HOW TO COLLABORATE IN A VIRTUAL WORLD: TEACHING TEAMWORK AND TECHNOLOGY

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Abstract

Today’s organizations leverage the opportunities offered by widely available information and communication technologies to bring together people with different knowledge and skills who may be geographically dispersed. As our students step into their professional lives they need to have the skills to succeed working in such virtual teams. This paper outlines an experimental curriculum in which college students from a marketing class teamed with students from a multimedia class to work on a common project. The curricular goal was to help students gain team experience and skills in an interdisciplinary team setting that simulated the real world. A scale that measures team knowledge was given at the beginning and end of the classes, the results of which showed no significant difference ($t=-.29$). This paper looks at the reasons for the results, lessons learned from this experimental collaboration, and discusses curricular components that may facilitate the development of technology-mediated teamwork skills in students.

Navigating a Flat World

In the last ten years the rise of the Internet and related technologies have created new, faster and less expensive ways for people to communicate with each other. Not surprisingly organizations across the globe have taken advantage of this trend to improve how, where and how fast they work. As organizations become geographically dispersed, there is an increasing amount of work done by virtual teams, teams who do not meet in person and rely on information and communication technology (ICT). Such teams carry out many critical functions, including information collection and dissemination, decision making, and implementation (Canney-
Davison & Ward, 1999). However, they also bring with them new challenges in communication, cultural norms, leadership, performance evaluation and other areas.

Technology can both rise to meet these challenges and contribute to them. These virtual teams could not function without the Internet, low cost communications and advanced ICT such as web-based chat and conferencing tools, e-mail, collaborative writing tools, group decision support systems and workflow automation systems. As information and communication technologies permeate every aspect of organizational and personal life they challenge us, changing how we interact. Professionals and those studying to become professionals need to adapt to be successful.

Are our students ready to be a part of this trend? In order to succeed in such a work environment it is necessary for students to learn how to work in teams mediated by these technologies. Harvard and MIT economists Richard Murnane and Frank Levy explain that in the future “good jobs will increasingly require expert thinking and complex communication. Jobs that do not require these tasks will not pay a living wage” (Levy and Murnane, 2004). It is increasingly likely that "expert thinking" and "complex communication" will make use of some form of ICT and that the jobs will be as part of a team or teams. To be ready for this trend students need both technological and collaboration skills.

**Technological Skills**

Studies show that student use of ICT is high and rising (Salaway et al. 2006, 2007). The newest generation of students is steeped in communication technology, many using it on a daily basis. They email, chat, send text messages, post videos on YouTube, share pictures on Flickr, and network with friends on MySpace and Facebook. And there is surely more to come. The 2007 ECAR Study of Undergraduate Students and Information Technology found that the average
student spends 18 hours a week online. While online, 99.9% of them use email, 84.1% use Instant Messaging and 81.6% use social networks such as Facebook, up from just over 70% a year ago. In addition, the median frequency of use for those who participate in social networks was daily use. This use of social networks also shows how fast students adopt new technologies. When the same study was done in 2005 social networking was not even included in the study. Evidence like this supports claims by those such as Mark Prensky that students are indeed "Digital Natives," (Prensky 2001) comfortable using these technologies and expecting to use them in their student as well as personal life. However, the question remains as to whether this familiarity with ICT actually translates into effective interpersonal communication and collaboration skills when those skills are needed to do "work" with teams, especially virtual teams.

Collaboration Skills

Industry representatives emphasize that recent graduates should have developed abilities to work in teams, to communicate effectively, to think critically, and to solve open-ended design problems (Black 1994; Coleman 1996). Academics agree. Murnane and Levy (1996) describe the essential skills necessary for today's generation to be successful in the workplace. Apart from basic academic and computer skills these include (a) the ability to solve semi-structured problems where hypotheses must be tested, (b) the ability to work in groups with persons of different backgrounds, and (c) the ability to communicate effectively, both orally and in writing.

What are the skills necessary for successful collaboration? A conceptual model developed by Stevens and Campion (1994) focused on knowledge, skills and abilities (KSAs) that make individuals more effective in teams. Based on review of extant literature they suggested that interpersonal factors such as conflict resolution, collaborative problem solving, and
communication and self-management factors such as goal setting/performance management and planning/task coordination are important for effective team performance. Interpersonal KSAs were generally defined as skills necessary to maintain healthy working conditions and to react to others ideas with respect, emotions, and differing viewpoints. Self management KSAs encompassed the abilities that team members must have to perform managerial activities such as goal setting and planning. Their measure of teamwork KSAs has been found to hold in different settings, including temporary student teams (McClough & Rogelberg, 2003) and has been recently extended to include components of trust, reliability and intercultural competency (rather than on personality traits or dispositions as characteristics) to develop a measure for selection and placement of members in virtual teams (Hertel, Konradt & Voss, 2006).

**Collaborative Exercise**

To address the need for technological and collaboration skills in today's students we modified two existing courses, a marketing class from the business field and a multimedia class from the field of technology. We used these two courses because they are both in professionally oriented fields, the interdisciplinary aspect of the project would parallel teams common in the real world and the skillsets of the students in the two classes complemented each other well for a hands-on project. The overall objective of the curriculum restructuring was to provide a setting for students where they could gain experience working in face-to-face and virtual teams and gain teamwork knowledge.

The curriculum planned for collaboration at two levels: within group collaboration and between group collaboration. Students in both the Marketing class and the Multimedia class were divided into an equal number of groups. Then each group in a class was paired with a sister group in the other class. Intra-class groups would communicate largely face-to-face and inter-class groups
would communicate virtually. The students were briefed by a client (in this case the career center) on a project that had to be completed by the end of the semester. The project was the creation of a learning object that was modular in nature and expressed as a web site. The Marketing students were responsible for developing the business specifications and much of the written content and the Multimedia students were responsible for developing the visual design, graphic elements and web pages. Each of the paired-groups was responsible for one module of the project.

In order to develop a module of the learning object, Marketing students responsible for that particular module would have to engage in close intra-group collaboration to write out and develop the business specifications for the module. They would then communicate this to their sister group in the Multimedia section using email and a web-based collaborative tool. That group of Multimedia students would then work closely with each other to create the graphic design, integrate the content and write the HTML and CSS to develop a web-based module of the learning object.

A number of steps were undertaken by the researchers to ensure that the groups were well-formed and part of the overall course curricula. The groups were chosen by the instructors with efforts to create relatively equal groups with diverse backgrounds and skills. Clear roles were outlined for the group members (the students themselves chose who would fill the roles), and a general timeline with deliverables was laid out. The inter-class workflow was also with the students. The groups were integrated into the curricula through various means. Group assignments were included in the curriculum and were part of the final grade for the courses. A technology was chosen by the researchers to facilitate the interclass communication. Class time was used to demonstrate the technology and train students in its use (the technology, JotSpot has
since been bought by Google). Students had time during class to work in groups with access to computers so they were able to use this technology during class time when the instructors were available for assistance.

**Effectiveness of the Exercise**

In order to assess whether the collaborative exercise increased students knowledge of how to work in teams, students were given a teamwork knowledge test at the beginning and then at the end of the semester. We used the team knowledge test (TKT) developed by Sims-Knight et al. (2002), based loosely on the format used by Stevens and Campion (1994) for their Teamwork KSA Test. The TKT is a measure intended to assess individual team members' general knowledge of team issues and concepts. The current test was designed for use with an undergraduate college population rather that an industrial or corporate population which made it particularly attractive for the present study. Its 20 items are designed to sample students' understanding of four domains -- team process, decision making, communication, and conflict resolution.

This test presents a series of hypothetical situations in which the respondent is asked to choose the best response from among several options. Some examples of the items used in the TKT test would be 'Your team leader comes to your scheduled meeting without an agenda. What should you do?' The four response options for this question are:

1. *Make your first agenda item developing an agenda as a team.*

2. Let the meeting proceed without an agenda.

3. Tell the team leader to write out an agenda right now and take the rest of the team for coffee until s/he is done.
4. Suggest the meeting be postponed until the team leader gets his act together.

Another example follows: 'When receiving feedback from your team members, it is generally useful to...’ The response options for this statement are:

1. Have an argument prepared ahead of time to defend yourself.
2. Anticipate that people won’t really understand where you’re coming from and be ready to explain.
3. *Try to perceive the feedback as information that you can use, not an evaluation of you as a person.*
4. Anticipate what they will say and wait to hear it.

The developers reported relatively high reliability coefficients for the TKT scale [pretest: Cronbach's alpha = .78; post-test: Cronbach's alpha = .76] (Sims-Knight et al. 2002). Thus the developers of the scale recommended that it would be valid to calculate an overall score for the TKT scale. The overall score can be interpreted as the amount of teamwork knowledge an individual possesses because it reflects knowledge of how to act in team situations.

While the test is designed so that participants can receive an overall teamwork KSA score (Sims-Knight et al., 2002) we looked at differences between the total score and also individual items because in our case the reliability coefficient was somewhat lower, with Cronbach's alpha being .64 for pre-test and .67 for post-test.

**Results**

The scores were summed to get an overall pre-test and an overall post-test score. On each item of the team knowledge test (TKT) students received a '1' for a correct answer and a '2' for an incorrect answer. Thus, a lower overall score meant more correct answers and implied greater
team knowledge. A paired t-test was run to examine if there was a significant difference between pre- and post-test scores. Results did not indicate a significant difference (t (1, 21) = -.29; p > .1)

Mean Overall Scores on Team Knowledge Test

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<th></th>
<th>Mean</th>
<th>N</th>
<th>Std. Dev</th>
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<tbody>
<tr>
<td>Pre-Test</td>
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<td>22</td>
<td>3.77</td>
</tr>
<tr>
<td>Post-Test</td>
<td>25.91</td>
<td>22</td>
<td>3.29</td>
</tr>
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Since the reliability coefficient of the TKT scale was not as high as those reported by the authors, we also examined differences between pre- and post-test scores for individual items using a Wilcoxon test, a paired non-parametric test. Results, again, did not indicate significantly greater team knowledge on any of the individual items.

A count of correct answers indicated that 54.5% improved from the pre-test to the post-test, 41.0% did worse and 4.5% remained the same. The average number of items correctly scored on the pre-test was 13.36 while the average number of correctly scored items on the post-test was 13.68.

Comparison of Pretest vs. Posttest Scores

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<th></th>
<th>N</th>
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<tbody>
<tr>
<td>Improved</td>
<td>12</td>
<td>54.5%</td>
</tr>
<tr>
<td>Same</td>
<td>1</td>
<td>4.5%</td>
</tr>
<tr>
<td>Worse</td>
<td>9</td>
<td>40.9%</td>
</tr>
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The TKT scale was meant to measure four domains: team process, decision making, communication, and conflict resolution, areas that are considered important for collaboration. Varimax factor analysis of both the pretest and post-test scores did not reveal any clear factor structure that reflected these domains.

In addition to the empirical data we collected we also observed the students during the class time allotted for them to work in groups. While a formal methodology was not used, some interesting observations were made. Overall students struggled with basic project management skills. This included day-to-day activities like setting meeting agendas, and progress updates, and the more overarching strategic skills such as looking for bottlenecks and dependencies and contingency plans for events like absent group members or missed deadlines. A significant number of students (although still in the minority) held paying jobs outside of school where they had been exposed to project-based work or some of the related activities like meetings and deadlines. These students seemed to have a better grasp of what needed to be done to manage a project. However, problems still arose when they got frustrated with other students who didn't have the same understanding or experience.

Another observation was that all students, even the business savvy ones, appeared to have trouble knowing how and what to communicate in the context of the project. One of the big problems seemed to be the lack of norms related to how much information to communicate and how often to communicate it and what tone to use. On more than one occasion when stalled teams were asked what the problem was they replied with something along the lines of "we sent the other team an email/JotSpot update and they did not get back to us."

Based on our observations it was clear that while the students did not have a problem with using technology itself (email, JotSpot, IM and others they used), they did have a problem using
technology to effectively communicate and work within and across groups. It appeared that transfer of effective use of ICT tools from one domain to the next (personal life to class team) is not a simple matter.

**Discussion**

Because of the small sample size used in this study (N=22), the results are not conclusive nor are they broadly generalizable. There are several possibilities for why no improvement was seen in the TKT scores and for the difficulties we observed. One possibility is that the TKT scale itself needs further development. Factor analysis of both the pretest and post-test scores did not reveal any clear factor structure. The scale was meant to measure team process, decision making, communication, and conflict resolution, areas that are considered important for collaboration. More work may need to be done to ensure that the scale actually measures these areas and that the items in the scale correlate with behavioral measures of these different domains of collaboration. However, we believe there are other, more significant, reasons for the lack of a significant difference between pre-test and post-test scores.

The lack of improvement between students’ pre and post-test scores in team knowledge and their observed difficulties could also be explained because of the absence of some specific interventions in the restructured curriculum. This absence may have been the result of two implicit assumptions that we made while setting up the course that then hindered the students from gaining more teamwork skills.

The first implicit assumption was that students' familiarity with various information and communication technologies would help them with inter- and intra-class communication and with the web-based tool we used for interclass communication. This assumption fails to acknowledge that a technology serves a larger purpose and in order for the technology to be used
effectively the larger purpose must be clearly understood. In our case the students did not have a
good grasp of the collaboration skills needed for the given project. Because of our assumption
we did not include any lessons or exercises to show the students how they could transfer their
existing ICT skills to the context of their group projects.

Our second implicit assumption was that students would get better at teamwork just by working
in teams. Unlike earlier studies that used this scale (Sims-Knight et al. 2002, Powers et al. 2002)
we did not specifically teach students these types of teamwork skills either by giving them
assigned readings on team skills or engaging them in team-building exercises. We created a
curriculum that required students to work on hands-on projects in teams, and supported them
with in-class time and communication technology, but it was not enough. The teamwork
assessment we used showed no improvement. This suggests that getting students together in
teams, however well supported, is not sufficient to help build their knowledge of how to
collaborate. Other research agrees with the idea that teams alone are not sufficient (Vik, 2001).

This second assumption led to a lack of directed interventions in the curriculum design: we did
not provide exercises or assignments focused explicitly on improving the teamwork knowledge,
skills and abilities of the students. There are three activities in particular that were not present: 1)
explicit teaching of knowledge and theory related to teamwork, 2) setting and discussing norms
and behavioral standards, 3) feedback on or formative assessment of the groups.

Teaching teamwork skills and theory at the beginning of the course would have set a foundation
for further practice and discussions of teamwork throughout the course. Making team-knowledge
an essential part of the course content and helping students practice this knowledge in team-
building exercises may be a necessary pre-requisite for success. However, it may be a necessary
but not sufficient requirement for students to learn teamwork. For example, Sims-Knight et al.
(2002) also found no difference between pre- and post-test scores on the TKT scale even though students had readings on effective team functioning, homework assignments on the readings and two team-building exercises.

Another necessary prerequisite may be norms. For teams to function effectively it is necessary for them to develop norms and expectations related to communications and feedback, set and monitor goals related to team product, manage conflicts, and develop effective team problem-solving skills. Norms and behavioral standards are important in any collaborative venture. They touch on how to behave in all four of the areas outlined by Stevens and Campion. In both personal life and in professional environments these norms are often well established in a culture. In the workplace people learn these norms through feedback from co-workers already familiar with them, bosses and customers. In an educational setting and especially in group projects in an educational setting there is not usually an existing culture to rely on and not the same opportunities for feedback. If norms are not established, modeled and brought up for discussion by the team and the faculty then they will develop in an ad hoc and not necessarily productive manner.

Feedback and formative assessment of adherence to norms and the performance of the groups are important for students to gain new skills. While people do internal checks of their own as they work in groups, relying on this informal self-assessment falls into the trap of our second assumption, that students will get better at teamwork just by being on a team. What is missing is a mechanism where students and groups are required to do self-assessment using more formal criteria and complete the assessment cycle by reflecting on the results, putting together an action plan for improvement and starting the cycle again. Faculty assessment of groups' collaboration skills would also be beneficial during the course of the semester. Sims-Knight et al. used a self-
assessment inventory they call the Team Process Check (TPC). Using the TPC the students scored their teams on processes, decision making, communication and conflict. However, students did not reflect on the results of the assessment and make a plan of action to improve team functioning based on the assessment. In their suggestions for improving the process Sims-Knight et al. suggest using the PTC in this way may have helped improve their students’ teamwork skills.

In short, we did not clearly explain what good teamwork was, show what good teamwork looked like in action, and give the teams opportunities for feedback, self-assessment (including reflection and action on the assessment) and assessment by the faculty on their teamwork skills during the course of their projects.

**Recommendations for the Future**

As previously mentioned, due to the small sample size and lack of significance in the test scores, we can not offer principles or conclusive results. However our results and experiences combined with the current literature lead us to offer two recommendations for those who plan to include technology-mediated collaborative projects in their teaching. The first recommendation is to recognize that it is not information and communication technologies alone that makes or breaks collaboration. It is in fact the underlying communication and project management skills in combination with technology skills that drive effective teamwork. Much has been written about the "digital native" students who are learning, playing and communicating in new ways through technology and their "digital immigrant" teachers who don't quite get it all (Prensky, 2001, 2005; McHugh, 2005). An implicit or explicit theme is that teachers need to "get with already" and master the new technologies. While we believe that keeping up with technological innovations is important, we feel that the race to keep up and the discussions it fosters hide the need students
have for more foundational, non-technical, skills and knowledge about collaboration. These core skills and knowledge are what allow students to effectively use their technological skills in academic and professional settings. It is great if students can set up a blog or wiki or post video online. But if they don’t know what is needed for good teamwork, then those technical skills alone will not help their teams function more effectively.

The second recommendation is to make teaching, practicing and assessing teamwork skills an important part of the curriculum. It’s not good enough to just put students in teams and hope for the best. If students are to improve their collaboration skills, those skills must be an explicit part of the curriculum. The following are three practical steps towards creating such a curriculum.

**Step 1: Provide Foundational Knowledge on Important Collaboration Skills**

The first step is to teach foundational knowledge of collaboration at the beginning of the course. Most traditional students entering college do not have much experience working in teams and therefore need to be provided with knowledge regarding how teams work and the skills that are salient to collaboration. One example of the kind of core knowledge to cover is the aforementioned four areas of team skills outlined by Steven and Campion (1994). The curriculum should cover how to make decisions, manage conflict, create communication networks, identify problems and develop solutions and develop decision making processes that allow all members to participate and voice their opinions. The teaching should also allow students to ask and answer questions such as: Is conflict bad? What happens when members have different goals and expectations? How do you facilitate creativity in a team? What is the best way to provide feedback? What tools can be used to facilitate team coordination?

**Step 2: Set Norms and guidelines on behaviors**
The second step is to set and model norms and behavioral guidelines. In order to be effective in team settings, members should be given norms, guidelines and training on what personal actions they can and should take to facilitate teamwork. Many students freeze at the first sign of conflict – they need to recognize when conflict is healthy and when it is not. Also they need to be shown what they can do to develop solutions and negotiate trade-offs to manage conflict. They need guidelines on when to practice brainstorming to generate good ideas and what criteria to use to short-list from these ideas. They need to be provided guidelines for consensus building, fostering trust and developing benchmarks for effective communications and coordination. These should be seen as a starting point for the students and not commandments in stone. Through the assessment process in the next step students should be able to evaluate and modify these norms.

Step 3: Weekly self-assessment process

The third step is to put in place a formative assessment process. This process should be based on the previous steps and also serve as a way to document the teams in action. Team processes are dynamic and it takes time for a group of people to emerge as a strong team. Thus, for teams to work well, it is necessary to assess and monitor both individual as well as team performance, setting group goals that are in congruence with individual goals. This assessment should also incorporate mechanisms for clarifying the norms and expectations of these team behaviors on an ongoing basis. Weekly documentation of team processes and decisions can be used for assessment purposes and allows the team to reflect on what works and what needs to be changed. Since these team dynamics underpin effective team performance, it is recommended that students be rewarded for completing these assessments. The weekly self-assessment can also be used by the faculty to monitor teams’ progress and can serve as a tool for intervention if a team falters.
**Conclusion**

Teamwork and collaborative skills play a vital role in today's workplace: a role that will only continue to gain in importance. In addition, information and communication technologies (ICT) have revolutionized the way collaboration happens. As educators we must prepare our students to enter this world. Many educators respond to this challenge by assigning team projects and collaborative exercises. While this is important, the results of this study indicate that simply putting students in teams and requiring the use of ICT will not make them, necessarily, better at teamwork. We recommend that the curriculum also includes explicit teaching, modeling and assessment of teamwork skills and knowledge.

**References**


