THE USES (AND MISUSES) OF COLLABORATIVE DISTANCE EDUCATION TECHNOLOGIES

Implications for the Debate on Transience in Technology

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Collaborative learning technologies (tools that are used for facilitating or mediating collaborative learning) have been widely incorporated in distance education as well as broadly adopted in higher education. While a range of collaborative technologies has been incorporated, their implementation has often failed to align with well-established and empirically validated principles for the design of learning (Bernard & Rubalcava, 2000; Chang & Hannafin, 2015; So & Brush, 2008). In this article we (1) describe how collaborative learning technologies have been effectively and ineffectively incorporated in the higher education setting; (2) review and analyze critical design principles for integrating collaborative learning technologies in higher education applications of distance education (with particular focus on online learning) and, (3) explore the relationship between technological transience and the effectiveness of collaborative distance education technologies.

COLLABORATIVE DISTANCE EDUCATION TECHNOLOGIES IN HIGHER EDUCATION

Collaborative distance education technologies build on the wealth of research on collaborative groups. *Collaborative groups* are “small, interdependent, and heterogeneous groups that construct knowledge (Vygotsky & Cole, 1978) to achieve consensus and shared classroom authority” (Bruffee, 1999). Use of collaborative group work can assist adult learners in many areas including mastery and retention of material, quality of reasoning strategies, process gains, and transferring of learning (McConnell, 2006). However, although instructors actively encourage student engagement and interaction within group tasks, not all groups’ work in an effective collaborative manner and construct shared knowledge. For various reasons, as they work together, groups create different levels of interdependence and engage in various types and levels of interac-

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tion. This is witnessed with group work in both conventional (face-to-face) settings, and to some extent may be at risk of being mystified in the distance education setting.

Collaborative technologies have been lauded as high potential supplementary tools designed to more deeply engage learners engaged in post-secondary-level distance education. Technological advances in information and communications technology promise even more powerful capabilities to support technology-enhanced collaborative learning (Alavi & Dufner, 2005). Indeed, collaborative learning technologies have been recommended for providing instructional support (McConnell, 2006) to improve the quality of distance education while overcoming documented weaknesses (e.g., challenges with isolation and compromised motivation reported by many distance learners). By incorporating collaborative learning technologies, instructors and students are presumably able to share and exchange key resources and interact purposefully independent of time and location.

Technology-facilitated options, such as distance education have increased rapidly across higher education institutions due in large measure to their perceived potential to address the educational needs of both instructors and adult learners, particularly as postsecondary institutions seek to assume a greater role in access to opportunities for professional and lifespan development (Allen & Seaman, 2008). In addition, collaborative learning technologies hold much promise for enhancing the quality of current online pedagogies experiences as instructional approaches and practices by augmenting interactivity among participants in online environments (Woo & Reeves, 2008), helping learners become more engaged (Shea & Bidjerano, 2009), and establishing a strong sense of belonging within the learning community (Palloff, Pratt, & Stockley, 1999). Online environments, for example, provide technological affordances and features that may more effectively support collaborative learning (de Jong, Veldhuis-Diermanse, & Lutgens, 2002; Garrison & Anderson, 2001; Roberts & McInerney, 2007).

CHALLENGES TO POLICY, RESEARCH AND PRACTICE

Whereas the promise of collaborative learning technologies has proved enticing, documented effects, particularly in distance education, have been scarce to emerge. Online learning literature reveals that while numerous studies have explored the nature of technology-mediated interaction and collaborative discourse among participants, and have examined the knowledge construction processes and outcomes resulting from online discussion activities. Examples of such research include the model of community of inquiry (e.g., Garrison, Anderson, & Archer, 2001) and the interaction analysis model (Gunawardena, Carabajal, Lowe, 1997). Studies investigating online discourse are meaningful in that they reveal how learners interact with each other, what types of discourse facilitate students learning in the distance education environments, and what strategies can be used to enhance student interactions and learning. However, considering characteristics of adult learners and their specific goals for education and life, the effectiveness of technology-mediated distance collaborative learning should be more closely examined. For adult learners, group work is a fundamental collaborative learning approach that enables an effective and meaningful learning experience. This method assists learners with not only the discussion of concepts and processes but also with enacting these ideas to produce real life outcomes that are relevant to their professional and perhaps even their personal lives (Johnson, 2007).

Higher education courses, including distance education ones, are often limited to discussion activities in which students respond to questions posted by instructors' peers and reply to detailed responses. While this type of discussion task might contribute to collaborative knowledge construction, these types of tasks would not require students to establish a high level of interdependence among each other (Graham & Misanchhuck, 2004). The effectiveness of such strategies is highly dependent on the efficacy of the collaborative learning strategy, and its' successful implementation. Distance education, particularly online postsecondary, may easily devolve into platforms for the final submission of group work, in contrast to a space that promotes the sharing of ideas, iterative and research-informed knowledge building, and coconstructive, dynamic knowledge events. Although instructors assign group work activities to encourage students to solve cognitive challenges while collaborating, students tend to approach the group work by completing each portion individually first and then combining those individual efforts into a "group" the final product (Chang & Hannafin, 2015).

In reality, collaborative technologies are often misapplied and misaligned as a result of misinterpretation or nonconsultation of well-established psychological and instructional groundings. Collaborative technologies too often lack grounding in learning theories and the psychology of individual differences. Indeed, as a result, we must humbly refer to them as "collaborative technologies" in lieu of "collaborating *learning* technologies," Without consistent application of validated pedagogies, the technology may in fact be employed with minimal (or undesired) impact on the nature and depth of student learning. While innovations and approaches have been studied in a given setting with particular students (i.e., Barab, Thomas, Dodge, Carteaux, & Tuzan, 2005; Casamayor, Amadi, & Campo, 2009; Johnson, Stewart, Brabeck, Huber, & Rubin, 2004), lacks generalizability across contexts.

DESIGNING EFFECTIVE COLLABORATIVE LEARNING ENVIRONMENTS WITH TECHNOLOGIES

Instructional designers have adapted emerging collaborative learning technologies as ways to enhance learning performance (Lajoie, Guerrera, Munsie, & Lavigne, 2001; Nelson & Ketelhut, 2007; Zurita & Nussbaum, 2004). Yet, the effectiveness of those innovative technologies for learning ha not been fully validated. Some have argued that maximum guidance is required for all types of learning, including those associated with case-based learning, discovery learning, student-centered learning environments (Clark & Hannafin, 2011). In reality, however, neither maximally guided direct instruction nor constructivist-inspired approaches can be appropriate for *all* learning goals. No given strategy can be universally applied to address all learners and types of learning independent of overarching epistemological goals, learning requirements, and specific contextual demands. Strategies must be considered and adapted to, and reflected appropriate and relevant epistemological and philosophical assumptions that accommodate individual learner differences, varied learning goals, varying contexts, and differential requirements. Fully guided instruction is likely appropriate for externally defined learning requirements such as skill training; although these same methods are inadequate and often inappropriate for self-directed, student-centered, spontaneous learning in many formal and informal distance education settings. Alternatives are needed to align epistemological assumptions with methodology to guide and not simply direct learning. When one employs a collaborative technology to incorporate in distance coursework, the instructors must defend their selection to themselves as well as for their students with validated empirical evidence.

WELL-ALIGNED AND MISALIGNED PRACTICES: SOURCES AND EFFECTS

It is necessary to analyze critical instructor and student considerations to integrate collaborative learning technologies in higher education before adapting new emerging technologies. Multiple instructional principles have been proposed to optimize collaborative distance education technologies and the environments in which they function. Research to date has rarely balanced back at students' learning issues, instructional issues, epistemological differences and strategies involving technology-enhanced collaborative learning. It is not the mere presence or complexity of technologies that improves learning experiences, but the quality of collaboration between technologies and the learning task (Jermann, Soller, & Lesgold, 2004). It is reasonable to assume that as we seek to meet the demands for quality higher education (preparing learners in their discipline and for the 21st century workplace) through collaborative learning technologies. This quality of collaboration will, therefore, be a function of their learning tasks and the technological capabilities at our disposal. Here, the issue of technological transience starts to come forward as a significant issue for researchers, leaders, students, professors, and instructional designers.

Traditionally, higher education institutions trained their graduates to repeat and recall information and perform these skills through behaviorally and cognitively based direct instructional approaches. Following years of externally directed approaches (i.e., instructor-directed instruction rather than student-directed learning), students become passively "compliant" (McCaslin & Good, 1992), expecting and receiving explicit external direction from instructors and subsequently assessed for concordance with external expectations. Students' expectations are tacitly honed through multiple years of often-successful, precollege experiences using similar paradigms; high school experiences and successes, have shaped both expectations for and performance in higher education. Common strategies often emphasize declarative, procedural, and conditional knowledge (Zimmerman, 2002) rather than higher order reasoning and metacognitive learning strategies.

Contemporary researchers, in contrast, suggest that students must assume greater autonomy and responsibility for their learning (Land, Hannafin, & Oliver, 2012). Efforts to account for prior knowledge and varying experiences have proven especially challenging when it comes to promoting independence. Students who lack adequate background preparation may struggle from a motivational standpoint when encountering difficulties, parsing through relevant and irrelevant resources, engaging self-regulatory strategies, and independently building meta-learning strategies. Likewise, instructional redesign researchers must, for example, explore and validate instructional options so that the course quality and currency remain acceptable without having a continuous, potentially low-net-value, and laborious process of change in the face of ever-shortening technology lifespans.

College faculty members may lack not only concrete conceptions of good teaching and learning but also appropriate uses of technology. Instructors are challenged not only to integrate content knowledge with pedagogical knowledge but also to integrate new technologies to support their teaching. However, few college instructors have experienced and observed effective teaching with technology and therefore lack training and preparation in integrating technology into their teaching (Koehler, Mishra, & Cain, 2013). Faculty members report limited expertise in and awareness of how to support individual students in assuming responsibility for their learning (Song, Hannafin, & Hill, 2007), as well as approaches to accommodating differences among students' prior knowledge and experience and self-regulation. Beliefs and conceptions of good teaching are shaped by a tacit apprenticeship and "trial by fire" during one's own teaching: "lecturers mainly have idiosyncratic, intuitively based knowledge about learning derived from their experiences with teaching and learning" (Burroughs-Lange, 1996, p. 47).

In addition, goals, standards, and expectations for college-level distance teaching and learning vary considerably across domains. Technology-enhanced resources are available to support the domain goals. Some variability is unique to specific disciplines; others reflect expectations for entry to professions; still others are inherent in different fields. Science educators strive for students to "think and act like scientists" (Kuhn, 1993). Students are encouraged to establish warrants and claims based the conversion/updating task and scientific reasoning skills. Conducting experiments has been a critical source for the construction of scientific knowledge within and outside the context of learning. In Co-Lab, a collaborative learning environment, groups of learners can experiment through simulations and remote laboratories and express acquired understanding in a computer model (Van Joolingen, de Jong, Lazonder, Savelsbergh, & Manlove, 2005). In history education, some instructors strive to promote conceptual understanding over simple declarative knowledge to foster historical thinking rather than recalling historical facts (VanSledright & Limón, 2006). For example, in the web-based, The Plantation Letters, multiple sources are evaluated in terms of their adequacy, and a historical narrative is created based upon an integration of these sources (Oliver & Lee, 2011). Learners are guided to interpret historical events by examining diverse and often contradictory historical sources, evaluating, and comparing to their prior knowledge as they individually construct personal historical knowledge.

Collaborative learning is neither a learning mechanism nor a prescriptive method to elicit learning. Rather, Dillenbourg (1999) argues that "the words 'collaborative learning' describe a situation in which particular forms of interaction among people are expected to occur, which would trigger learning mechanisms, but there is no guarantee that the expected interactions will actually occur" (p. 7). Instructors' lack of pedagogical knowledge has caused misaligned practices. Often, instructors do not understand or employ effective collaborative learning technologies in either face-to-face or online environments. Instructor's understanding about collaborative learning is critical when using online collaborative learning technologies. Lack of face-to-face meeting and less interaction between and among instructors and students have been indicated as barriers of online learning environments (Frank, Reich, & Humphreys, 2003). Without a sense of community, students cannot get support from online interaction and their academic performance cannot be improved (Davies & Graff, 2005). Procedural facilitation of collaborating strategies enhances students' collaborative problem-solving activities. Providing a worked-out collaboration example and cooperation scripts helped 36 psychology majors and 36 medical school students' collaborative problem solving activity via videoconferencing (Rummel & Spada, 2005).

For this reason, some courses are delivered synchronously rather than asynchronously to encourage interaction between students. For effective learning to take place, during collaborative learning, monitoring how students work together during the collaborative learning process is crucial. By monitoring students' collaborative learning process, instructors can keep track of students' ongoing performance and provide prompt support. It enables teachers to discern individual students' contributions in order to assess them fairly. Once students knew that instructors were monitoring their performance, they were often more engaged in their work (Caballé, Juan, & Xhafa, 2008). However, previous research regarding synchronous online learning environments was conducted with only a small number of students, as instructors could not provide prompt feedback to students' questions or responses. Wang (2010) conducted a study with 690 students assigned to 23 groups. Student groups' online workplaces were designed to provide prompt feedback for their group work, however, the author found that, "it was hardly possible for the instructor to interact with all groups every week" (p. 1275).

As a result, despite its known strengths, many college instructors often view the challenges of implementing collaborative learning via online as formidable (Roberts & McInnerney, 2007); much along the same lines of instructor's reactions to technology in the face of constant and augmenting rates of technological change. Peer collaborations often promote shallow online participation due to insufficient instructor guidance; instructors need to assume increased responsibility for organizing and scaffolding students' learning during online and classroom discussions (Christopher, Thomas, & Tallent-Runnels, 2004). Lack of instructor guidance as well as poorly scaffolded peer interactions reify misconceptions among students with limited background knowledge/experience and also encourage rote learning over deeper understanding resulting in shallow engagement. College students report difficulty due to limited abilities and insufficient support from instructors (Desruisseaux, 1998).

Lacking essential support, students focus narrowly on satisfying explicit expectations and course grades rather than their independent reasoning. As a consequence, students fail to evolve personal theories or explanations, and retain initial misconceptions (De Jong & Van Joolingen, 1998; Hannafin & Land, 1997; Nicaise & Crane, 1999). For example, when students failed to engage in reflective thinking and metacognitive activities during inquiry (Hill & Hannafin, 1997; Wallace & Kupperman, 1997), they were unable to provide coherent explanations and produced primitive, often superficial artifacts devoid of related evidence. These are initial puzzle pieces that may cause us to ask the parallels question for collaborative learning and technological transience: "What are the pieces of the puzzle, and how can students adopt them to begin on a path of developing a disposition to constructive learning and collaboration"

Not all students are engaged into the collaborative learning process. Students of varied background and knowledge often resist efforts to collaborate with peers on key learning outcomes. Multiple studies found that effective collaboration may not occur naturally in a group and that students may not use information and communications technology spontaneously to support their collaboration (Hamalainen, 2008; Kirschner, Strijbos, Kreijns & Beers, 2004). College students, especially chronic underperformers, reported limited understanding of (or skill in) collaborative learning; therefore, they resist training, believing it is unnecessary (Armstrong, Chang, & Brickman, 2007; Choi, Land, & Turgeon, 2005; Eiselen & Geyser, 2003; D. Johnson, 2007). Both underperformers and higher performers, therefore, need the ingredients summarized in Figure 1.

In addition, students sometimes were reluctant to share their online collaborative learning progress with instructors. To support adult learners' collaborative learning in online environments, the instructor allowed students to use a shared workplace (i.e., Wikis, Facebook Group) to complete the final course project. Students were encouraged to use this shared workspace to collaborate as much as possible while the instructor monitored and provided feedback on their working process. The study found that more than half of the groups simply used the shared workplace to report their progress or as repositories for sharing resources without further discussions (Wang, 2010).

Consequently, using collaborative distance education technologies could hinder students' learning when they lack the understanding of collaborative learning and technologies. Simply having membership in a group is not sufficient in accomplishing quality team outcomes and productivity; successful collaborative group work requires a high level, positive interdependence and strong common ground among group members. Many researchers argue that positive interdependence among group members has many benefits for group learning including (1) producing better learning, performance outcomes, and greater productivity; (2) facilitating more frequent higher level reasoning; (3) showing stronger individual accountability as well as encouraging and supporting each other's efforts to achieve a shared goal; (4) establishing stronger mutual trust and effective communication exchanges; and (5) creating a stronger perception of the group's "sense of unity and bonding" (Johnson, Johnson, & Smith, 2007).

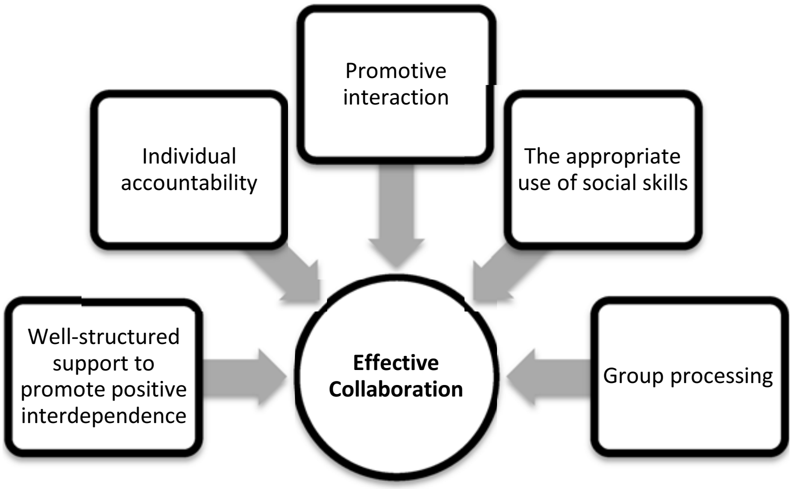

FIGURE 1
Ingredients Required All Learners to Experience Effective Collaboration

For students who lack self-regulated learning skills, technology limits the learning progress, yet it has been widely incorporated to facilitate independent and collaborative learning. Blended learning environments, for example, are designed to promote learning by developing the capacity for reflection. Students often report positive outcomes among courses that incorporate technology (Cooner, 2010; Huon, Spehar, Adam, & Rifkin, 2007). Student learning and conceptual understanding were significantly greater when a large upper division biology class was made more interactive by introducing student participation and cooperative problem solving via technology (Knight & Wood, 2005). Girasoli and Hannafin (2008) suggested that audio-based asynchronous discussion could allow students to speak more coherently and understandably, aided by the use of inflections and expressions that are absent in text-based discussion. Incorporating a variety of technologies: (a) enable students to acquire a deeper understanding of the subject; (b) promote positive perceptions of the teaching received; and (c) clarify goals and rules; (d) provide students with a higher level of independence in the learning process (Ginns & Ellis, 2007). However, the use of technology may have added an extraneous cognitive load among students with limited prior knowledge and a lack of metacognitive strategies. When exposed to unstructured, technology-enhanced learning and diverse instruction, extraneous cognitive load likely increased (Van Merrienboer & Sweller, 2005). Smidt and Hegelheimer (2004), following interviews to identify adult's web-learning strategies, reported that only advanced learners actively presented metacognitive strategies, while middle- and low-performing students relied on basic cognitive strategies. Students whose performance on final exams exceeded 70%, tended to contribute more online postings at higher cognitive levels (e.g., analysis, evaluation, etc.), while lower performing students tended to post questions related to lower cognitive levels (Boyer, Langevin, & Gaspar, 2010). College freshmen demonstrated poorer self-regulated and self-directed learning strategies and therefore required scaffolding techniques. Whereas college seniors tended to be more self-directed and self-regulated and also pursued study-related activities beyond initial learning tasks (van Den Hurk, 2006).

A CASE STUDY OF COLLABORATIVE LEARNING TECHNOLOGIES FOR LARGE ENROLLMENT COLLEGE-LEVEL SCIENCE COURSES

A design-based research examined how technology supported individual and group inquiry-based activities for achievement among academically diverse students. Design research is often situated within a domain and, in many cases, uses the structure of the domain as a theoretical guide (Cobb, Confrey, DiSessa, Lehrer, & Schauble, 2003). Following a year of preliminary study, a pilot study was conducted to refine the current research design. The ongoing study was conducted in situ to monitor the failure or success of collaborative learning technologies in a biology classroom to identify and support emergent needs. In each study, we employed a mixed methods study involving 245 to 303 undergraduate, nonscience majors enrolled in required large-enrollment college biology courses.

Collaborative peer activities through distance education environments have been employed both to engage students conceptually and to deepen student reasoning in large enrollment college-level science courses. Most students were freshmen and were divided into small groups: 74 (four to five group members per one group) small groups were created. To explore the influence of collaborative learning activities and the challenges that learners encountered by triangulation, results from the qualitative and quantitative data were compared and contrasted. Group activity scores as well as individual test scores were used as quantitative data and interview data (n = 11), and field observation notes and students' open-ended responses to course midevaluation were used as complimentary data for the quantitative measure. Based on a median split of solo test scores, students (n = 303) who were ranked in the upper 50% were categorized as higher performers (n = 151) while the lower 50% were categorized as lower performers (n = 152).

The instructor uploaded an open-source textbook and relevant multimedia materials on the learning management site. During class meetings, students either used a smartphone or a laptop to respond to quizzes and download lecture slides. Students accessed the learning management site to view the course materials, grades and to submit outside-class group work/individual projects. The outside-class group work required applying and synthesizing knowledge within a unit. Real-life situations were provided for group members to discuss and report their interpretations. For example, in an alcohol metabolism unit, a case was provided that entailed students consuming alcohol. Students were then asked to analyze the reason why some students had an Asian glow and to explain how enzymes impact this occurrence. All group members received the same scores from the outside-class group assignment. To support group activities, students evaluated each group member evaluated individual member, via the online peer evaluation system. To encourage equal contribution to the group work, the peer-evaluation scores applied to the individual student's final project grade.

We examined differences in the extent to which online group activities influenced both content knowledge and higher order thinking skills between higher and lower performing students. The results indicated that online group-based activities positively influenced the achievement of higher performers but no group activities improved lower performers' learning achievement. Online group-based activities accounted for 18.4% of the variance ($P < .001$) among higher performers; for lower performing students, online group activities explained 17.7% of the variance.

Both higher and lower performers questioned the value of the collaborative activities:

> Sometimes we felt a little lost because … we didn't fully understand the lectures and then we were given a sheet and told to think about it more and we were like, "We don't understand the first part." (Higher performer)

> I wish we'd actually learn about what will be on the test. (Lower performer)
>
> It correlates with the lecture in some ways but in other ways it's kind of an off topic … like those questions that we have to do or whatever we have (to) formulate for the group assignment is not on the test,

commented Laura, one of the lower performers, describing activities as irrelevant for learning and test performance.

> It's (inquiry-based activities that) will not affect your grades and cannot really find why and how it (the activity) is related to (what you are learning from the lecture). (Emma)

These observations, from a lower performer, were echoed by a group of higher performers and three lower performers reported, who stated they completed activities to document their work, instead of engaging in the inquiry. For instance, one lower performer mentioned, "We simply just wrote it (group work sheet) down and passed it on," stated Laura, one of the lower performers but who expressed positive perceptions about her group work, mentioned.

Not all students of varied performance levels benefited from collaborative learning. The benefits of interdependence rely on dynamic rather than individual performance alone; improvements by any individual member or subgroup should benefit all members when investing in common goals (Lewin & Lewin, 1948). Positive interdependence facilitates the development of new insights and discoveries and the more frequent use of higher level reasoning strategies (Skon, Johnson, & Johnson, 1981). Challenging each other's reasoning and conclusions should promote both decision making and creativity among the group (Lizzio & Wilson, 2006; Johnson, Johnson, & Smith, 2007). Flynn and Klein (2001) reported that college students who engage in collaborative case-based learning were more highly motivated and learned more effectively than those working independently.

However, the study also indicated that students and groups failed to develop positive interdependence or promotive interactions. Consistent with previous research, social loafing occurred during the group work time; negative interdependence resulted in oppositional interactions (Curşeu & Pluut, 2013; Johnson & Johnson, 2007). One higher performer noted that group work benefits team members by challenging thoughts and thinking processes. This was reflected in the comments of one high performer (confidential source):

> If you're here to participate as a group, as a whole unit, together, that means four brains are now one brain. The thinking process must be taught to others and told to the others and then if the group member agrees then they'll tell them and if they disagree, then they'll tell them why they disagree, etc. They'll give the reasons, they'll give debates here and there … so that's how people learn, you know? You give out your ideas and if you make a mistake, then you learn from it.

However, two higher performers complained about the limited contributions of their lower performance group members and expressed unwillingness to help;

> And so it's like getting really frustrating and so … I'm starting to act like really irritating toward them, just like when they ask me a question about what happened and I'm like, "It's on the slide."

The results demonstrated unequal and potentially detrimental learning influence of group work among lower performing students. Theoretically, all students should benefit from group work by sharing knowledge and deepening understandings of course concepts: When higher performing students benefit from online outside-class group work, for example, lower performing students should also benefit. However, results indicated that only higher performers benefited from online outside-class group work while lower performers failed to benefit. Interview data showed higher performers typically devoted extra time and effort to group activities while lower performers reported limited active engagement in-group work. Negative interactions frequently discouraged participation, resulted in negative effects (i.e., frustration) and reduced the quality of socially shared regulation (Johnson, 2007). For example, lower performing students did not show any statistical influence from group-based activities. To expand on this finding, supportive evidence from the lower performing students' interview was noted. The interview data found that lower performers prefer noncollaborative learning and prefer just listening to group members' discussion while only engaging in the activities that would be graded. This was clearing demonstrated through the interviews:

> I probably study differently. And even when I did study with groups like in high school, usually while they're talking, I'm doing my own thing. (Chloe)

> I was in the conversation but not really. If I'd be thinking about what I was going to say then I'd forget about everything else … (so) I listen to the whole conversation and wait until the end. (Jacob)

These findings question the extent to which students benefit equitably from learning in small-group settings, especially when individual members are openly criticized or discouraged from participating by their collaborating peers.

Students with effective metacognitive strategies, and those who develop them during self-regulated learning, perform more successfully than those who do not. In the current study, the instructor allowed the use of laptops and smartphones during the class. During interviews, both higher and lower performers mentioned self-regulation concerns when using laptops or smart phones during the class. College age students obtained and documented evidence in portfolios and generated hypotheses to guide future inquiries. Self-regulated learning functioned as expected only when students had adequate background knowledge, evaluated their knowledge limitations, critically questioned and clarified, and evaluated faulty explanations (Land & Zembal-Saul, 2003). In the current study, the instructor integrated technologies in the class for in-class activities as well as outside group activities. However, during the interview, the study found that students' usages of technologies were limited and the effects of using multiple technologies were questioned. For example, some groups used email communication as instructed, while others did not although they were required to submit outside class group work online. Eventually, groups tended to divide individual portions of the online group assignment and submit without group discussion (n = 7); "And so we just kind of split up those four paragraphs. And we just emailed the information to Ben and he submitted it" (Higher performer).

Although group works are implemented widely in college courses, few studies have documented strategies that enhance their effectiveness in distance education courses. Effective groups need to support all participants' thinking skills and knowledge acquisition. However, our study revealed that lower performers rarely benefited from group work and only a few higher achievement levels remains to be verified.

Ineffective group work is likely the product of insufficient instructor support, widely varied prior knowledge within groups, lack of student preparation or willingness to engage in group work strategies, or deficient individual learning strategies (Christopher et al., 2004). Still, it is unclear which factors contribute to ineffectiveness among learners of diverse achievement levels. Authors have provided guidelines to facilitate effective group work, but such guidelines have rarely been validated in the college distance courses.

Research is needed to identify circumstances and methods where distance group work benefits performance across achievement levels, as well as how to improve college learners' achievement. The extent to which the logistics associated with the learning impact distance group work within large-enrollment online courses also requires further study. These methods and mechanisms entail cognitively complex tasks that are commonly implemented in social activities such as discussion, negotiation, and consensus building. The extent to which learner variables, instructor variables and context variables encourage or discourage individual as well as group learning needs to be scrutinized.

The notion and demand of using emerging technologies has been increasing while the lifespan of a technology has been shortened. However, without considering how to bridge the gap between misaligned practices when using collaborative technologies and adopting short-life spanned technology will not add value but may hinder students' learning in distance education. Rather than adopting new collaborative distance education technologies, instructors will need to recognize the importance of providing appropriate scaffolding techniques and design the online collaborative learning environments.

Previous studies with collaborative learning technologies tended to emphasize the use of technology per se rather than emphasize the effects on students' learning. Simply analyzing the frequency of online resource access fails to account for the influence of supplementary online resources. When integrating collaborative distance education technologies in large classroom settings, learning progress needs to be documented. In distance education environments, we need to determine when, where and how instructors are able to promote positive interdependence to support *all* students' academic performance. How, when and where does the use of embedded interaction formats (e.g., discussion board, guided discussion threads, chats, group work) promote diverse underperforming students' participation and academic performance in asynchronous online learning environments? The use of students' online postings and responses may be documented empirically using empirically validated scoring rubrics. Triangulating evidence from discussion boards, semistructured students' reflection journals and interviews should clarify the unique as well as collective impact on student performance. In order to gauge whether individuals improve their understanding from discussions, contents of the postings should be analyzed accordingly by using content analysis or thematic analysis. According to Cohen, Lotan, Darling-Hammond, and Goodland (2014), comparing the quantity and quality of online discussions may provide important indicators of knowledge construction. By empirically analyzing both the frequency and quality of participation, the relative value of individual group participants can be determined.

In addition, contemporary online scaffolding is mostly fixed, rarely faded, and generally brought into play at the instigation of the learner rather than a more knowledgeable other (Pea, 2004; Puntambekar & Hubscher, 2005). More research is essential to understand when, how, and why to scaffold online collaborative learning about complex topics. The instructor's role is to provide an optimal level of guidance/scaffolding techniques rather than to provide fully guided instruction. Also, spontaneous monitoring of what is known and what needs to be known is required with external scaffolding, support, and modeling. Scaffolding is one method that has proven especially useful in developing higher order reflection within the instructional context (Hannafin & Land, 1997). The types of scaffolding are varied, but can be classified according to four functions that support student learning in open-ended learning environments: conceptual (what knowledge to consider), metacognitive (how to think about the problem), procedural (how to use learning environment features), and strategic (what the alternative strategies are) (Hannafin, Land, & Oliver, 1999). In group work, instructors could support students of varied abilities by providing heterogeneous or homogenous group setting purposefully.

While technology has been widely adopted for collaborative learning in large enrollment online college courses, the effectiveness among underperforming students has not been conclusively demonstrated. Underperforming students sometimes scored better when they collaborated with heterogeneous group members (Hooper & Hannafin, 1991) or outperformed in homogeneous group setting (Jensen & Lawson, 2011). Minimal research has been conducted validating the extent to which feedback and scaffolding affect underperformers' academic performance when learning with collaborative distance education technologies. While diverse guidance has been emphasized, it is not clear how instructors balance guiding versus directing as they provide guidance (Land & Hannafin, 2000).

Further research is needed to document the effects of group activities on both individual *and* group performance. Group size may influence online collaborative learning: larger group size may encourage social loafing issues. Nonnecke and Preece (2000) suggested that as the number of members increases, the need for any given group member to contribute might decline. A larger group can invoke extraneous cognitive load onto the participants (Schellens & Valcke, 2006) as they potentially need to deal with large quantities of online interaction (e.g., postings); this could lead to reading fatigue, and cause the participants to cease from contributing in the collaborative learning process. For online group discussion, a group size of about 10 participants increased higher level knowledge construction (Hew & Cheung, 2010), however, the study did not examine the equitable influence on learners in diverse performance levels.

Educators and designers of distance education environments confront increasingly dynamic and varied demands. Our designs must address the shifting capabilities of rapidly evolving technology as well as varied perspectives, values, and expectations. To meet these challenges, we need to recognize, understand, and address different learning and performance goals, needs, and requirements. While some propose collaborative learning strategies that apply equally, this may prove ill advised and unwarranted given the needs of vastly different clients and contexts. Designers determine whether (and how much or little) we support the needs, expectations, and requirements of varied disciplines and clients. Clearly, continued advances in theory and research will inform the design of collaborative distance education environments. Indeed, while progress has been realized, further study and supporting evidence is needed to ground our design practices to support collaborative learning and performance in traditional and nontraditional settings.

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