a particular structure overlaid onto the interactions. In addition, the psychological processes of individuals from increasingly diverse backgrounds create an intriguing interplay within a team. These internal representations of “self” and “other” are negotiated, manipulated, and transformed in the context of team interaction.
8. Cognitive perspectives (social cognition) on learning in online teams include attribution theory, which views how members attribute the causes of one another’s behavior (Kelley, 1979). Team members can begin to have “run-away” attribution where every conflict can be attributed to the negatively perceived personality of one or more members.
9. Knowledge schemas and scripts represent what a team member knows about online learning teams and these structure incoming information about the team to the team member. A team member’s past experience on teams, structures current experiences.
10. Affect models include Buck’s (1984) theory of emotional communication which posits that true “non-verbal” communication is a syncretic response or a communication between two (or more) limbic systems. These core unfiltered emotional responses correspond to ancient and modern brain structures. Emotion is now understood to be the primary motivational cause behind all human behavior. These emotions have a key role to play in online learning teams and this role may be complicated by the virtual interface.
11. Social-emotional competence and skills perspectives on teams understand that team members will have differing levels of communicative skills at their disposal. Some members will have not had a lot of practice working in online learning teams.
12. The interaction model for understanding team communication takes the perspective that the type, number, and quality of communicative interaction are the key focus of study in team relations. Each interaction can be coded for dominance, affect, clarity, informational exchange, conflict, and support (Bavelas, Rogers, & Millar, 1985).

These group communication theoretical approaches are useful for investigating online learning teams. Studies that have investigated communication in teams contribute empirical data to highlight key variables.

Communication variables. Key variables regarding communication in higher education online teams are identified in the literature. Studies from different theoretical perspectives provide variables of interest for research. Key variables include roles, norms, gender, disclosures, trust, clearly communicated goals, and communication dominance, as well as others. Perspectives from a sociological perspective have looked at power, social class, and minority issues. These variables relate to group member status. How dependent one is or as seen to be in the group, the lower the group member’s power can be.

Roles within the team, gendered communication, and the development of norms are key communication process variables salient to team work. Gender has received some attention in the literature and appears to have an effect on team communication. In general, women value intimacy and caring while men tend to value justice and equality more than nurturance between team members. Men can be more likely to withdrawal from team relationships (Gilligan, 1982). It has been said there is a basic gender difference for men and women in team relationships on the emphasis on justice vs. connection. Women do appear to be aware of interpersonal problems sooner than males (Rubin, Peplau, & Hill, 1981).

Communication disclosures and trust are two key variables in communication. In addition, team relationship satisfaction would be an essential outcome variable for online learning teams. Bales (1950) found in his content analyses of group communication that there is a constant balance between task and cohesion concerns inherent in interactions and members strive to reduce tension by pro-social talk. Group communication approaches grew through the 1960s to include a range of social norm (normative) variables: conformity, risky shift, groupthink, and group polarization.

The importance of a meaningful group purpose or goal cannot be understated. This goal must be able to be clearly articulated by all of the members. Achieving the performance goals is the outcome of functional group communication. Authenticity or frank and honest communications with team members that hold each other

accountable for the work are functional in communication for online learning teams. Synergy occurs as an outcome of working toward a common goal under a certain set of special circumstances. Synergy is the phenomenon when the whole is greater than the sum of its parts. This synergy is created and maintained through communication or interactions. This web of group communications creates a network effect where synergistic performance is the outcome.

Group decision-making tends to follow predictable paths of identifying the problem, searching for alternatives, and making a decision. One or two individuals do tend to dominate any given group. Kirkman, Rosen, Gibson, Tesluk, and McPherson, (2002) identified five key challenges for virtual team success in their case study of the Sabre reservations system. These challenges include building trust, cohesion, and team identity, and overcoming isolation. In the absence of face-to-face contact in this case, participants were able to increase trust by demonstrating reliable performance.

In sum, the variables of interest for online learning in teams include roles, communication interactions, trust, satisfaction, clear goals, cohesion, and candid/frank communications, as well as others, such as power dynamics and gender.

Technological Impact on Virtual Teams

The outcomes of teams and virtual teams above identify differences between the two approaches. In current learning practice, the growth of online education and acceptance of technology has transformed the basis of team interaction. Underlying this transformation is an enablement linked to technology. The communications considerations related traditional communication theory to the remote or virtual world. To complete the review of the literature, a technology view of virtual teams provides a consideration of the new underlying dependency.

Early reviews of online or virtual teams highlighted the shortfall in team function when there was a limited face-to-face component (Shneiderman, Borkowski, Alavi, & Norman, 1998; Smagt, 2000). The limited capability and especially the complexity of technology options limited practical communications (Shneiderman, et al.). Virtual teams were effectively limited by complexity rather than function of technology, resulting in the perceived need for establishing underlying requirements such as trust through physical meetings. Smagt found that one could eliminate the limitations by building trust first and then using telephone to complement text-based email and discussion boards.

As technology evolved, new capabilities and underlying infrastructure allowed improved emulation of traditional meetings. Over time, the required degree of technology expertise reduced from the Shneiderman et al. (1998) and Smagt (2000) era, to more manageable proportions. The transition was initially just a matter of degree with technology understanding and skills remained a severe limitation (Heffner & Cohen, 2005; Lewis, Shea, & Daley, 2005). In considering undergraduate student virtual teams, research by Heffner and Cohen found that the degree of Web-based interaction was a predictor of performance. While students mostly started a course with limited skills and reduced efficacy, Lewis et al. were able to track a marked improvement throughout the duration of the course leading to improve virtual team outcomes. Consideration of demographics indicated the female undergraduate students started with a distinct disadvantage; however, the research showed that the differential quickly narrowed. Students recognized the value of technology only where they had been exposed to the technology (Heffner & Cohen; Lewis, et al.).

The use of Time-Interaction-Performance theory by Munkvold and Zigurs (2007) enabled the analysis of outcomes by virtual teams working with limited timelines and less stable membership. While the later study did not focus on a learner population by design, it did capture the typical scenario applicable to learners. Munkvold and Zigurs discovered that students did not identify technology deficiencies unless they had practical experience of alternative options. Pressures did increase the need to advance their interaction on multiple fronts; however, this led to an acceptance of their known options rather than seeking improved tools. One can anticipate that the technology insight of the course presenter has to take into account the variety of technology available and the skill set of students. The implication extends to the need to exploit what students might know from other sources.

Knowledge of technology to enable teams is not the only experiential limitation for virtual teams. Learner understanding of the expectations, content, and process by faculty was a further factor (Hasler-Waters & Napier, 2002). The degree of learner collaboration was directly related to the quality of instructions, with the lack of synchronous interaction limiting the ability to recover from any misunderstandings. A similar need exists between members of the teams (Piccoli, Powell, & Ives, 2004). The research covering 51 virtual student teams by Piccoli et al. identified the need for coordination between team members, without fixed meeting times, it became important to have reliable points of coordination. If one considers asynchronous courses, special procedures or technology tools need to fill the void. In research analyzing the outcome of 12 virtual teams, the need to train members in methods to establish effective communication showed a strong correlation with outcomes (Beranek & Martz, 2005). The researchers found links to outcomes in the cohesiveness, perception of progress and satisfaction areas. Walter and Bunz (2005) used quasi-experimental research to identify a significant improvement when students were given a formula for success. The formula might be considered a concise set of instructions or a transfer of experience and knowledge.

As implied in the acquisition of knowledge above, a vital capability that technology needs to facilitate is communications. Hasler-Waters and Napier (2002) showed the need for instructions, these revolved around processes to overcome communication problems that were escalated due to communications limitations implied by being a virtual team. The research implies that student experience, skills, and use of improved technology would mitigate this communications limitation. Communications richness was a factor in virtual team interactions (Workman, Kahnweiler, & Bommer, 2003) as limited depth and the static nature resulted in over-analysis of limited input. The risk isolated by Workman et al. was that miscommunication became a more serious impediment to virtual team success. Munkvold and Zigurs (2007) implied the same outcome in their research by highlighting the dangers of suppressed implications due to assumptions and limited interaction. Specific issues included media, timing, frequency, and the lack of enhanced communication transfers. The same communication implications emerged in the work by Piccoli et al. (2004) where the advantages of self-directed work required technology to provide rich communications. The danger of separated interactions implied by asynchronous virtual teams led to sub-group communications with other team members not receiving all of the information (Andres, 2006). Improved technology was shown to overcome the communication limitation leading to an improved information exchange.

Earlier, it was stated that the impact of technology on trust could be avoided if trust was established in a traditional team setting before moving the team to a virtual setting (Smagt, 2000). This role of trust and the implicit role of technology were endorsed as a prerequisite for knowledge exchange. Most forms of learning, the aim of virtual teams in education, require the free exchange of knowledge. Kanawattanachai and Yoo (2002) emphasize the role of trust in graduate student projects. Technology has to support the formation of trust in both the cognitive and affective domains for improved outcomes (Kanawattanachai & Yoo). The role of the cognitive domain was found to be more important for improved performance. The previous considerations have identified a number of roles where technology needs to provide a solution for virtual teams and this may imply a need for diverse solutions.

Considering the human interaction and psychological influences, identifies the complexity that may be implied. In considering a model of interpersonal processes relating to conflict, motivation, confidence and affect management, then multiple nuances within communication become more important (Maruping & Agarwal, 2004). Furthermore, the outcome of the virtual team should consider satisfaction, team commitment, and group cohesion according to Maruping and Agarwal. They continue by linking the process of interpersonal development to the outcome requires technology that can address immediate feedback, symbol variety, parallelism, rehears ability and reprocessability (p. 983). In terms of current technology offerings, a single tool cannot meet these needs. Maruping and Agarwal conclude that there is a need multiple technologies to address the range of interactions leading to success. Despite the implied complexity, should technology not limit any forms of interaction, then virtual teams would not result in any difference from traditional teams (Gordon, 2005).

Extending the previous, Kirschner and Van Bruggen (2004) consider learning styles and conclude that a rich and varied set of technology tools would be needed. They reiterate the need for effective capability, implying ease of use. A similar sentiment was provided in an MIT publication, linking the need for rich media support by technology would be required for negotiations and knowledge transfers (Malhotra & Majchrzak, 2005). The ability for enhanced interactions, beyond text and voice, finds further support for knowledge exchange, communications,

cognitive styles, and trust (Griffith, Sawyer, & Neale, 2003; Kanawattanachai & Yoo, 2002; Munkvold & Zigers, 2007; Workman, et al., 2003). Considering the recent technology and learner skills (Karpova, Correia, & Baran, 2009), the role of technology remains one needing multiple solutions; however, the degree of matching traditional teams is improved. Older tools such as email remain important to learners, according to Karpova et al., as do the new rich media offerings. Their research found that few learners struggle to cope with the adoption of technology.

Building on team options and communications, one can conclude that technology is an important underlying facilitator. Technology skills, faculty facilitation, and trust are integrated and important factors for virtual team success. Within the former, communications facilitated by a rich array of technology options provided the bridge to equivalent success with traditional teams.

Conclusions

While considerable research has been done with student teams in traditional classroom settings, since online learning is a relatively new phenomenon (within the last ten years), there has been little formal research on the issues involved with virtual student teams. A few qualitative studies have started developing models for online learning, but quantitative studies have not replicated or validated those potential models. There have been several instructional design studies aimed at overcoming issues surfaced in qualitative studies or anecdotal experience; however, studies of instructional design approaches have explored better tools and techniques for online learning without necessarily knowing what problem areas are most important to address.

Table 1: Commonly identified variables in qualitative research on online student teams

Inputs	Throughputs	Outputs
Agreeableness	Work/Task	Satisfaction/dissatisfaction
Conscientiousness	Social/Interpersonal	Trust
Attitude towards teamwork	Management	Learning
Attitude towards technology	Team Process	
Orientation/team directions	Using technology	
Team size	Communication/interactions	
	Virtual Presence	
	Collaboration	
	Team Effectiveness	

Further research, both qualitative and quantitative, is needed to identify and measure student learning (and interference with learning) when virtual teams are used in online instruction. Further qualitative research could validate key variables from earlier studies or identify new variables to develop a model of virtual team learning that could be studied using quantitative methods. These variables could then also be used in quantitative instructional design studies in which one or more variables are modified for the study to determine best practices. Until that happens, models for online learning and online instructional design studies may be premature, and results may not be generalizable.

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