

**AC 2008-1463: GROUP COMMUNICATION VIA TECHNOLOGY FOR
ENGINEERING WORK: PERCEPTIONS ON EFFECTIVENESS**

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Group Communication via Technology for Engineering Work: Perceptions on Effectiveness

Introduction

Group work is an important part of the engineering curriculum as employers are stressing the need for future engineers to be able to work collaboratively with those both in and out of their preferred field. The use of technology in the classroom is also becoming a necessity as most students today have been immersed in technology since childhood and globalization is forcing engineers to connect to all parts of the World¹.

Engineers must become World-Class Engineers that are able to work with a wide variety of cultures in a collaborative setting from their own desk as the World is "flattening" through the effects of globalization and technology². The need for students to be prepared for collaborative work through technology brings about the question on just how does technology, such as email, instant messaging (IM), and text messaging, affect the group dynamic.

The traditional face-to-face collaboration for localized group work may be reshaped by the widespread use of technological communication³, such as IM. Most new college students are arriving to school already familiar with communication technologies. A recent Pew Internet and American Life Project study found that in 2004, 62% of the internet users between the ages of eighteen and twenty-seven had used IM⁴. This number will only continue to rise as the technology becomes more and more popular.

A trend towards the use of IM over face-to-face meetings is already taking place in the business world. In addition to personal use, 10% of the IM users in 2004 were business people⁵ and the Radicati Group predicted half the IM users to be business users by 2006⁴. The use of IM in the business world leads one to believe that students should be exposed to IM as a tool for group collaboration. However, inclusion of IM as a tool for group collaboration brings about other concerns that should be addressed.

One concern with the use of IM for group work is how this technology will affect the traditional group dynamic. If the students use IM heavily, will the face-to-face meetings cease to exist? If this is the case, will it defeat the purpose of exposing engineering students to the experience of group work that employers say is a necessary skill?

Another concern is how different students will react to and perceive the use of the technology. Gender and learning style are two differences that may play a key role in how students feel about using technology as a collaboration tool, and thus should be addressed. Gunawardena and Boverie⁶ found that student satisfaction varied according to learning style when using computer-mediated classes. Chou and Wang⁷ studied learning during homepage design training and found that the learning style was a significant factor in the scores for different tasks. These results are enough to draw concern that if technological collaboration tools are a necessity for tomorrow's engineers, these differences should be addressed to determine how all students could benefit.

The purpose of the research is to assess how engineering students perceive the use of communication technology during group work, the current use of communication technology by students, and how technology may affect the traditional interactions of localized group work. The more specific goals are to understand how different learning styles feel about the use of technology for group work and to determine if there is a difference between genders. These goals will be addressed through four research questions: (1) What are the current technologies available for collaboration during group work and which of these students use? (2) Does the use of technology take away from the traditional face-to-face group work or does it enhance the experience? (3) Is there a difference among students with different learning styles on the use of technology and group work? Does it affect the learning of those individuals? (4) Is there a difference due to gender on the use of technology and group work? Does it affect the learning of those individuals?

Methodology

Research questions, indicated above, require a comprehensive multi-method data collection. The data collection and related results will be presented in a series of publications. This paper is the first in the series. Below first we summarize plans for data collection and related instruments for the comprehensive study. Then, we provide details on the completed pilot study.

Overall, students will be asked, through surveys and focus groups, what type of technological communication, if any, they currently use to complete group work, if they have had any experience with remote group work, and their perceptions on incorporating group work through technology into the engineering curriculum. These data will indicate the level of technology already in use by the students and if they feel it would be beneficial to their education. Comparisons will be made based on the students' learning style and gender. This will help determine if differences between these groups need to be addressed when implementing technological communication into in-class group work.

A survey on the use of communication technology will be distributed to all students in the College of Engineering at The Pennsylvania State University. This survey will indicate how frequently students use tools such as instant messaging and text messaging in both their social and school lives. Students will also be asked about the requirement of using communication technology in their classes. The students will be asked to list the courses in which they use communication technology to separate the use in engineering courses from the use in general education courses.

The survey results will be examined for the use of communication technology among all engineering students as well as for predetermined groups. Differences between engineering disciplines, class levels, gender, and learning styles will be investigated to determine if there may be gaps in the use of technology among these groups. The difference between the use of technology for social communication and class project communication will also be explored.

Focus groups will be conducted to explore how students perceive the introduction of communication technology, such as IM, into the curriculum. Ideas on how best to implement the technology will also be gathered from the students. This information will then be used in a

second phase of the research where groups will be required to use technology to communicate. The behavior and class outcomes from students in classes that are taught both on-campus during the regular school year and online during the summer session will also be examined.

Pilot Study

The survey, which was designed for the pilot study, was distributed to a group of 15 engineering students. The 15 students are all enrolled in an Engineering Entrepreneurial course for the current semester (Spring 2008). This class was chosen based on availability and the fact that the class consists of a diverse group of students and requires group work. The survey included questions on the frequency of technological communication usage such as instant messaging and text messaging in both their social and school lives. The students were also asked which technology tools they use during group work and which they believe would be most useful, effective, and efficient. Students were also asked about the requirement of using communication technology in their classes.

The pilot survey results were examined for the use of communication technology among all subjects as well as for differences between class levels, gender, and major to determine if there may be gaps in the use of technology among these groups.

Results

Fifteen engineering students were included in the study pilot group. All the students were male; therefore, no analyses on gender differences could be made. The group consisted of seven 2nd year students (sophomores), four 3rd year students (juniors), and four students in year four or above (seniors). There were six Civil Engineering students, four Mechanical Engineering Students, and five students in other engineering disciplines (Industrial, Aerospace, Computer Science, and general).

All but three of the students (80%) use IM to communicate with their friends in a social setting as well as a communication tool for class work. However, the three students not using IM in a social setting were not the same three that do not use IM for school. The most common instant messaging program for both settings is American Online Instant Messaging (AIM) with 100% of those students who use instant messaging in either a social or class setting using AIM. Six other programs are also used including Facebook, which is used by three of the students surveyed. Although the same percentage of students use IM both socially and for school, students spend an average of 1.5 hours more using IM to talk to friends than for class work. When comparing students based on school year (Figure 1), the greatest difference in time is seen in the 3rd year students (slightly over 2.5 hours) while the 4th year students show the least difference in time (slightly over 0.5 hours). Comparisons between majors (Figure 2) show the “other” group has the greatest difference in time spent using IM at 2 hours while the Mechanical Engineers indicate a difference of only a little less than 1 hour. However, none of these differences in time spent using IM are significantly different for the pilot group.

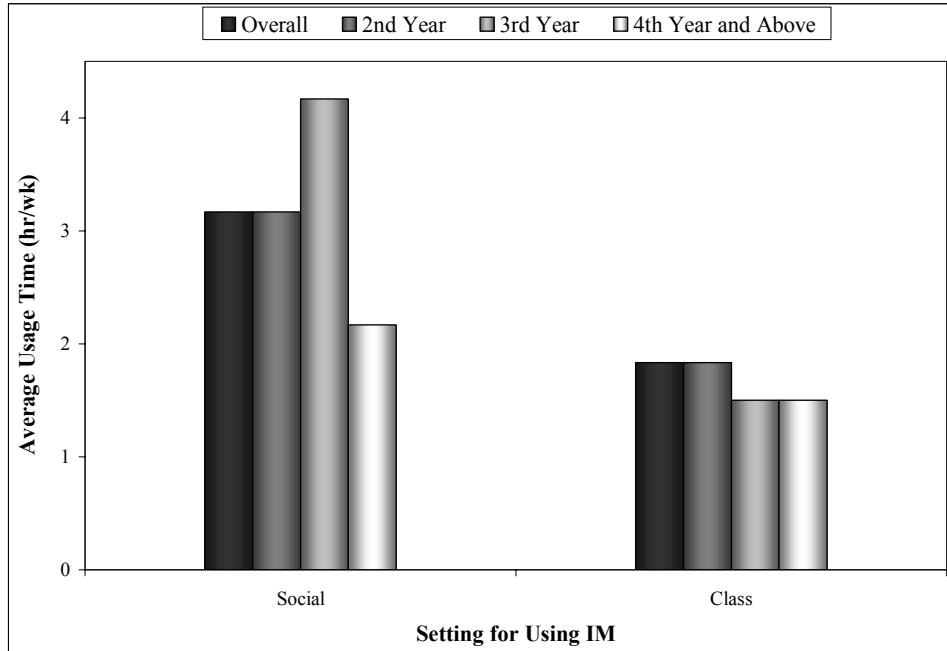


Figure 1 Average time using IM in social and class settings: school year

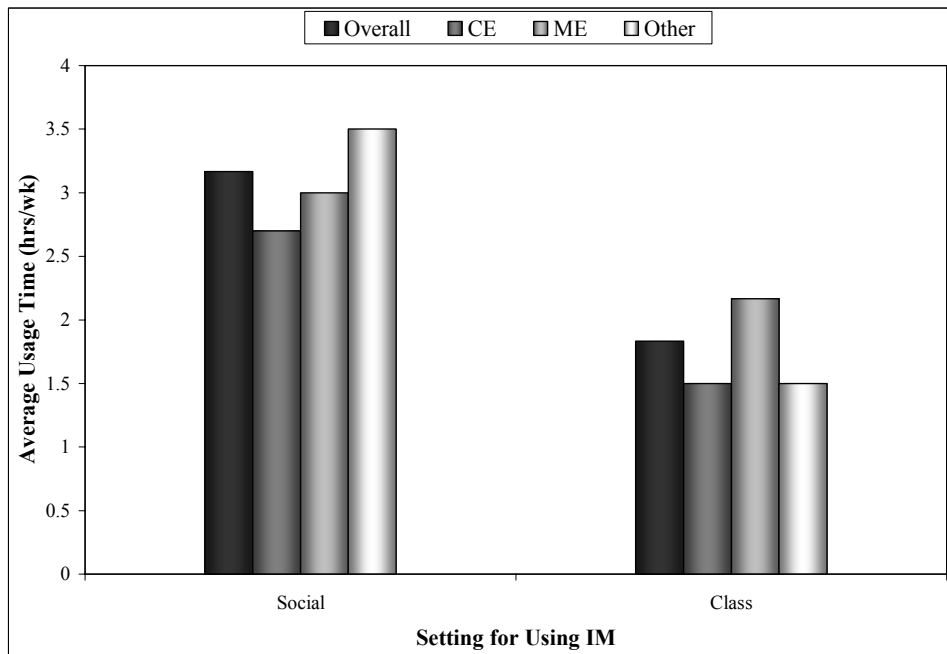


Figure 2 Average time using IM in social and class settings: major

The students were also asked what types of communication they use when conducting group work at school. The choices were face-to-face meetings, instant messaging, ANGEL (course management program at Penn State), phone (voice), text messaging, or email. All the students responded that they use face-to-face meetings, the phone (voice), and email to communicate for group work. The least used form of communication is ANGEL at 33% usage, while IM and text messaging are used by 80% and 93% of the students, respectively. The 2nd year students use

ANGEL the least (0%) while the 3rd year students use IM and Text messaging the least. When examining students according to major, the Mechanical Engineering students use ANGEL the least (0%) while IM and text messaging are used the least by the Civil Engineering students.

The average frequency of usage (times used per project) for each type of communication can be seen in Figure 3 for school year. Email is the most frequently used form of communication for all students and groups except for the 3rd year students, which use face-to-face meetings just as frequently. It appears that the average face-to-face frequency steadily increases the longer the students are in school. ANGEL is used the least frequent with an overall average of less than once per project. IM is the second least used form of group communication with an overall frequency of less than twice per project. The 2nd year students appear to use IM more than the other students surveyed, although this difference is not significant. ANOVA and paired t-test analyses indicate that the only significant difference when comparing school year is between the 2nd year students and the seniors when using ANGEL. When comparing the overall frequency of using each type of communication, analyses show that IM and ANGEL are used significantly less than face-face meetings, the phone, and email.

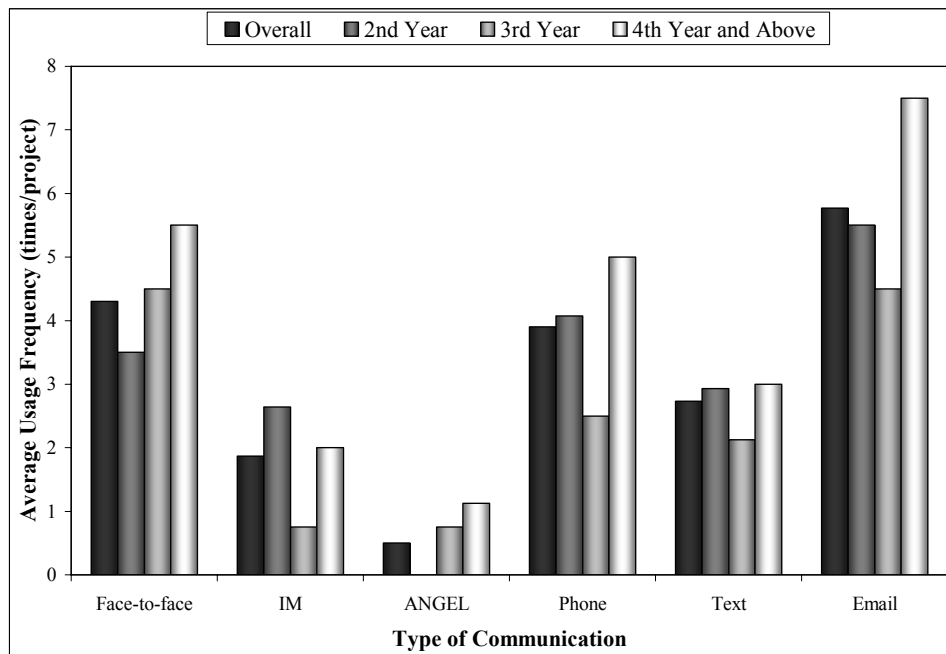


Figure 3 Average usage of group communication per project: school year

The average frequency of usage for the different majors can be seen in Figure 4. Email is once again the most frequently used form of communication for all groups. The second and third most frequently used forms of communication, face-to-face meetings and the phone, are used more often by the “other” majors than the Civil or Mechanical Engineers. ANGEL is used the least frequent with an average of less than 1 time per project for all groups. IM is the second least used form of group communication with less than two uses per project for all groups except the Mechanical Engineers, which use IM an average of three times per project. There were no significant differences found between majors, only those associated with the overall ratings mentioned earlier.

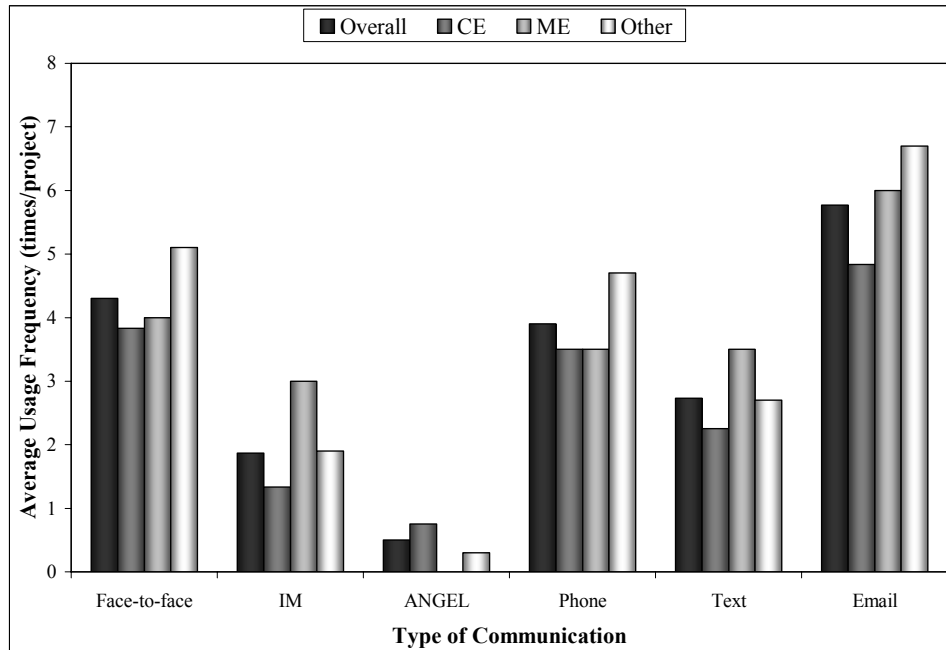


Figure 4 Average usage of group communication per project: major

For each of the five technological communication methods, the students were asked how important it is to learn how to use each method for group work communication. Students ranked the methods on a scale from zero to four, with zero being not important at all and five being extremely important. The results for differences between school years can be seen in Figure 5; there were no significant differences in the pilot study. All groups may feel that it is most important to learn to use email and the phone for communication. Although students overall possibly feel it is least important to learn to use ANGEL, the 3rd years believe it is more important than IM and text messaging. It appears that the seniors think learning to use IM, ANGEL, and text messaging are all of the same importance.

The results for differences between majors (no significant differences) can be seen in Figure 6. As with the results from school year, all groups seem to feel that it is most important to learn to use email and the phone for communication. The Civil Engineering students appear to believe it is more important to learn to use ANGEL than IM or text messaging, while the Mechanical Engineers and “other” group may feel IM is more important than ANGEL or text messaging.

Students were also asked how effective (Figures 7 and 8) and efficient (Figures 9 and 10) they thought each method is for group work communication, with a response of zero relating to not effective or efficient at all and a response of four relating to extremely effective or efficient. Similar patterns are seen when dividing the students into school year and major. Students responded that using email and the phone are the most effective for group communication followed by text messaging and IM with ANGEL once again ranked lowest. Although the students also believe email and the phone are also the most efficient forms of communication technology for group work, most believe IM is almost just as efficient. No differences were shown to be significant for the pilot group.

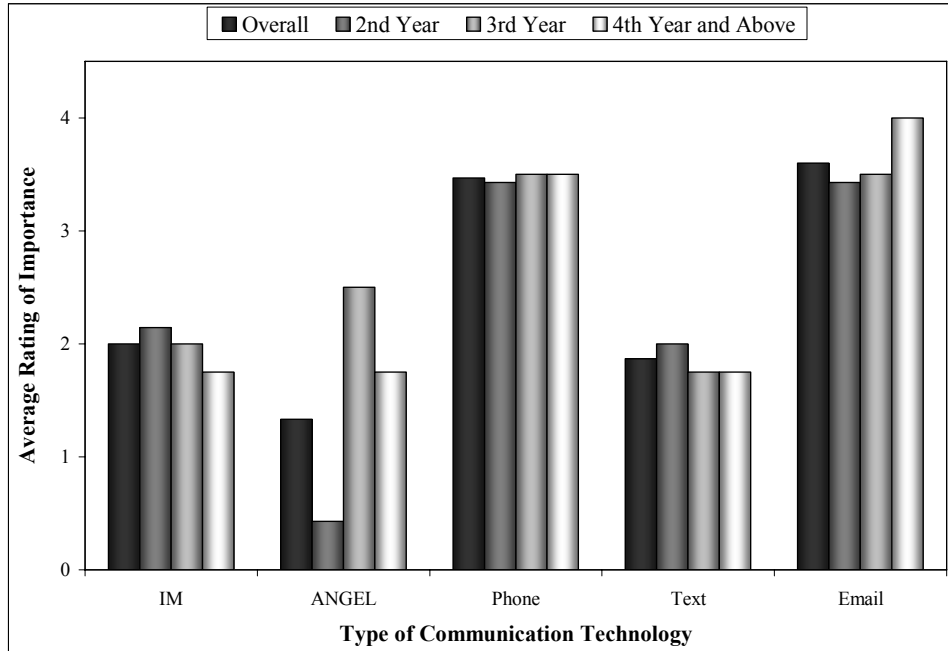


Figure 5 Average rating of how important it is to learn to use communication technology for group work: school year

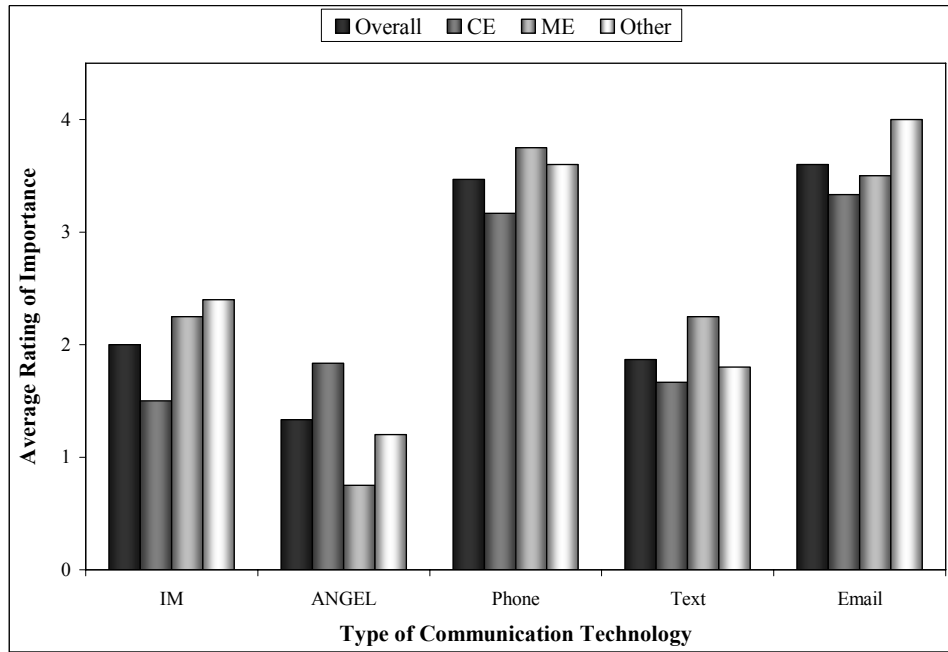


Figure 6 Average rating of how important it is to learn to use communication technology for group work: major

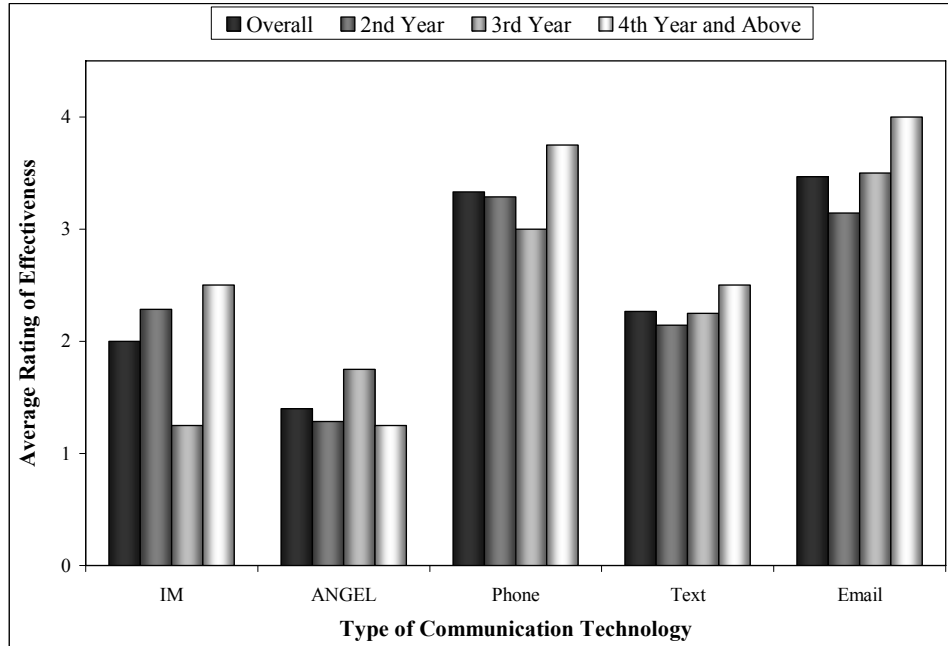


Figure 7 Average rating of how effective communication technology is for group work: school year

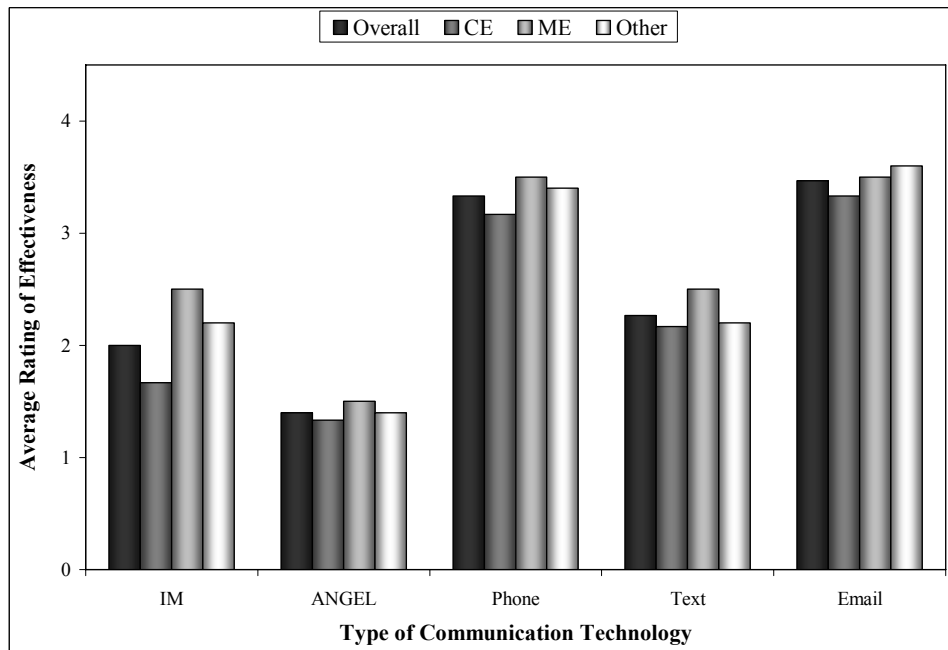


Figure 8 Average rating of how effective communication technology is for group work: major

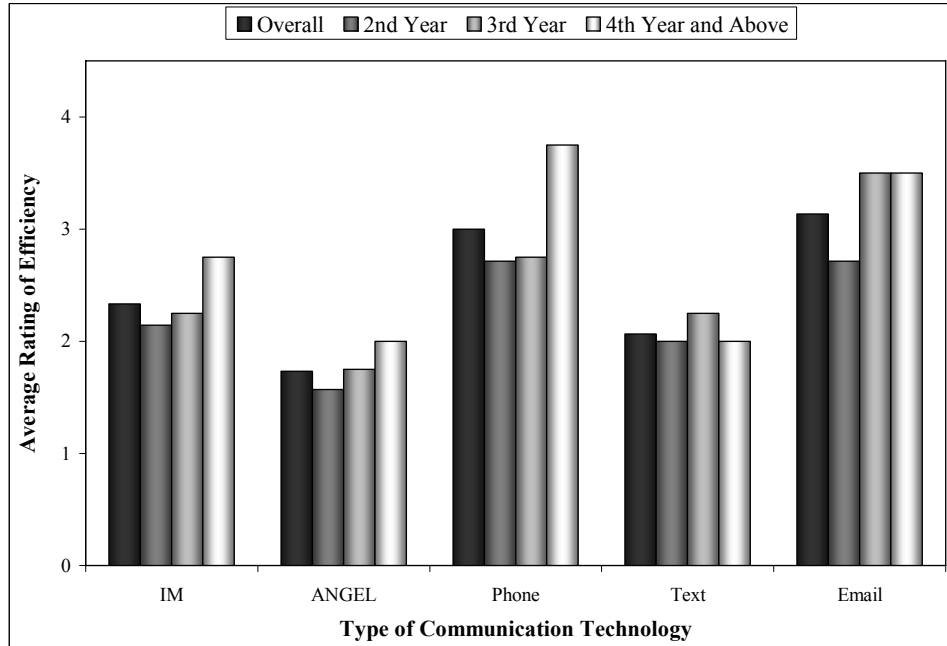


Figure 9 Average rating of how efficient communication technology is for group work: major

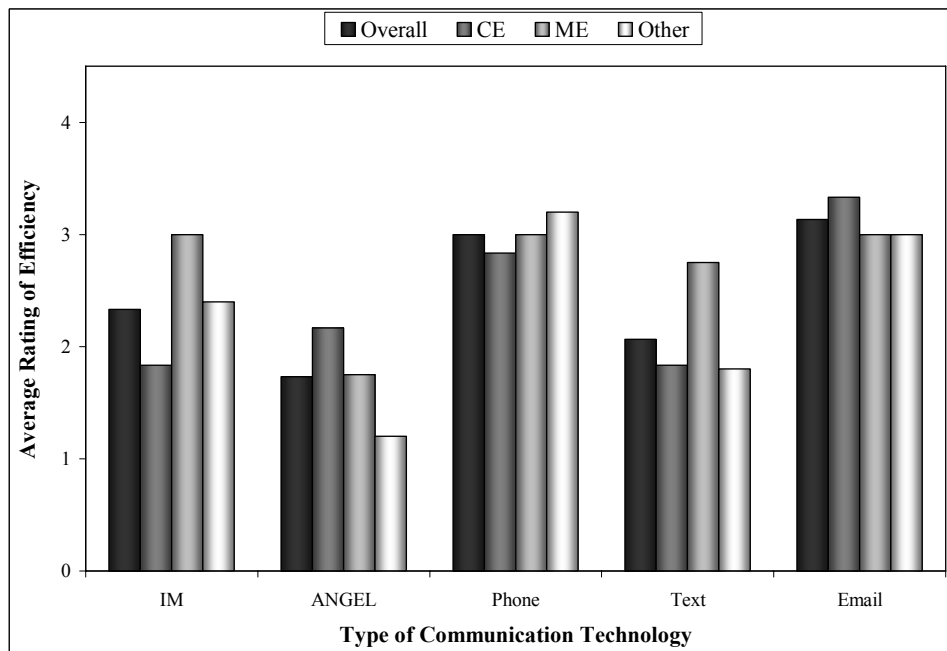


Figure 10 Average rating of how efficient communication technology is for group work: major

Further results currently being collected will further indicate how frequently students in the College of Engineering use technological communication in their group work and whether or not this is a result of personal choice or a course requirement. The findings also hope to show whether students believe they will use communication technology in the workplace, and their perceived readiness for it as well as if they would like it implemented and practiced in the classroom.

Discussion

The responses from the pilot group show that, while all the students have face-to-face group meetings, they are also using technological methods to communicate. However, while engineering students use technological communication on a regular basis, they do not feel all methods are conducive to successful group communication. ANGEL consistently ranks last among the students. This may be due to the idea that ANGEL is thought of strictly as a website for course material and not a way to communicate with group members. Further questions related to the utilization of ANGEL and the reluctance to use it for group work will be explored in future surveys as well as the focus groups.

In the case of IM, students use the method for both social and class communication but tend to use it less frequently for group work. However, this may simply be due to students using IM to talk to their friends in their spare time, which may occur more often than they need to talk to group members. In terms of importance to learn how to use IM for group communication, the students feel that IM is one of the least important methods. It could be thought that this is because students already know how to use IM and do not feel they need to be instructed on its use, but the students rated email and the phone as extremely important. This indicates that the students do not see how IM would be beneficial to group work or how it may benefit them in their careers. Examples of IM use in industry may demonstrate to the students that IM is indeed a skill they will need to master to become World-Class Engineers.

Although the students do not believe IM may be an important method of group communication, they do feel it is just as efficient as email and the phone. These findings may indicate that students feel they can use IM to get work done in a timely manner through all these methods, or that email and the phone have their problems, too. Further research will explore the idea that students think IM is efficient but not effective or important.

When asked about the impact of technology on student learning, the students feel technological communication will improve overall group work, but can never replace face-to-face meetings. The consensus is that the main advantage of the use of technology is that it allows information to be shared more easily and quickly. Some students believe that using technological communication for group work would improve the overall communication skills of each student, and prepare them for their future in the workforce. However, the students did indicate that the group members must be on the same page in order for the experience to be beneficial.

Future data on actual group interactions for on-campus and online classes should allow a better understanding of how technology affects the group dynamic in engineering classes. The students' learning styles will be explored in the class studies to determine if the usage and acceptance of technological communication differs among the styles and should be addressed when incorporating technology into group work. The use and acceptance of the different communication technologies will also be examined among genders, as this was not possible for the pilot group.

Conclusion

The pilot study of the study indicates that engineering students are currently using technological communication for group work, but possibly only as a supplemental tool. Globalization is forcing many engineers to work with others in different cities, states, and countries where face-to-face meetings may not always be viable; thus, learning to communicate effectively through technology will be an essential skill for the future engineer.

Acknowledgements

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