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Task Virtuality and its Effect on Student Project Team Effectiveness

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ABSTRACT

This study explores the extent to which students in colocated teams use synchronous and asynchronous computer-mediated communication channels (task virtuality) and how this use affects their perceptions of the team's performance, their satisfaction with the team, and the learning they derive from the process. Survey results show that different computer-mediated communication channels relate to each team outcome. These findings could help educators refine the student experience with these technologies to prepare them for virtual teamwork in the workplace.

Keywords: teamwork, task virtuality, colocated teams, computer-mediated communication.

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Introduction

According to the Project Management Institute, 'Teamwork is integral to modern project management.' (Dewhirst, 1998). As a work group that is time-limited and that produce one-time outputs (Cohen & Bailey, 1997), a team provides an appropriate vehicle to execute a typical project with definite goals and schedules. In a business environment of tight resources and greater accountability, learning teamwork skills is critical for college graduates (Alie et al., 1998).

In a review of higher education institutions worldwide, it was observed that distance courses in the undergraduate level are most commonly offered in the United States (Hanover Research, 2011). According to a report by the United States Department of Education, however, 74.2% of post-secondary students enrolled in Title IV institutions (those entitled to federal financial aid funds) in the fall of 2012 still do not take any distance courses (Ginder & Stearns, 2014). This does not mean, however, that these on-campus students do not use computer-mediated communication (CMC) media when interacting with each other in colocated project teams. Orhan (2014) defines an individual's reliance on computer-mediated communication (CMC) to perform tasks as *task virtuality* as opposed to the concept of *team virtuality* which refers to teams whose members are geographically dispersed.

Just what role do CMCs play in traditional, colocated student teams? Previous studies have found a strong relationship between communication and work team effectiveness (Werner & Lester, 2001; Mathieu et al., 2008; Martinez-Moreno et al., 2009). With the advent of computer-mediated communication (CMC) technologies, some have examined the use of ICCs beyond face-to-face (FTF) communication (Triana et al., 2012) such as synchronous (phone calls, chat rooms, video conferencing) and asynchronous CMCs (text messaging, emails, discussion forums and group decision support systems) in student teams, and their impact on team effectiveness. The use of social media (Web 2.0 technologies) in teamwork has not generated as much attention (Okoro et al., 2012). Many of these, however, compared colocated and virtual teams and did not deal with task virtuality within colocated teams alone. The few that have did not consider the full range of CMCs available to the students. As each new CMC channel promises better facilitation of information exhange and knowledge-sharing in teamwork (Snyder & Lee-Partridge, 2013) and with most students still choosing to take on-campus courses, it is important to determine the effectiveness of the full range of CMCs in student project teams in colocated team settings.

Literature Review

With the link between team effectiveness (as measured by team output, satisfaction and learning outcome) communication firmly established in the literature (Cohen & Bailey, 1997), most of the research have shifted to exploring the extent of virtuality as an enabling mechanism for team processes according to Martins et al. (2004). As stated earlier, many of the studies on the use of computer-mediated communications (CMCs) in student project teams have compared traditional, colocated teams that predominantly use face-to-face communication (FTF) with virtual teams that use CMCs. For example, Andres (2006) found that there is a positive relationship between greater information exchange and process productivity and satisfaction in both colocated and virtual teams. Williams and Castro (2010) added that learning was similarly affected in both face-to-face (FTF) and CMC settings.

Other comparative studies have examined the effectiveness of various synchronous and asynchronous ICCs used within student teams. Ocker and Yaverbaum (1999) found that the extent of communication in teams that use asynchronous CMCs were

both positively related to the quality of and satisfaction for the objective outcome. Satisfaction with the team process and learning experience, however, was not associated with asynchronous ICCs. When the performance of FTF teams, asynchronous CMC teams, and synchronous (video conferencing) teams were compared, teams that used asynchronous CMCs were found to be the least performing ones among the three (Martinez-Moreno, et al, 2009). Hansen (2015), however, found that virtual student teams exhibited greater participation in team activities and greater satisfaction than colocated teams.

Studies on the effectiveness of synchronous CMCs (such as phone, chat rooms, video conferencing) have produced mixed results for each type of team outcome. Martinez-Moreno et al. (2009) found a positive association between the use of synchronous communication technologies in student teams and team objective performance. Among colocated students, Fulick (2006) observed that they frequently exchanged information virtually using synchronous CMCs. He suggested that these rich interactions could lead to lead to increased learning among students. Lerouge et al. (2004), on the other hand, discovered that students considered synchronous CMCs as least useful for collaborative work when using multi-functional course environments like Blackboard and WebCT. The authors attributed this to students' complaint about the need to be on-line simultaneously – a convenience factor. With FTF communication as an alternative synchronous channel, lower satisfaction could result if they had to resort to using synchronous CMCs instead. Mannecke and Valacich (1998) experimented with colocated students who only used synchronous CMCs and those who could meet face-to-face and found that those who used CMCs were less satisfied than those who met face-to-face. Based on these results, the following hypotheses about task virtuality within colocated student project teams are proposed:

H1a The extent to which a team member uses synchronous CMCs when performing project teasks is positively associated with the member's perception of goal attainment.

H1b. The extent to which a team member uses synchronous CMCs when performing project tasks is negatively associated with the member's level of satisfaction with the team experience.

H1c: The extent to which a team member uses synchronous CMCs when performing project tasks is positively associated with the member's perception of teamwork skill improvement from the team experience.

Studies on the effectiveness of asynchronous CMCs in student teamwork have similarly led to different results across team effectiveness measures. Students tend to use asynchronous CMCs such as text messaging and e-mail more often than synchronous media (Lewis et al., 2005). Critical incidents involving students using asynchronous CMCs were characterized by few but rich interactions (Fulick, 2006). Ocker and Yaverbaum (1999) found that the extent of communication in teams that use asynchronous CMCs were both positively related to the quality of the objective outcome. Warkentin et al. (1997) argued that asynchronous ICCs (such as email, discussion forums) can allow students to concentrate on the message content and respond more carefully, thus, improving team outputs. Due to its ability to transcend location and time barriers, students find asynchronous CMCs as more useful than synchronous CMCs (Lerouge et al., 2004). When it came to team member satisfaction, Wilson et al. (1998) found that the use of e-mail did not help with the team's socialization activities. Satisfaction with the team process and learning experience were also not associated with asynchronous ICCs (Ocker and Yaverbaum, 1999). Thus, the following hypotheses about task virtuality using asynchronous CMCs are proposed:

H2a: The extent to which a team member uses asynchronous communication when performing project tasks is positively associated with the member's perception of goal attainment.
H2b: The extent to which a team member uses asynchronous communication when performing project tasks is negatively associated with the member's level of satisfaction with the team experience.
H2c: The extent to which a team member uses asynchronous communication when performing project tasks is negatively associated with the member's perception of teamwork skill improvement from the team experience.

Method

The sample consisted of 237 senior-level business students who took an on-campus, capstone business strategy course from the same instructor in six sections that met twice a week. The students were grouped into 53 colocated teams with four to six members each. Each team undertook a similarly-structured six-week long project that resulted in a written report. All teams were given an opportunity to use one class session to meet face-to-face about the project. Other communication incidents occurred off-session.

Each student was asked to fill out a questionnaire after the written report was submitted but before the project grades were released. This was done to eliminate the effects of knowing the project grade on his or her perception of team processes and team outcomes. The questionnaire asked how often he or she used six ICCs (information and communication channels) when performing team tasks. The ICCs included face-to-face meetings, synchronous CMCs (talking on the phone, chat rooms on social networking websites such as Facebook, and on-line meeting tools such as OneDrive and GoToMeeting), and asynchronous CMCs (email and text messaging). Although face-to-face interaction is not computer-mediated communication, it was included in the study to account for its impact on team performance and get a better gauge of the net effect of CMCs on the communication process of colocated teams. The team tasks asked in the survey related to transition and action processes as identified by Marks et al. (2001) and which have been extensively used in subsequent research on teamwork (Martins, et a., 2004). Students were asked about their use of the six ICCs when establishing team goals and assigning responsibilities (a transition process task), and when tracking progress and coordinating actions (an action process task). Student responses were recorded using a seven-point Likert-type scale ranging from "Never" to "Always."

Each student was also asked to rate the team's effectiveness on a seven-point scale from "Not at All" to "Completely" by answering three questions relating to the three team effectiveness measures as identified by Guzzo and Dickson (1996): 1) To what extent did you achieve your goals for the project?; 2) To what extent were you satisfied with the team; and 3) To what extent did this project experience enhance your team working skills?

The students completed a survey with open-ended questions on their beliefs and experiences with computer-mediated communications. This was included to provide insight on some of the results that might be found in this study.

Results

Table 1 shows the means and standard deviations for the use of the six ICCs for each task. The results show that, on average, students used face-to-face meetings, and the asynchronous methods of text messaging and e-mail more extensively for both tasks than the other ones. This confirmed what Lewis et al. (2005) found in their study.

There is a greater variability in the use of on-line meeting tools, possibly reflecting differences in the knowledge and comfort levels of students with these channels. It is also noteworthy that talking on the phone generated the lowest mean score among the CMCs.

Table 1:
Means and standard deviations for each project task and ICC used

Team Task and ICC	Mean	Standard Deviation
Transition Task: Establishing team goals and assigning responsibilities		
Face-to-face meetings	4.60	1.535
Asynchronous CMCs		
Text messaging	4.75	1.868
E-mail	4.57	1.603
Synchronous CMCs		
On-line meeting tools	2.63	2.259
Social network chat rooms	2.30	1.872
Talk on the phone	2.06	1.484
Action Task: Tracking progress and coordinating actions		
Face-to-face meetings	4.49	1.572
Asynchronous CMCs		
Text messaging	4.60	1.955
E-mail	4.51	1.644
Synchronous CMCs		
On-line meeting tools	2.58	2.267
Social network chat rooms	2.20	1.867
Talk on the phone	2.09	1.540

A principal components analysis using a varimax rotation procedure was performed on the responses to items related to the use of the six ICCs for the two tasks. This process extracted five factors that aggregated along the same ICCs across both tasks (see Table 2). This suggested that students used each of the ICC to the same extent for both tasks. Two ICCs – social network chat rooms and on-line meeting tools were both web-based CMCs, and items related to these loaded on the same factor. Composite measures were developed to represent these five factors: Web-based CMC (Factor 1), Phone (Factor 2), E-mail (Factor 3), Texting (Factor 4) and Face-to-face (Factor 5). The resulting Cronbach's alphas, 0.835, 0.937, 0.907, 0.929 and 0.925, respectively, showed that there were reliable measures of the factors they represented.

Table 2:
Factor analysis of ICC used in each project task

	Factor				
Item	1	2	3	4	5
On-line meeting tools (Transition task)	.880	-.165	-.142	.181	.056
On-line meeting tools (Action Task)	.878	-.132	-.117	.190	.069
Social network chat rooms (Action task)	.757	.359	.276	-.109	-.052
Social network chat rooms (Transition task)	.737	.383	.281	-.095	-.050
Talk on phone (Action task)	.032	.902	.037	.208	.070
Talk on phone (Action task)	.036	.899	.027	.199	.131

E-mail (Transition task)	.041	-.004	.924	.090	.105
E-mail (Action task)	.013	.081	.924	.102	.121
Text messaging (Transition task)	.062	.166	.080	.925	.050
Text messaging (Action task)	.109	.215	.115	.913	.015
Face-to-face meetings (Transition task)	.046	.076	.115	.001	.950
Face-to-face meetings (Action task)	-.008	.100	.104	.064	.949

The hypotheses were tested by using linear regression with each team outcome measure as a dependent variable in a regression equation. The five factors developed from the students' responses to the use of the six ICCs (refer to Table 2) were entered into the equation as independent variables using a stepwise procedure where a variable was either added if it contributed significantly to the model's r^2 and then dropped if not.

Based on the results shown in Table 3, the data found significant support for H2a in terms of the use of e-mail and goal achievement. The same cannot be said, however, for text messaging. The results did not support H1a. There was no positive association between the use of synchronous CMCs and perceived goal achievement.

Table 3:
Regression results for perception of goal achievement

Model	Sum of Squares	DF	Mean Square	F	Sig.
Regression	32.777	2	16.388	11.062	.000
Residual	342.219	231	1.481		
Total	374.996	233			
Included Variables	B	Std. Error	β	t	Sig.
(Constant)	4.357	.313		13.910	.000
Face-to-face	.092	.027	.218	3.389	.001
E-mail	.064	.026	.158	2.460	.015
Excluded Variables			β in		
Texting			.041	.637	.525
Phone			.059	.915	.361
Web-based CMC			.008	.120	.904
$r=.296$; $r^2=.087$; adjusted $r^2=.080$; Std. Error of the Estimate=1.217					

The hypotheses on the link between team member satisfaction and the use of CMCs, H1b and H2b, were not supported by the data. Table 4 suggests that only the use of face-to-face meetings had a significant effect on the students' satisfaction with the team experience. There seems to be a negative association between the use of web-based CMCs and satisfaction (H2b), but the results were not significant even at the .10 level.

Table 4:
Regression results for team member satisfaction

Model	Sum of Squares	DF	Mean Square	F	Sig.
Regression	30.216	1	30.216	16.987	.000
Residual	412.677	232	1.779		
Total	442.893	233			
Included Variables	B	Std. Error	β	t	Sig.
(Constant)	4.894	.277		17.653	.000
Face-to-face	.120	.029	.261	4.122	.000
Excluded Variables			β in		
Texting			.052	.815	.416
E-mail			.023	.359	.720
Phone			.047	.724	.470
Web-based CMC			-.096	-1.513	.132
r=.261; r^2=.068; adjusted r^2=.064; Std. Error of the Estimate=1.334					

The results in Table 5 provides significant support for H1c in the use of the phone – a synchronous CMC – and the degree to which the student perceived an improvement in his teamwork skills. This did not translate, however, to the use of web-based CMCs that also involve synchronous interactions with team members. No significant results were found for the relationship between the use of asynchronous CMCs and the learning outcome (H2c).

Table 5:
Regression results for teamwork skill improvement

Model	Sum of Squares	DF	Mean Square	F	Sig.
Regression	62.081	2	31.041	10.594	.000
Residual	676.825	231	2.930		
Total	738.906	233			
Included Variables	B	Std. Error	β	t	Sig.
(Constant)	3.509	.371		9.459	.000
Face-to-face	.126	.038	.212	3.323	.001
Phone	.102	.040	.164	2.568	.011
Excluded Variables			β in		
Texting			-.049	-.730	.466
E-mail			.087	1.337	.183
Web-based CMC			.022	.351	.726
r=.290; r^2=.084; adjusted r^2=.076; Std. Error of the Estimate=1.712					

Discussion

Although this study did not test the relationship between face-to-face communication and the effectiveness of study project teams, the results affirm this belief when one observes how the variable relating to the use of face-to-face meetings is significantly positively related to goal accomplishment, team member satisfaction, and teamwork skill-building.

The results suggest that students in colocated teams engage in task virtuality and that the use of some CMCs contribute signifcantly to team effectiveness. The use of an asynchronous computer-mediated communication medium (CMC), e-mail, is positively linked to the student member's perception of goal accomplishment. And although text messaging was not found to be significantly linked to any of the measures of team effectiveness, Table 1 shows that many students used this asynchronous CMC channel when performing team project tasks.

A few of the comments given by students when asked about the use of e-mails and text messaging could shed some light on these results:

> 'It gives us time to put good thought into our answers.'
> 'Texting and email is much quicker and easier than trying to get every member to meet.'
> 'Easy to check in with group members' progress and coordinating meeting times.'
> 'It is easier to go ahead and get a start on your project without having to meet up.'
> 'We used texting to plan group meetings so we could work around everyone's schedule.'
> 'The only reasonable use for it is to set up face-to-face meetings.'

The last two statements about texting appeared often and could explain why texting was commonly used but have no significant impact on team effectiveness. Text messaging is limited in content by nature compared to e-mail, so the information exchange using this medium is not expected to be as rich as an e-mail message. These results confirm past research about the positive impact of richer and more thoughtful conversations that could happen within student project teams through e-mail as opposed to asynchronous CMCs. The lack of a significant link between the highly used text messaging medium and team goal accomplishment, however, suggests that the effectiveness of asynchronous CMCs do not necessarily depend on how much they are used.

This sample of students did not avail of synchronous CMCs as much as asynchronous channels. However, the use of one, talking on the phone, was significantly positively linked to the student's perception that she improved her teamwork skills. This result is surprising given that the phone was the least used of the six communication methods. Two student comments could partially account for this result. One student complained, 'Sometimes it can be frustrating not to communicate verbally.' Another stated, 'You only communicate via typing which takes away a great deal of communication.' It is clear that these two students are some of the very few who could have learned a valuable lesson about the advantages of verbal over non-verbal communication.

The use of web-based CMCs in the form of chat rooms in social networks or on-line meeting tools were not found to be related to any of the team effectiveness measures. Colocated teams have more opportunities to meet face-to-face unlike teams in virtual settings which previous studies have shown synchronous CMCs to be useful. Traditional, on-campus students might not have the incentive to use or even the knowledge about these tools. One student among many said, 'It is good if you know which tools to use.' And all team members have to agree to use a particular social media platform or on-line meeting tool to make it useful (Shen et al., 2010). Computer-mediated communication methods were not found to have a significant effect on member satisfaction. CMCs did not contribute to any socialization benefits of teamwork which is a source of satisfaction with the team experience according to one student, 'This way of communication does not seem to make you feel part of a team.' Another was more succinct about CMCs, 'Good, helpful, convenient, impersonal.' Asynchronous CMCs have one point against it according to one student, 'It is hard to become motivated to accomplish the assignments because you aren't having to face someone frequently.'

Conclusion

It is clear from these results that students working on colocated team still prefer to meet face-to-face when working on their projects. But task virtuality still emerges with the most basic forms of computer-mediated communication technologies – e-mail and text messaging. Of these, only e-mail seems to have a positive impact on team effectiveness. The results also suggest that the millenial generation uses the phone as a text-delivering device to a greater extent than for verbal communication. And there is evidence that students' teamwork skill-building is positively associated with its use. These students not only did not use Web-based synchronous CMCs but did not feel that this omission affected their team outcomes.

On-campus students have the opportunity and the preference for face-to-face communication. But as they join their virtual colleagues in the workplace, task virtuality using Web 2.0 technologies will be a valuable competence (Etim & Huynh, 2015). Greater exposure to more complex CMCs when working in colocated team projects while still in college can emphasize its value for self-management and interactivity (Borstnar, 2012, Gudmundsson & Southey, 2012). Comfort level and usage of CMCs even by students in virtual teams are initially low but improve with experience (Lewis et al., 2005). One student in this study admitted, "Google Drive played a big role in our project where we could all see the same screen and edit the project with no problem."

There is untapped potential for Web 2.0 technologies in higher education (Gerlich et al., 2010). It is up to educators to harness this generation of student's aptitude for using social media in their private lives and convert these into project tools in professional settings.

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