

The Pennsylvania State University
The Graduate School
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**THE EFFECT OF TEAM EXPERIENCE ON COLLABORATIVE
INFORMATION SEEKING BEHAVIORS OF STUDENTS**

A Thesis in
Information Sciences and Technology

by
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Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Master of Science

December 2009

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ABSTRACT

Information seeking has primarily been viewed as an individual not collaborative activity. This has led to models and systems that focus on individual information seeking. However, collaboration is becoming increasingly prominent in organizational settings. Yet, we are still in the early stages of understanding collaborative information seeking (CIS) behavior. Consequently, it is important to develop a more detailed understanding of CIS behavior in order to support this behavior through the development of appropriate processes and technologies.

Information seeking is an important aspect of student teamwork. In this thesis, the relationship between experience working in teams and CIS behavior is examined through a survey given to students in three IST 301 classes in Fall, 2007. Through the survey, I examine whether the level of experience that students have working in teams affects their communications methods and information source preferences among other features during CIS activities. I found that the most used communication method during CIS is face to face (f2f) communication and the most frequented source of information is the Internet. I also found that the level of teamwork experience of students did not affect communication or source preferences nor did it affect the obstacles that students may face during CIS activities. This study improves our understanding of CIS behavior in an educational setting and can also help inform designers developing collaborative information retrieval (CIR) tools.

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ACKNOWLEDGEMENTS

I am heartily thankful to my thesis advisor, Madhu Reddy, whose constant encouragement, guidance, support and reassurance right from the beginning to the end of this process enabled me to develop a thorough understanding of the subject. Without Professor Reddy constantly keeping me on track, I would not have been able to complete this thesis and for that I am extremely grateful.

Lastly, I would also like to thank and acknowledge all those who supported me in any respect during the completion of this thesis. I would especially like to thank Tricia Spence and Phil Ayoub in always being available to help out or properly guide me in the right direction.

Yusuf Raza

Chapter 1

Introduction

1.1 Introduction

Individuals in organizations are working increasingly in teams and groups to perform tasks and tackle problems. This is especially true of students in the academic domain. Projects are being assigned more frequently to teams of students rather than to individuals because collaborative groups have “higher levels of self-efficacy regarding the achievement of tasks because they are challenged by group members to cope with difficulties and to persevere” [1], group activities encourage students to display greater basic value of the subject matter or the task to be fulfilled and peer support can lead to positive motivational impact for learning [1]. As these students work increasingly in teams, collaborative behaviors such as information seeking are becoming more prominent. Behaviors such as information seeking are critical in organizations because gathering the right information can determine the success of a project or task. According to Milewski, “information-seeking is a critical aspect in the work of many productive teams as it includes behaviors associated with actively acquiring information required to accomplish some task” [2]. Therefore, to better understand collaborative information behavior, this study will examine the collaborative information seeking behaviors of student teams.

1.2 Definitions Used in Study

Before examining the process of collaborative information seeking, the terms used throughout the study need to be defined.

Collaborative Information Seeking: There is no single definition for CIS but for this study the following definition is used: “Collaborative information seeking can be defined as two or more people working together to find the needed information” [3]. This definition is used because there are two important ideas central to CIS present in this definition. These are 1) the concept of collaboration in that there are multiple people involved in the activity and 2) a perceived information need in that there is a need for certain information that causes individuals to engage in information seeking behavior.

Social Interaction Factors: This refers to interaction amongst individuals, specifically, “patterns of connection and interaction” [4]. Examples of social factors include communication, presence issues, and culture of team.

Contextual Factors: This is defined as issues arising from a particular circumstance. Examples of attributes used to describe a context include place, time, competition, tasks, situations, organizations, and types of participants.

Affective Factors: These are the emotions and feelings that affect individuals or groups of individuals. A few examples of what are considered affective factors include belief, comfort levels and trust factor.

1.3 Motivation

Information seeking and retrieval are commonly perceived primarily as individual processes [5-7]. Talja stated that research and theories have traditionally focused on the individual as a seeker and user of information [7]. For instance, models encapsulating information seeking such as Wilson's 1996 [8] and Kuhlthau's Information Search Process (ISP) model [5] have focused solely on the individual seeker. Furthermore, there have been several studies examining individual information seeking behavior in various contexts [9-12] yet, only recently have researchers started focusing on collaborative information seeking [13-15]. Additionally there have only been a few models that have explained collaborative information seeking behavior such as the model developed by Reddy and Jansen [16] and the model developed by Hyldegard [17] which extends Kuhlthau's ISP model.

Collaborative information seeking (CIS) is a relatively new area in the field of information behavior, primarily because the majority of studies have traditionally focused on individuals instead of groups or teams [7, 16]. Additionally, since collaboration is largely an interactive process dependent on communication, the advance in communication technologies has allowed collaborative behaviors to become a more prominent feature in day-to-day activities. This has led to researchers to increase their focus on examining collaboration and collaborative activities. Researchers are taking multiple approaches in understanding CIS behavior that include looking at aspects of CIS such as sources used, communication methods preferred, examining the models from individual information seeking to see if they fit CIS and examining the manifestations of

collaboration during information seeking [17, 19, 20]. Hansen and Jarvelin have stated that another way to gain a deeper understanding of CIS is by examining factors which affect CIS [20]; which is the method used in this study.

In the present study, the collaborative information seeking behavior of members of student teams was examined. Information seeking is one of the many important activities students engage in to be successful. As a result, there have been numerous studies examining the information seeking processes of individual students. An example of such a study includes one conducted by Myers [18] in which he examines the student's information seeking strategies and how they are affected by perceived verbal instructions of professors. However, classrooms are now increasingly encouraging teamwork and collaboration and although collaboration is becoming more prominent in classrooms, there have only been a few studies that have examined the collaborative information seeking behavior of students [17]. Collaboration is an important aspect of teamwork [4] and since students are increasingly encouraged to work in teams, this study will examine CIS by determining if the teamwork experience of students affects CIS behavior. By examining and understanding the CIS behavior of students, it will allow for the increase in support of CIS behavior which will then help better prepare them for their future careers.

1.4 Research Approach

This study intends to investigate the effect team experience has on CIS activities of student teams. The following research question will be investigated in this study:

1. *Does the past teamwork experience of students play a role in their CIS behavior?*
 - a. *Does teamwork experience affect the communication preferences of students during CIS?*
 - b. *Does teamwork experience affect the source preferences of students during CIS?*
 - c. *Does teamwork experience affect the various affective, contextual and social obstacles that students may face during CIS?*

1.4.1 Null Hypotheses

Considering the above research questions, the following null hypotheses were posited to be tested:

1. Communication Methods
 - a. *There will be no significant differences between the uses of IM among students with different experience levels.*
 - b. *There will be no significant differences between the uses of F2F among students with different experience levels.*
 - c. *There will be no significant differences between the uses of telephone among students with different experience levels.*
2. Source Preferences
 - a. *There will be no significant differences between various source preferences used by students with different experience levels.*

3. Contextual Factors

- a. *There will be no significant difference for 'time as a deadline' between students with different experience levels*
- b. *There will be no significant difference for 'competition amongst teammates' between students with different experience levels*
- c. *There will be no significant difference for 'geographically dispersed teammates' between students with different experience levels*
- d. *There will be no significant difference for 'outside factors' between students with different experience levels*

4. Social Interaction Factors

- a. *There will be no significant difference for 'multiple deliverables' between students with different experience levels*
- b. *There will be no significant difference for 'lack of shared vision' between students with different experience levels*
- c. *There will be no significant difference for 'lack of communication' between students with different experience levels*
- d. *There will be no significant difference for 'presence between students' with different experience levels*
- e. *There will be no significant difference for 'pressure between students' with different experience levels*
- f. *There will be no significant difference for 'culture between students' with different experience levels*

- g. *There will be no significant difference for 'power struggles between students' with different experience levels*
- h. *There will be no significant difference for 'lack of integration in teams' between students with different experience levels*
- i. *There will be no significant difference for 'team conflict' between students with different experience levels*
- j. *There will be no significant difference for 'difference in understanding by students' between students with different experience levels*
- k. *There will be no significant difference in 'expert students' between students with different experience levels*
- l. *There will be no significant difference in 'sharing of expertise in teams' between students with different experience levels*
- m. *There will be no significant difference in 'equal participation of teammates' between students with different experience levels*
- n. *There will be no significant difference in 'working with novices' between students with different experience levels*

5. Affective Factors

- a. *There will be no significant difference in 'lack of caring' between students with different experience levels*
- b. *There will be no significant difference in 'belief in communication technologies' between students with different experience levels*
- c. *There will be no significant difference in 'working with experts' between students with different experience levels.*

1.4.2 Approach

To test these hypotheses, members of student teams in a class in the College of Information Sciences and Technology at The Pennsylvania State University were surveyed. An online survey was used to collect the necessary data from the students. The survey was used to collect data about the process of CIS by asking questions regarding technology used, communication methods used, sources preferred and factors affecting CIS. The hypotheses were then tested by running multiple statistical tests on the survey data.

The outcomes of this study will highlight whether team experience affects aspects of CIS behavior. This study will contribute to the growing research conducted on CIS by highlighting the importance of team work and team experience on CIS behavior of student teams.

1.5 Thesis Overview

The thesis is organized as follows:

Chapter 1-Introduction: Collaborative Information seeking is introduced and the problems associated with not studying it.

Chapter 2-Background: Past literature is discussed collaborative information seeking.

Chapter 3-Methods: Techniques used for data collection and analysis are discussed. A description of the sites and participants is also discussed.

Chapter 4-Results: A presentation of the results as found through the data analysis is given.

Chapter 5-Discussion: A discussion of the results and what they mean in the context of the study.

Chapter 6-Conclusion: Briefly summarizes findings and thoughts for potential future work.

Chapter 2

Background

2.1 Introduction

Studies in information seeking have primarily focused on the individual as the information seeker. Consequently, tools and technologies supporting information seeking have mainly focused on the individual during information seeking. Due to the increase in prominence of people working together in teams and collaborating, researchers are focusing more on examining collaborative information seeking behaviors [16, 17, 20]. In information seeking research, there have been numerous methods used to gain a conceptual understanding about the behavior. Researchers have created models, examined components that make up information seeking such as source preferences and have designed tools and technologies that aim to support and facilitate the behavior. One way to gain a deeper understanding of CIS is by examining the factors affecting CIS. This study determines whether team experience is a factor affecting the CIS behavior of student teams.

To provide a foundation for the current study, a review of literature in the following areas is presented in this chapter: collaborative information seeking behavior and teamwork of student teams.

2.2 Collaborative Information Seeking

The research in collaborative information seeking is constantly growing. Collaborative information seeking differs from individual information seeking in that individual information seeking is characterized by one person seeking information whereas CIS is characterized by multiple people working together to seek information [16, 18, 20, 21]. Therefore, communication plays a very important role during collaborative information seeking. As a result, researchers have examined the communication preferences during CIS [13]. Furthermore, the choice of source during CIS can determine the success of finding information, thus understanding source preference is important and there have been numerous studies that have examined the preference of sources [7, 10, 11]. Furthermore, Hansen and Jarvelin have stated that another way to understand CIS is by examining the factors that affect CIS behavior such as affective, social and environmental or contextual factors [19]. The following sections review CIS studies that have examined the communication preferences, source preferences and the factors or obstacles affecting CIS behavior.

2.2.1 Communication Preferences during CIS

Collaborative information seeking depends on the successful communication between participating individuals otherwise CIS would not be possible. Communication methods are typically separated into two categories: asynchronous and synchronous [22; 23].

Asynchronous communication methods are defined by non-instantaneous communication such as email, fax, or snail mail [24; 25; 37]. Synchronous communication methods are

defined by their instantaneous communications such as face to face meetings, instant messaging or telephone [24, 25].

Research in communication preferences during CIS have examined the type of communication methods preferred. In a survey of collaborative information seeking practices of academic researchers, Spence et al. [13] found that traditional methods such as face to face, phone and email were the preferred means of communication during CIS. Face to face communication was also the preferred method of communication in a study of two healthcare teams, one in the SICU and the other in ED [15, 16]. In this context, face to face was preferred because of the fast-paced work that is typically conducted in these two departments. Furthermore, since team members were physically co-located, face to face was the most convenient choice of communication.

It is interesting to note the common traits in these studies. First the methodology used to gather data in a majority of these studies has been via qualitative methods, either via interviews or observations. Secondly, all these studies have determined that during collaborative information seeking the preferred way of communicating is via face to face meetings and using synchronous communication over asynchronous communication methods. The reasons that are generally stated are the speed with which the communications occur and the convenience and ease in setting up a face to face meeting.

2.2.2 Source Preferences during CIS

During information seeking, sources must be carefully chosen as the choice of source can affect the success of the information gathered. Over the years, sources of information

have increasingly progressed towards digital media such as the internet and electronic articles. This has led to more information being available at a faster more convenient rate. The shift to digital information has also led to several alternative options in sources that were previously not available. Information seekers now do not only have to rely on paper media or libraries but can now also now access almost limitless information from the Internet all from a convenient location. Sources have been put into two categories: formal and informal [7; 11]. Formal sources are defined as books or articles whereas informal sources are defined as information gathered from people. Research in CIS have examined when individuals use one source over another and the reasons behind the choice.

Examples of such studies include one conducted by Talja where she found informal sources and channels during information seeking are preferred over formal sources as they save time and energy [7]. Additionally Bruce, Fidel et al. [21] also found the use of informal sources as the preferred source of information in their study of design teams. They found that during collaborative information seeking, design teams often relied on each other for their information needs. This highlights the importance not only of informal sources but also use of own teammates as a source of information.

Further examples of using teammates as an informal source of information was found in a study conducted by Reddy and Dourish [27]. They found that during collaborative information seeking the first resource used in a surgical intensive care unit was team members because team members were right there and information seekers could just query their teammates [27]. Hansen and Jarvelin further investigated the manifestations of collaboration in information retrieval (IR) in the patent domain [20].

They found that human collaborative activities “show a pattern that comprises of asking colleagues both internally and externally regarding experiences, and search strategies” [20].

These studies have shown that, the use of informal source is prominent during collaborative information seeking. Furthermore, these studies have also shown that during collaborative information seeking individuals rely heavily on their teammates thus highlighting the value in reliability of teams and teamwork during CIS.

2.2.3 Factors Affecting CIS

Along with examining the communication and source preferences during CIS, researchers have also examined the factors affecting CIS. Studies have examined various contextual, affective, cognitive and social interactive factors that could potentially affect CIS [26]. Examining these factors can not only help in better understanding CIS behavior but also help in the design of better tools and technologies to support the behavior.

Hyldegard examined the CIS behavior of a group of students to see if they followed the stages identified in the ISP model developed by Kuhlthau, which was based on individual information seeking [17]. She found that “work task-related and social activities seem to dynamically affect the outcome of the process, both cognitively and emotionally” [17]. A major finding of this study was the role social dynamics had on the outcome of information seeking. During collaborative information seeking there are multiple people working together and interacting to seek the information rather than just the individual. Therefore, these individuals now have to be aware of the affect they have on each other

and the roles they play. Furthermore, Hyldegard found that since there are multiple people working together to seek information, “work tasks and its effect on students are more complicated in a group-based setting” [17]. This means that as more people get involved, the more complicated the work-tasks become. Work-tasks, context, and social factors affecting information seeking were further examined in other studies, such as Prekop’s study which described the collaborative information seeking behaviors performed by a working group created to perform the command control support study [28]. Similarly, Sonnenwald and Pierce also studied information behavior in command and control context [6]. Two themes related to factors affecting CIS were found through their study. The first was an interwoven situational awareness-essentially a shared understanding of the situation by everyone involved in the task at hand. The second was having a dense social networks basically frequent communication between participants about work context, situation work process, and domain-specific information. Both these studies described the importance of roles and social networks when individuals worked together to seek information

In their investigation of CIS, many of the previous studies have highlighted the importance of work-tasks on collaborative information seeking. Reddy and Dourish further highlighted the importance of work-tasks in information seeking by investigating this process in the SICU [27]. They found that the “process of information seeking and providing are seamlessly interwoven with other working activities” [27]. This study examined the importance of work-tasks which in turn highlighted the importance of interaction, which was found to be an integral part of the SICU and collaborative information seeking in general.

These studies have shown that when multiple people work together to seek information, individuals have to be aware of more than just themselves. They have to take into account their surroundings, their teammates feelings and emotions and the effect it has on everyone. Therefore, during collaborative information seeking it is extremely important to understand that there are several factors in place to consider for successful CIS to occur.

2.3 Teamwork and Collaboration

In organizations, work is increasingly being performed in teams or groups. Rarely now do individuals work independently in these settings. According to Reddy and Spence “these teams are critical to an organizations ability to implement its goals” [29]. Researchers are now increasingly studying collaborative behaviors of teams in various contexts such as education, medical, military and engineering [6, 27, 30, 31].

Collaboration in teams requires effective teamwork. According to Lessard, Morin et al “all team members must ensure functional modes of communication, common objectives, awareness and acknowledgement of each members contributions; mutual confidence and respect; and consensual and legitimated leadership” for effective teamwork to occur which would then facilitate effective collaborative behaviors [41]. Teamwork also facilitates collaboration in student teams by providing students with access to many different learning, working and writing styles, which then allows students to gain a deeper understanding of collaboration generally [42, 43].

However, according to Van den Bossche et al [44] successful collaboration is not merely a case of putting people with relevant knowledge together but also understanding the factors that make up successful collaboration. It is necessary to understand the factors that affect collaboration so as to be able to potentially control these factors to allow for more effective behavior. In this study, the factor examined is the student's past teamwork experience and its effect on collaborative information seeking behaviors. As students increasingly work in teams and move from one team to another, they gain experience with teamwork. These students are then influenced by their past teamwork experience in their future or current teams. Furthermore, team members that have previously worked together are more effective at teamwork than ad-hoc teams [45]. According to B.J. Alge et al [45], individuals with greater experience working with people ought to be able to communicate more effectively than ad-hoc teams. Mathieu et al [46] state that the experience of a team member expands a team's capacity for effective communication and interaction. Finally, researchers have also stated that experienced teams are more likely to have a more developed shared mental model allowing them to make more accurate decisions and work more effectively in teams [46].

These studies show that as the experience of team members and teams increases, teamwork becomes more effective. This study determines whether the past teamwork experience of students in student teams affects aspects of collaborative information seeking behavior such as communication preferences, source preferences and if it affects how students manage obstacles to CIS.

2.4 Summary

Researchers have primarily examined information seeking by looking at the individual as the seeker. There have been numerous studies of individual information seeking of students and scholars in the education domain. However, recently researchers have started to look at groups or teams of people and their information seeking behaviors. Collaborative information seeking is being studied in multiple domains from the military to the education world. Nevertheless, CIS is still largely in the very early stages of comprehension.

Studies examining CIS do so by studying the components that make up CIS such as the communication preferences, the source preferences, and the factors or obstacles affecting CIS. Researchers have further stated that team work and interactions between individuals working together is an extremely important facet for collaboration because achieving a shared mental model or common ground can facilitate collaborative activities [46].

Studies have found that effective teamwork leads to effective collaborative activities in team [45-47]. However, it is not enough to simply group students together and expect effective collaboration to occur. It is necessary to determine what factors affect the behavior and what can be done to make the behavior more efficient. Studies have shown that individuals with greater past teamwork experience are more likely to be effective working on teams [46]. The present study determines whether a student's past teamwork experience has any affect on their collaborative behaviors in current or future

teams. The following chapter details the sites, participants and methods used to collect and analyze the data.

Chapter 3

Research Methods

3.1 Introduction

This chapter discusses in detail the study site, the participants, the data collection and the data analysis techniques and a description of the variables tested.

3.2 Site

The aim of this research study was to understand the collaborative information seeking behavior of student teams. The site for this research project was the College of Information Sciences and Technology (IST) at the Pennsylvania State University. In IST, students participate in several team activities and projects throughout their undergraduate careers. The students are required to manage these projects themselves and attempt to solve any problems that may arise using their own team management skills before involving the professor or teaching assistant. A technique used in IST to encourage teamwork and team-based learning is the Problem-Based Learning (PBL) approach. Students are not expected to simply memorize information, but rather apply the information to real situations. It enforces the understanding of what is being taught rather than the ability to restate facts [33]. In the college of IST, PBL is team based and most of the work on problems and projects is done in teams of three to six students. Teamwork during PBL encourages students to think on their own and become effective managers of time, projects, and meetings [33].

3.2.1 Site Details

Members of student teams were examined from the class *IST 301: Information and Organization*. IST 301 consisted of one hundred and twenty students spread across three sections. During class time, students had access to laptops and desktops and were able to follow the instructor's presentation. Additionally, students were given time in class to work on their projects but were free to meet outside the classroom at their own convenience. During class time, they had access to the Internet and were able to send and receive emails, as well as use instant messenger programs. Access to these technologies supported collaboration and teamwork as it facilitated communication and interaction. Teamwork was further facilitated by encouraging students to sit in proximity with their team members.

3.2.2 Participants

All participants had to consent to be part of the study. The students were from multiple class levels in the College of IST and brought their own expertise and experiences to their teams. Being in IST, these students had also participated in numerous PBL projects in their teams throughout the semester. Table 3-1 shows the demographics of the student participants.

Class Level	#	Gender	#
Freshmen	3	Male	103
Sophomore	0	Female	4
Junior	93		
Senior	11		
Total	107	Total	107

Table 3-1: Demographics of survey participants

3.3 Data Collection

An online survey (Appendix A) was used to gather data about CIS behavior. CIS in the past has largely been examined from a qualitative perspective, mainly through observations and interviews [34]. In this study, a quantitative approach was used to collect data by distributing an online survey. The survey allowed for the collection of quantitative data on which statistical analysis was run to determine whether relationships and correlations existed between variables of interest. A survey was also used because it was an efficient way of collecting data from a large sample size.

3.3.1 Survey

In a study conducted by Spence et al. which examined the collaborative information behavior of academic researchers, a web-based survey was used [13]. A web-based survey was utilized because it allowed for efficient handling of a large volume of participants, as well as allowing edits without printing and redistributing the survey

repeatedly. There are several online survey tools available but for this study Survey Monkey was used. Survey Monkey allows users to create surveys either from scratch or from one of their multiple templates. The designer also has the option to create multiple types of questions such as Likert scales, rank order questions, and multiple choices. A security feature was available in the design of the survey to prevent participants from skipping questions. This feature did not let students complete the survey until all the questions were answered. The designer also has an option to edit the questions during any phase of the survey, even while participants are taking the survey. There is also a feature available to observe the results of the survey in real time, as the survey is being taken. Once the data collection process is over, Survey Monkey offers several methods of exporting the data in multiple formats for simplifying the analysis process.

The survey consisted of four sections: Practices, Tools, Challenges, and Demographics (Appendix A). These sections were designed to achieve a better understanding of the collaborative information seeking behavior of student teams by focusing on the hypotheses and research question posited in chapter 1.

Practice: This section of the survey was concerned with understanding how and when students collaborate. Questions such as ‘Would you work individually or with your teammates when the information you are searching for is difficult find?’ were used to determine what caused students to move from individually seeking information to collaboratively seeking information. The answers to this question and several others provided insight into the processes that students follow when working with their teammates during information seeking.

Tools: This section of the survey was primarily concerned with the technology students used to support and facilitate their collaborative information seeking behavior. A goal of this study was to help in the design of systems that would better support and facilitate CIS. Determining the technologies that students use for sharing information or the sources they prefer during information seeking was one of the many important questions asked in this section. Answers to these questions highlighted what is important to students during CIS.

Challenges: This section of the survey determined whether social, environmental, or affective factors had an impact on the collaborative information seeking behavior of student teams. Questions such as ‘How does lack of communication between teammates affect collaboration?’ gave insight into how various factors affected CIS of students

Demographics: This section of the survey allowed us to get an accurate profile of who took the survey. Demographic data collected included, but was not limited to, the semester standing of the student, and gender of the participant.

3.3.2 Reliability and Validity of Survey

Reliability in research studies is generally described as the extent to which an experiment or test will give the same results based on repeated trials. To measure reliability in the present survey, a reliability analysis was conducted and the Cronbachs alpha was used as a scale of reliability.

Cronbach’s alpha measures the internal consistency reliability of an instrument, which in this case is the survey used. It is generally accepted that a Cronbach alpha value of between 0.7 and 0.8 is considered an acceptable value for a reliable scale. On average, the present survey had a Cronbachs alpha of over 0.7 meaning the survey was sufficiently internally consistent.

Validity on the other hand generally refers to whether a study accurately assesses the concept (in this case, CIS) that is being measured. Validity is split into 2 categories: internal and external validity. External validity refers to how much the results are generalizable and internal validity refers to the rigor with which the study was conducted. For this study, validity was tested in the survey by giving the question set to multiple experts in the field and incorporating their feedback and refining the question sets. Plus when the question sets were finalized, a pilot testing phase was conducted to further refine the survey. This ensured that the survey was asking questions related to the students collaborative information seeking behaviors and was not drifting off-topic. The survey was validated through pilot testing as well as having it periodically reviewed by peers and experts in the field of Information Sciences and Technology. Furthermore, there were multiple iterations of the survey before an acceptable question set was achieved.

There were twenty pilot testers who were Graduate students from the College of Information Sciences and Technology. Their objective was to find inconsistencies with the survey as well to judge the content of the survey. The survey was first converted to a web-based survey and was distributed to the testers along with a paper-based version for further comments. The pilot-testers tested the survey by taking the on-line survey and writing comments on the paper-based version. Once comments were received and reviewed from the test group, the changes were incorporated in a final iteration of the paper-based survey. This version was then reviewed by an expert in the field of information seeking. After review, the final version of the survey was converted into digital format using Survey Monkey and was checked for inconsistencies.

3.4 Quantitative Data Analysis

The survey data was analyzed using quantitative data analysis techniques. Statistical software was used to find relationships between variables. From the survey data, a number of dependent variables were chosen to measure against the independent variable to test the hypotheses.

3.4.1 *Dependent Variables*

Dependent variables used in this study represented five categories of measure.

Communication Method: The survey asked students the methods of communication used most frequently during CIS with teammates. A variety of communication methods such as e-mail, instant messaging, telephone, blogs, Facebook, and face to face communication were given as choices for the students to select from. Communication plays a key role during CIS and therefore it is necessary to examine the various communication methods used.

Source Preference: The survey asked students their choice of source when working with teammates during information seeking. Examples of sources from the survey included the use of teammates, using the internet, using electronic journals, and outside experts. Information seeking relies on using sources of information. Without these sources, information seeking cannot exist. Therefore it is imperative that studies examining information seeking also understand the sources used during this behavior.

Social Interaction Factor: These factors were responsible for causing an effect in the interactions that occur between people and teams or groups. Many researchers have

highlighted the importance of social networks and interactions during CIS [17]. The following table (Table 3-2) describes the social factors used in the survey, including their definitions.

Competition between teams	Different teams working against each other to finish the assigned work in the most effective manner.
Lacks Shared Vision	Not having a shared motivation to complete the project.
Lack of Communication	When there is little to no discussion or interaction amongst teammates.
Issue of Presence	Real-time (physical or virtual) appearance of teammates during meetings.
Culture of Team	Teammates are strict or laidback with each other
Power Struggles within Team	Conflict about team roles and leaders
Lack of Integration	Teammates not able to work together cohesively
Conflict within team	Arguments among teammates
Different Understanding of project	Having a different idea of what the project entails.
Working with experts	Whether teammates like working with other experts in the field of interest
Share Expertise	Whether teammates share their expertise between teammates
Equal Participation	All members of the team carry equal weight
Novice rely on experts	Whether novices in teams depend on experts to carry them.

Table 3-2: Social Factors from Survey

Contextual Factors: These factors occurred from outside the team, i.e. factors outside the student's control. Researchers such as Prekop, Sonnenwald and Pierce are a few of the many researchers in information seeking who have discussed the importance of context in which information seeking [6,28]. The table (Table 3-3) describes the contextual factors used in the survey.

Outside Influences (mandatory meetings, trips home)	Uncontrollable factors which the student cannot ignore
Pressure	When professors or other teams push students in performing a task
Location of teammates	Whether the general location of where teammates are located has an impact on CIS.
Time as a constraint	Time becomes a factor during CIS.

Table 3-3: Contextual Factors from Survey

Affective Factors: These factors were the internal feelings and emotions of people. Researchers such as Hyldegard and Kuhlthau have stressed the importance of studying these factors in both individual information seeking and collaborative information seeking [5, 17]. The following table (Table 3-4) describes the factors used in the survey.

Caring	Whether students care for each other and the team.
Self-Efficacy	Students own idea of how capable they are in completing a task
Belief	Students own personal belief in communication technologies.

Table 3-4: Affective Factors from Survey

3.4.2 Independent Variables

The independent variable for this study was the experience students had with working on a team. Experience was split into three categories novice (1-4 team projects), intermediate (5-9 team projects) and experts (10 or more team projects). Students were able to accurately determine where their experience level was based on these predefined categories and answer the survey question appropriately. Responses to this question were used to compare the different levels of expertise with the dependent variables. The

category of novice was eliminated from the data analysis because there were only 2 participants who identified themselves as novices, which would have skewed the data.

3.4.3 Tools used to Analyze Data

SPSS is statistical software capable of running several statistical analytical tools to find relationships between variables and was the primary software used to analyze the data. Statistical techniques such as ANOVA and Pearson's Correlation methods of comparing means were very easily accessible and very intuitive features in the program. SPSS was also capable of running multiple post-hoc to find out which means differed and whether the means differed due to a sampling variation or due to actual statistical significance.

3.4.4 Process of Quantitative Data Analysis

To compare the means between the ordinal variables (communication and source preferences), a Mann-Whitney test was used. The level of significance (alpha) was set at 0.05. This test is an alternative to the independent group t-test when the assumption of equality of variance is not met and uses ranks instead of means to compare [35]. To test whether the variances of the population are equal, Levene's Test was used. Levene's Test assesses the assumption that variances are equal and is often used before a comparison of means [35]. The interval variables (factors) were analyzed using a 2 independent sample t-test as there were only 2 categories to test against, intermediate and expert and the dependent variables were set on a likert scale. [36]. Despite potentially having statistical

significance, it is also important to determine whether the results have any *practical* significance. Variables could have statistical significance but not be practically significant which would result in the variables not being useful. Practical significance is calculated by looking at the Effect Size. Given a sufficiently large sample size, a statistical comparison will always be significantly different, whereas the effect size determines whether the difference is important. To calculate effect size, *Cohen's d* is calculated by finding the difference between the two means and dividing by the standard deviation for the data.

3.5 Summary of Methods

In this study, student teams in a course (IST 301) in the College of Information Sciences and Technology were examined. This setting provided for a well-rounded opportunity to study the collaborative information seeking behavior of students because of its team oriented problem based learning approach. A 45 question survey, which dealt primarily with collaborative information seeking behavior of students, was distributed to the students. The survey was validated by frequent revisions and reviews by experts and pilot-tested by peers. To find relationships between various independent and dependent variables, SPSS was used to run numerous tests to measure the differences between the means. The following chapter presents the results to the data analysis described in this chapter.

Chapter 4

Results

4.1 Introduction

The main objective of this study was to understand the CIS behavior of the members of student teams. In this chapter the results from the data analysis conducted on the survey are presented and examined in detail. The descriptive results of the survey will be reported first and then the results from testing the null hypotheses will be reported. The experience levels are numerically identified with '2' representing intermediate and '3' representing experts.

4.2 Demographics

Table 4-1 shows the characteristics of the students who participated in the study. The students identified their class level, their experience level with teamwork based on the number of projects they have been involved with and their gender.

Class Level	Experience Level	Gender	Response Rate
Freshmen (n=3)	Novice (n=2)	Male(n=103)	89.2% (n=107)
Sophomores(n=0)	Intermediate (n=59)	Female(n=4)	
Juniors(n=93)	Experts (n=46)		
Seniors(n=11)			
Total(n=107)			

Table 4-1: Demographics

There was an 89.2% response rate to the survey which is high. The reason for this high response rate is because the professor in charge of the class offered an incentive in the form of extra-credit for students who participate in the study. The students came from varied past experience levels as can be seen in the table (Table 4-1). However, there were only 2 students who identified themselves as novices. This was not an adequate representation of the novice population and would skew the data analysis. Therefore, for the sake of normalcy in the data, this group was not included in the analysis.

4.3 Survey Results

In this section, the descriptive results for the communication and source preferences of students are presented.

4.3.1 Communication Methods

The student's preferences for various communication methods during different frequency levels were tested and the results are shown in Figure 4-1. The communication methods presented are synchronous communication methods and the frequency levels were categorized as 'never', 'sometimes' and 'everyday'.

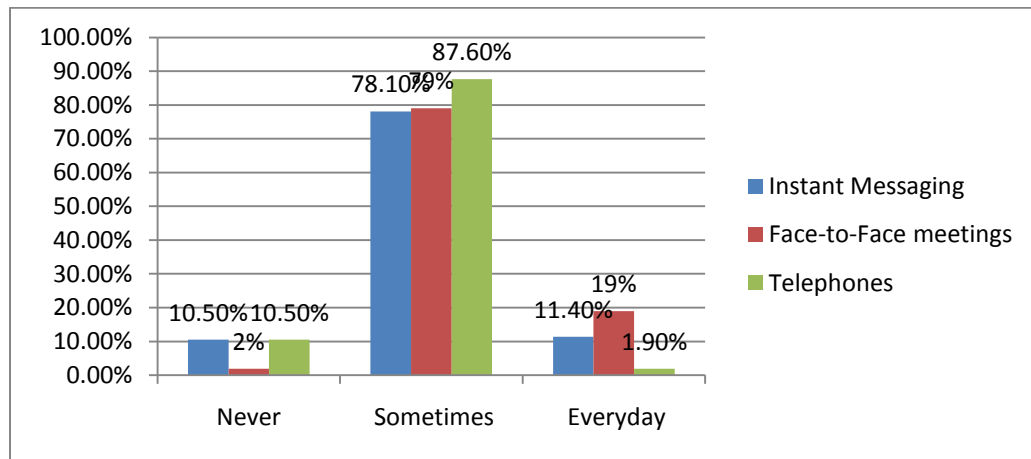


Figure 4-1: Comparison of Communication Methods

It can be seen from the figure (Figure 4-1) that face to face was the most frequently used form of synchronous communication method when students had to communicate everyday during a project, however when they only had to communicate sometimes (2-3 days) they used a telephone the most frequently during collaborative information seeking

4.3.2 Source Preferences

The student's preferences for the type of source they most frequently used during collaborative information seeking were surveyed and the results are shown in Figure 4-2.

Students were asked to rank order their preferred source of information from 1 to 12 with 12 being ‘most used’ and 1 being ‘least used’.

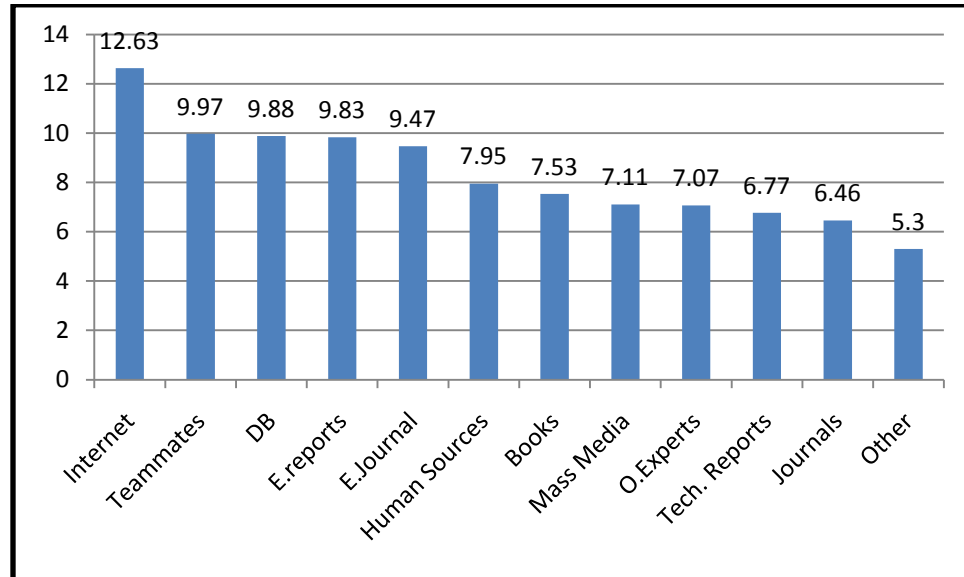


Figure 4-2: Comparison of Sources

Figure 4.2 shows that the highest percentage of students (12.63%) preferred to use the internet as their primary source of information.

4.5 Hypothesis Testing

All the hypotheses were tested to determine whether team experience plays a role during CIS behavior of students. In this section, the hypotheses, along with the data analysis tables showing the results are presented below.

4.5.1 Communication Methods

The hypotheses being tested are stated as follows:

- 1) *There will be no significant differences between the uses of IM among students with different experience levels.*
- 2) *There will be no significant differences between the uses of F2F among students with different experience levels.*
- 3) *There will be no significant differences between the uses of telephone among students with different experience levels.*

The hypotheses were tested using a Mann Whitney test. First the descriptive of the various communication methods are presented in Table 4-3 (Cronbachs $\alpha = 0.72$).

Ranks				
Team Experience		N	Mean Rank	Sum of Ranks
Use-Instant Messaging	2	59	52.56	3101.00
	3	46	53.57	2464.00
	Total	105		
Use-Face to Face	2	59	53.75	3171.50
	3	46	52.03	2393.50
	Total	105		
Use-Telephones	2	59	53.06	3130.50
	3	46	52.92	2434.50
	Total	105		

Table 4-2: Descriptive ranks of Communication Methods

Table 4-3 shows (Table 4-3) that there was a difference in the mean ranks between the different experience levels. The Mann-Whitney test determined whether the difference was due to statistical significance or sampling variation.

Test Statistics^a

	Use-Insant Messaging	Use-Face to Face	Use- Telephones
Mann-Whitney U	1331.000	1312.500	1353.500
Wilcoxon W	3101.000	2393.500	2434.500
Z	-.233	-.407	-.040
Asymp. Sig. (2-tailed)	.816	.684	.968

a. Grouping Variable: Team Experience

Table 4-3: Mann-Whitney Test for Communication

The null hypothesis is accepted because there was no statistical significance for the communication preferences between the two experience levels. This means that regardless of the pats experience level students have with teamwork, the frequency with which they use face to face, IM and telephones will remain the same. Experience is not a factor for the communication preferences of students.

4.5.2 Source Preferences

The hypothesis being tested for source preference is stated as follows:

There will be no significant difference between various source preferences use by students with different experience levels.

Table 4-5 presents the descriptive results of the source preferences of students with different experience levels.

Ranks				
Team Experience		N	Mean Rank	Sum of Ranks
Team-Mass Media	2	59	49.31	2909.50
	3	46	57.73	2655.50
	Total	105		
Team-Books	2	59	54.24	3200.00
	3	46	51.41	2365.00
	Total	105		
Team-Hardcopy Journals	2	59	57.08	3368.00
	3	46	47.76	2197.00
	Total	105		
Team Softcopy Journals	2	59	54.25	3201.00
	3	46	51.39	2364.00
	Total	105		
Team-Teeammates	2	59	53.81	3174.50
	3	46	51.97	2390.50
	Total	105		
Team-Outside Experts	2	59	49.17	2901.00
	3	46	57.91	2664.00
	Total	105		
Team-Tech Reports Hard	2	59	55.36	3266.00
	3	46	49.98	2299.00
	Total	105		
Team-Tech Reports Electronic	2	59	53.42	3152.00
	3	46	52.46	2413.00
	Total	105		
Team-WWW	2	59	52.12	3075.00
	3	46	54.13	2490.00
	Total	105		
Team-Library Databases	2	59	56.95	3360.00
	3	46	47.93	2205.00
	Total	105		
Team-Human Sources	2	59	49.85	2941.00
	3	46	57.04	2624.00
	Total	105		
Team-Other	2	59	55.59	3280.00
	3	46	49.67	2285.00
	Total	105		

Table 4-4: Descriptive result of source preferences

Table 4-5 shows that there is actually a difference in the mean ranks for the varying experience levels. Based on Table 4-5, it means that different experienced level students prefer different sources. The Mann-Whitney test presented in Table 4-6 (Cronbachs $\alpha = 0.76$).determined whether these differences had a statistical significance to them.

Test Statistics^a

	Team-Mass Media	Team-Books	Team- Hardcopy Journals	Team Softcopy Journals	Team- Teammates	Team- Outside Experts	Team-Tech Reports Hard	Team-Tech Reports Electronic	Team-WWW	Team-Library Databases	Team-Human Sources	Team-Other
Mann-Whitney U	1139.500	1284.000	1116.000	1283.000	1309.500	1131.000	1218.000	1332.000	1305.000	1124.000	1171.000	1204.000
Wilcoxon W	2909.500	2365.000	2197.000	2364.000	2390.500	2901.000	2299.000	2413.000	3075.000	2205.000	2941.000	2285.000
Z	-1.412	-.474	-1.569	-.483	-.309	-1.470	-.905	-.163	-.405	-1.523	-1.207	-1.058
Asymp. Sig. (2-tailed)	.158	.635	.117	.629	.758	.142	.365	.871	.685	.128	.227	.290

a. Grouping Variable: Team Experience

Table 4-5: Mann Whitney Test for Source Preferences

The null hypothesis was accepted in this case because there was no statistical significance for any of the source preferences (Table 4-6). This indicates that regardless of a student's prior team experience, the Internet will still be the most used source of information

4.5.3 Contextual Factors

The hypotheses being tested for the various contextual factors that affect the CIS behavior of students working in teams were stated as follows:

- 1) *There will be no significant difference for 'time as a deadline between students with different experience levels'*
- 2) *There will be no significant difference for 'competition amongst teammates' between students with different experience levels'*
- 3) *There will be no significant difference for 'geographically dispersed teammates' between students with different experience levels'*
- 4) *There will be no significant difference for 'outside factors' between students with different experience levels'*

Table 4-7 first shows the descriptive results of the various contextual factors tested in the survey. The results of the descriptive are split into intermediate and experience expert levels (Table 4-7).

Group Statistics					
Team Experience		N	Mean	Std. Deviation	Std. Error Mean
Competition	2	59	3.25	1.677	.218
	3	46	3.54	1.870	.276
Time	2	59	4.69	1.567	.204
	3	46	5.48	1.206	.178
Geographically Dispersed	2	59	3.85	1.387	.181
	3	46	4.39	1.612	.238
Outside Factors	2	59	4.39	1.377	.179
	3	46	4.50	1.517	.224

Table 4-6: Descriptive results of Contextual Factors

The table shows that there is a difference in the means for the various contextual factors (Table 4-7). Table 4-8 determined if it was due to statistical significance or sampling variation.

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Competition	Equal variances assumed	.977	.325	-.834	103	.406	-.289	.347	-.977	.399
	Equal variances not assumed			-.822	91.284	.413	-.289	.352	-.988	.409
Time	Equal variances assumed	3.895	.051	-2.803	103	.006	-.783	.280	-1.338	-.229
	Equal variances not assumed			-2.894	102.989	.005	-.783	.271	-1.320	-.246
Geographically Dispersed	Equal variances assumed	2.392	.125	-1.856	103	.066	-.544	.293	-1.125	.037
	Equal variances not assumed			-1.822	88.955	.072	-.544	.299	-1.137	.049
Outside Factors	Equal variances assumed	.781	.379	-.389	103	.698	-.110	.283	-.672	.452
	Equal variances not assumed			-.384	91.976	.702	-.110	.287	-.679	.459

Table 4-7: T-test for Contextual Factors

As can be seen from the table, the null hypothesis is accepted for all contextual factors except for Time (Table 4-8). Students with lesser teamwork experience ($M=59$,

SD=1.567) are more affected by ‘time as a constraint’ than students with greater experience ($M=46$, $SD= 1.206$, Cronbachs $\alpha = 0.74$), $t(103) = - 2.803$, $r = 0.267$, $p=0.005$. Since the mean differences were low, it was necessary to determine whether these results had a practical significance. Cohen’s d was calculated by finding the difference between the means divided by the standard deviation. For ‘Time’ the effect size was 0.267 which is a percentile overlap of only 14.7%. This indicates that although ‘Time’ was statistically significant for the varying experience levels it had negligible practical significance.

4.5.4 Social Interaction Factors

The hypotheses being tested for the social factors affecting the CIS behavior of students were stated as follows:

- 1) *There will be no significant difference for ‘multiple deliverables’ between students with different experience levels*
- 2) *There will be no significant difference for ‘lack of shared vision’ between students with different experience levels*
- 3) *There will be no significant difference for ‘lack of communication’ between students with different experience levels*
- 4) *There will be no significant difference for ‘presence between students’ with different experience levels*
- 5) *There will be no significant difference for ‘pressure between students’ with different experience levels*

- 6) *There will be no significant difference for 'culture between students' with different experience levels*
- 7) *There will be no significant difference for 'power struggles between students' with different experience levels*
- 8) *There will be no significant difference for 'lack of integration in teams' between students with different experience levels*
- 9) *There will be no significant difference for 'team conflict' between students with different experience levels*
- 10) *There will be no significant difference for 'difference in understanding by students' between students with different experience levels*
- 11) *There will be no significant difference in 'expert students' between students with different experience levels*
- 12) *There will be no significant difference in 'sharing of expertise in teams' between students with different experience levels*
- 13) *There will be no significant difference in 'equal participation of teammates' between students with different experience levels*
- 14) *There will be no significant difference in 'working with novices' between students with different experience levels*

Table 4-9 shows the descriptive results of the social interaction factors tested in the survey.

Group Statistics					
	Team Experience	N	Mean	Std. Deviation	Std. Error Mean
Multiple Deliverables	2	59	4.44	1.500	.195
	3	46	4.78	1.474	.217
Lack Shared Vision	2	59	5.53	1.072	.140
	3	46	5.57	1.167	.172
Lack of Communication	2	59	6.14	1.058	.138
	3	46	6.20	1.128	.166
Presence	2	59	5.19	1.408	.183
	3	46	5.20	1.558	.230
Pressure	2	59	4.44	1.454	.189
	3	46	4.78	1.459	.215
Culture	2	59	4.56	1.317	.171
	3	46	5.00	1.520	.224
Power Struggles	2	59	4.66	1.397	.182
	3	46	4.76	1.268	.187
Lack of Integration	2	59	4.85	1.186	.154
	3	46	5.37	1.062	.157
Team Conflict	2	59	4.98	1.371	.178
	3	46	5.33	1.283	.189
Outside Factors	2	59	4.39	1.377	.179
	3	46	4.50	1.517	.224
Different Understanding	2	59	4.76	1.291	.168
	3	46	4.85	1.505	.222
Experts	2	59	3.19	1.456	.190
	3	46	2.91	1.872	.276
Sharing Expertise	2	59	4.46	1.304	.170
	3	46	4.61	1.273	.188
Equal Participation	2	59	3.51	1.394	.182
	3	46	3.24	1.537	.227
Novices	2	59	4.64	1.270	.165
	3	46	4.89	1.337	.197

Table 4-8: Descriptive of social interaction factors

There were mean differences between the various social interaction factors (Table 4-9) which the independent sample t-test determined whether it was due to statistical significance or sampling variation.

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Lack of Integration	Equal variances assumed	.352	.554	-2.342	103	.021	-.522	.223	-.964	-.080
	Equal variances not assumed			-2.374	101.000	.019	-.522	.220	-.958	-.086

Table 4-9: T-test for lack of integration

The null hypothesis was rejected for all social interaction factors except for ‘Lack of Integration’ (Table 4-10). ‘Lack of integration’ was more of a factor for the collaborative activities of students with lesser team work experience ($M = 59$, $SD = 1.186$) than students with more team work experience ($M = 46$, $SD = 1.062$, Cronbachs $\alpha = 0.71$), $t(103) = -2.342$, $r = 0.22$, $p = 0.021$. The effect size resulted in a percentile overlap of only 14.7% ($r = 0.22$) indicating that there was no real practical significance to ‘Lack of Integration’ regardless of the statistical significance.

4.5.5 Affective Factors

The hypotheses which were tested for the various affective factors were stated as follows:

- 1) *There will be no significant difference in ‘lack of caring’ between students with different experience levels*
- 2) *There will be no significant difference in ‘belief in communication technologies’ between students with different experience levels*
- 3) *There will be no significant difference in ‘working with experts’ between students with different experience levels.*

Table 4-11 shows the descriptive results of the affective factors when compared between the different experience levels of students.

Group Statistics					
Team Experience		N	Mean	Std. Deviation	Std. Error Mean
Work w/experts	2	59	5.19	1.420	.185
	3	46	5.72	1.241	.183
Communication technology	2	59	5.59	1.019	.133
	3	46	6.00	.869	.128
Lack of Caring	2	59	5.56	1.343	.175
	3	46	5.76	1.119	.165

Table 4-10: Descriptive of Affective Factors

There is a difference in the means of the variables (Table 4-11). The following test determined whether the differences were due to a sampling variation or not. Table 4-12 presents the results of the independent t-test.

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Work w/experts	Equal variances assumed	.645	.424	-2.007	103	.056	-.531	.265	-1.056	.006
	Equal variances not assumed			-2.041	101.608	.044	-.531	.260	-1.047	-.015
Communication technology	Equal variances assumed	4.883	.029	-2.162	103	.033	-.407	.188	-.780	-.034
	Equal variances not assumed			-2.205	102.129	.030	-.407	.184	-.773	-.041
Lack of Caring	Equal variances assumed	1.645	.203	-.820	103	.414	-.202	.246	-.689	.286
	Equal variances not assumed			-.838	102.507	.404	-.202	.240	-.678	.275

Table 4-11: Test for Affective Factors

‘Belief in communication technologies’ was the only variable which was statistically significant, rejecting the null hypothesis. Therefore, the result implies that students with lesser team experience ($M = 59$, $SD = .133$) believe more in communication technologies to share experience and expertise than students with more team experience level ($M = 46$, $SD = .128$, Cronbachs $\alpha = 0.74$), $t(103) = -2.162$, $r = 0.21$, $p = 0.03$. The effect size for ‘belief in communication technologies’ was calculated to be low ($r = 0.21$)

which indicates a percentile overlap of 14.7% indicating that the result had minimal practical significance.

4.7 Summary

The survey was designed to get an understanding of the CIS experience and behaviors of students. From the survey data, several hypotheses stating a relationship between teamwork experience of students on teams and CIS behaviors were posited. The results were used to determine whether team experience was a factor to consider during CIS behavior of student teams. The results indicated that team experience was not a factor in the CIS behavior of students. The following chapter discusses these results and their implications.

Chapter 5

Discussion

5.1 Overview of Findings

Students are increasingly being encouraged to work with their peers in teams and groups to complete coursework and projects [1]. This has led to an increase in collaborative activities such as information seeking because teamwork necessitates collaboration. The success of a project can depend on the successful gathering of useful information; therefore information seeking plays a key role during a project or assignment. This study identified elements important to consider during collaborative information seeking such as communication preferences, source preferences and various obstacles to collaboration. Furthermore, since students come from varying backgrounds with different experience levels with working on teams, it was necessary to determine whether this affected their CIS behavior. Thusly, the research questions which were developed were:

1. *Does the past teamwork experience of students play a role in their CIS behavior?*
 - a. *Does teamwork experience affect the communication preferences of students during CIS?*
 - b. *Does teamwork experience affect the source preferences of students during CIS?*
 - c. *Does teamwork experience affect the various affective, contextual and social obstacles that students face during CIS?*

It was found that past teamwork experience of students is not a factor for the communication preferences, source preference or the various obstacles students may face during CIS. Discussions of these findings are presented below.

5.2 Discussion of Survey Results

Past studies have primarily used qualitative methods to understand collaborative information seeking [28]. Many of these studies have examined the communication and source preferences of teams or groups during CIS. This study has used a quantitative approach to examine CIS and in doing so has also found the preferred communication methods and source preferences used by students during CIS.

5.2.1 Communication Preferences

The synchronous communication methods examined in this study were: face to face communication, phone and instant messaging. The survey data revealed that when comparing synchronous technologies amongst student teams during CIS, the most frequently used method when communicating everyday was face to face. Face to face communication has generally been accepted as being the most versatile of communication methods. Individuals interacting f2f can share information instantaneously, can read non-verbal communication and quickly resolve conflicts. Furthermore, f2f communication has the added benefit of not necessarily relying on technology to work; therefore there is no issue of lost or miscommunication due to

technological breakdowns. However, when students had to communicate only 2-3 days a week, they preferred using telephones. Phone has the benefit over f2f and IM in that it does not need participants to be at a specific location at a particular time. Face to face requires members be co-located and IM requires users to be in front of their computers. Whereas with a phone the students are more portable, meaning that when students only need to communicate something quickly or briefly, they do not necessarily have to set these f2f or IM meetings up and can simply use the phone.

The findings in this study have confirmed those in the past that have examined the communication preferences during collaborative information seeking [13]. Spence and Reddy conducted a study on the collaborative information seeking behavior of a multidisciplinary patient care team [15]. They found two advantages to face-to-face communication in the ED such as the speed with which they could give and receive information and the ability for team members to acquire information they would not have been able to otherwise acquire. These advantages could also be the reasons why students examined in this study preferred face to face communication over any other synchronous or asynchronous communication method during CIS as f2f was easily accessible.

5.2.2 Source Preferences

Another important aspect of CIS that researchers have examined is the source preferences of teams or groups. Sources are typically categorized into two categories: formal and informal [7]. Informal sources are characterized by using people as a source or guide to information and formal sources are characterized as books, articles or journals. Studies

have typically found that during information seeking individuals tend to increasingly use informal sources and use formal sources as a way to complement the informal sources [11].

This study found that students use the Internet most frequently as a source of information. The Internet is unique in that it has elements of both formal and informal sources. The formal aspect comes from accessing scientific journals/articles plus having access to various books. Then there is the informal aspect where students can communicate with other people about any topic. This categorizes the Internet as a hybrid source of information with traits of both formal and informal sources. It is likely that students use the internet as a combination source instead of two separate forms of sources. For example, instead of using teammates as a source and then complementing the information received with a formal source, the student can do both those things from the same location synchronously. The student can access a scientific journal on the Internet and then in a forum or medium discuss that particular journal.

This study further confirmed the use of informal sources as the preferred source of information by students when it was found that they also use their teammates as a source of information. Using teammates or peers as a source during information seeking has been found in several studies on collaborative information seeking [7,10,11]. These past studies have stated that a possible reason for this could be that teammates are very easily accessible[11]. Furthermore, teammates tend to bring their own expertise and knowledge to a team thus they can have information that other teammates do not possess.

Furthermore, some teammates may not have the necessary information but may be able to better direct the information seeker. This can also potentially be true for the

student teams used in this study since these students were encouraged to work together on projects and in IST coursework students usually come together from different backgrounds and can have a wide variety of knowledge and expertise.

5.2 Discussion of Analytical Results

The following sections will discuss in details why team experience was not a factor for the communication preferences, source preferences and obstacles faced during CIS. This discussion stems from the data analysis conducted on the survey.

5.2.1 Communication Preferences

The analysis of the data revealed that team experience was not a factor for communication methods used. Students, regardless of experience, indicated that face to face (f2f) communication was the most preferred means of communicating during CIS.

It is high likely that team experience did not affect the communication preferences of students because f2f communication is the most effective means of communication [24, 25]. Students can still receive instantaneous feedback and read non-verbal communications regardless of their background. Furthermore, in IST professors encourage members of a team to sit in close proximity to each other and also allot time in class to work on projects. This allows f2f communication to be easily accessible and since f2f does not rely on technology, it also makes it easier to set up.

There have been several studies on teamwork and communication methods in the CSCL and CSCW domain [22-25, 37]. The findings of this study have largely confirmed the findings in CSCW and CSCL research in that face to face communication is an important facet of teamwork and information seeking. Rocco found that face to face communication can support teamwork when trustworthiness is a factor and individuals have not previously worked together which can be the case for student teams in the IST curriculum [24]. Sometimes students form teams with students they have not previously worked with and have either a semester or less to establish this level of trust. Nardi et al. [25] argue that face to face communication can also be the preferred method of communication because it “sustains the social relationships that make distributed work possible”. In terms of student teams this means that technological communication such as email, IM or phones detach students from the level of interaction that face to face allows. Plus a large part of building relationships is through social interaction. Face to face communication allows that to a greater extent thus allowing for more effective collaboration and interaction amongst teammates which then enables for more effective CIS.

5.2.2 Source Preferences

The data analysis revealed that team experience also did not affect the preference of sources used to gather information. For both experience levels, the preferred method of finding information was the Internet. In general, people prefer the Internet for the ease of accessing large amounts of data, and savings in time and money [38]. The internet is a

host to a plethora of sources and with the convenience of search engines, such as Google, accessing and searching for almost limitless information has become a convenient process.

Students in the IST classrooms have convenient access to computers and the Internet as well as computer labs on campus. Students, regardless of experience, are very likely to first approach the Internet to at least start their search process because the chances of the information being available are high.

The impact the Internet has on information seeking has recently been studied by several researchers as the popularity and accessibility of the Internet has increased [38; 39]. The findings in this study confirm that the use of the Internet has become a critical tool to use during information seeking [21]. The increase in popularity of the Internet does not necessarily imply that books, journals, newspapers or TV are obsolete but rather the Internet simply allows an information seeker to access all the information contained in these other media from one central hub and from any location [38].

5.2.3 Affective, Contextual and Social Obstacles to CIS

The data analysis revealed that the student's team experience did not have any statistical or practical significance on the factors affecting CIS. CIS is a collaborative activity that involves multiple people working together. Past studies examining teamwork and collaboration have found that effective teamwork helps students collaborate with each other more effectively [41-43]. The implication of these studies is that the more experience a team has the better the team will be able to work together and collaborate

thus be able to manage factors more effectively. However, this study was examining individual students working in teams and the results showed that teamwork experience does not affect how students perceive the factors affecting CIS. The reason for this is that when individual students in a team encounter these factors, they may not necessarily rely on their teamwork experience to adapt to them and have their own individual methods to decrease the influence of the factors.

5.3 Limitations

These findings should be understood within the limitations of the methodology, the context adopted and the confounding variables. This study was implemented in a college classroom and due to the general trend in population of an Information Sciences and Technology classroom; the participants of the study were predominantly male. Secondly, the data gathered in the survey provided helpful insight into the collaborative information seeking behaviors of student teams, but was not sufficient to answer the ‘why’ questions. There were also confounding variables that had to be taken into account. First was the timeline of when the survey was distributed to the students. The survey was distributed to the students in the Fall semester. The students may have had different responses if distributed during the Summer or Spring semesters. The second was how the students perceived the survey. In other word, the students may have answered the survey question using their experience in their current teams at which point the specific stage during a project’s lifecycle may have had an impact on their responses Student’s response may change over time as the project moves through a lifecycle. The third confounding factor

was the past team sizes the students were a part of. Students who participated in different team sizes may have had different experiences with CIS. Another confounding factor that could have affected the results was the roles these students had in the various teams in the past. A project manager may have had different CIS experience than a technical writer in the group. Finally, the last confounding factor that most likely affected the results of the data analysis was the measure of teamwork experience. Teamwork experience is a broad area and can be measured in several ways. For this study, teamwork experience was measured using the number of projects a student has participated in. However, if teamwork experience was determined using some other measure, there could be a change in the results of the data analysis.

These factors and constraints were taken into account during the design and analysis of the study. This study was conducted with students pursuing a degree in a “technical” area, which has generally been pursued more by males than females. The Information Sciences and Technology degree is no exception. There are more males than females in the courses offered. Therefore, when distributing the survey to these students, it was expected to receive a higher male response rate than a female response rate. However, this study was about examining the effect team experience has on CIS and to that effect it provided interesting insights on CIS behavior of student teams. Secondly, a majority of studies examining collaborative information seeking have typically used qualitative methods such as observation and interviews to understand the behavior. This study has examined CIS by collecting data using a quantitative method via an online survey. Since CIS is still in its very early stages of research, utilizing every possible

means to understand and examine the behavior is very important and can provide insights to areas that may be overlooked by extensively adopting only one methodology.

To address the confounding variables, the survey was purposefully made clear to stress the point that this survey was regarding the students past teamwork experience and not their current teamwork experience. Focusing on their past teamwork experience also negated the confounding factor of when in the lifecycle of the project the students were because the survey asked about their cumulative teamwork experience and collaborative behaviors. Finally, although team size could play a factor in the responses of the students, the survey did ask about the most common team size these students were a part of. Since a majority of the student said they were part of a team consisting of 4-5 students in the past, the results were considered to not be affected by team size.

Chapter 6

Conclusions

Information seeking behavior plays a central role in the daily activities of individuals in both the modern workplace and educational settings. Information seeking behavior has typically been studied by examining individuals, as such tools and technologies have primarily been designed to cater to the individual [17, 18, 21]. However, research has shown that in modern organizations individuals are increasingly working in teams or groups [16]. Due to a lack of research in the area of collaborative information seeking there is a lack of conceptual understanding about the fundamentals of collaborative information seeking and therefore there are only a limited amount of tools and technologies to facilitate and support the behavior. This research study examines the collaborative information seeking behavior of student teams in a college classroom by determining whether team experience impacts CIS behavior to better understand the collaborative information seeking process.

The study was conducted using quantitative methods in the form of a web-based survey [Appendix A]. The survey first identified the participants experience level with teams based on the number of projects they have been participated in. The survey then asked about the student's information seeking activities such as communication methods and source preferences. The results of the study concluded that team experience did not affect the communication methods or source preferences of student teams during CIS nor did it affect the factors that were considered obstacles during CIS.

In answering the question of whether team experience affected CIS behavior of student teams, the survey shed light on a few critical aspects of collaborative information seeking behavior such as the source preferences of student teams and the communication methods used by them. The survey found that regardless of experience, students in a team preferred to communicate with each other using synchronous communication techniques, specifically face to face communication methods as f2f is the most instantaneous, easy to execute form of communication. Secondly, it was found that regardless of experience student teams preferred to seek information by accessing the internet and also relying on informal sources, specifically their teammates.

The results of this study can help several groups of people. Teachers, researchers and designers can all use the results of this study to help facilitate CIS behavior in classrooms, conduct further research and design technologies to better support the behavior.

Teachers can use the knowledge that during CIS, students prefer to communicate primarily via face to face. They can take advantage of this by scheduling more class time for projects, which gives students an opportunity to work together in a non-virtual environment. Furthermore, teachers can organize their classrooms so that students in teams can sit in close proximity to each other. Another reason for students in the same team to sit in close proximity is because since they prefer to use each other as a source of information, this seating arrangement facilitates that behavior. Finally, if the curriculum allows or if it is possible, the teacher can permit the use of computers connected to the internet in classrooms since it was found in this study that during CIS students prefer to use the internet as a primary source of information.

Researchers can take the results of this study about communication methods, source preferences, factors affecting CIS and the effects of team experience on CIS and expand their knowledge on CIS behavior. Furthermore, this is one of the few studies that have examined CIS from a quantitative method as all others have primarily used a qualitative method to examine CIS; therefore to gain more depth about certain aspects of this study researchers can supplement it with interviews or observations. Finally, this study examined team experience effects on certain aspects of CIS such as communication and source preferences and obstacles, however there are many aspects of CIS behavior that were not covered in this study where team experience could have an effect, which researchers can focus on.

CIS is still in its very early stages of comprehension and because of this lack of knowledge about the behavior; designers of technologies to support or facilitate the behavior have a difficult time capturing the behavior. However, with more knowledge and studies conducted into CIS the more information designers have to create the appropriate CIS tools. From this study, designers can take the communication findings that synchronous communications are the preferred medium of interaction amongst student teams and that internet or search engines are the preferred method of seeking information. The results of this study may not necessarily solve all the design issues associated with CIS tools but is definitely taking the right steps in helping in the development of more well-informed technologies.

In closing, this study helps in better understanding collaborative information seeking of student teams in a college classroom. However, more research is required to not only confirm but to also expand these preliminary findings. Collaborative information

seeking plays a key role in the daily lives of students. By better understanding this behavior, there can be better designed tools and processes in place that will support and facilitate the behavior. This in turn can help improve the performance of these teams and prepare them for their future careers in the real world.

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Appendix

Survey

Practices

1. How much experience do you have working on student teams?
 - a. Novice (1 to 4 team projects)
 - b. Intermediate(5 to 9 team projects)
 - c. Expert (10 or more team projects)

2. What is the most common team size you have been on?
 - a. 2-3
 - b. 4-5
 - c. 6-7
 - d. Other (Please describe)_____

3. How often do you use the following when working with your teammates on a team project? Please choose option that applies

	Never	Sometimes (2-3days/week)	Everyday
Email			
F2F			
IM			
Phone			
Integrated Application Suite			
Facebook			
Other			

4. On a scale of 1-7, how comfortable are you with working on a team for a class project?

Not Comfortable

Very Comfortable

1	2	3	4	5	6	7
*	*	*	*	*	*	*

5. On a scale of 1-7, if you do not understand what to do on a team project, how would you try to figure out what to do?

- a. Just think it through myself
- b. Ask my teammates
- c. Ask someone else besides my teammates
- d. Do research on the web
- e. Other

6. On a scale of 1-7, when the information you are searching for is difficult to find, what would you do to find the information?

Work individually

Work with my teammates

1	2	3	4	5	6	7
*	*	*	*	*	*	*

7. On a scale of 1-7, when searching for information outside of your knowledge base and you need to find information, would you typically:

Work individually

Work together

1	2	3	4	5	6	7
*	*	*	*	*	*	*

8. On a scale of 1-7, when information is spread out across several sources (internet, journal, book), and you need to sift through information, would you typically

work Individually

work with my teammates

1	2	3	4	5	6	7
*	*	*	*	*	*	*

9. On a scale of 1-7, do you find it generally easier to search for information individually or with your teammates when working on a team project?

10. Always individually

Always with my teammates

1	2	3	4	5	6	7
*	*	*	*	*	*	*

11. In an individual setting, where are you most likely to look when searching for information?

Please rank order from 1-12 (1-least likely, 12-most likely)

- a. ___ Mass Media (Newspaper, radio, TV)
 - b. ___ Books
 - c. ___ Journals (hardcopy)
 - d. ___ Journals (electronic)
 - e. ___ teammates
 - f. ___ Outside Experts
 - g. ___ Technical Reports (hardcopy)
 - h. ___ Technical Reports (electronic)
 - i. ___ World Wide Web
 - j. ___ Library Databases
 - k. ___ Human Sources
 - l. ___ Other (Please elaborate)
-

12. What sources of information are you most likely to use when working with your teammates?

Please rank order from 1-12 (1-least, 12-highest),

- a. ___ Mass Media (Newspaper, radio, TV)
- b. ___ Books
- c. ___ Journals (hardcopy)
- d. ___ Journals (electronic)
- e. ___ Outside Experts
- f. ___ Technical Reports (hardcopy)
- g. ___ Technical Reports (electronic)
- h. ___ World Wide Web
- i. ___ Library Databases
- j. ___ Human Sources
- k. ___ Other (Please elaborate)

13. When looking for information individually, what is your primary motivation for choosing the source? (Please rank order from 1-4, where 1 is lowest and 4 is the highest)

- a. ___ Convenience
- b. ___ Reliability
- c. ___ Ease of access
- d. ___ Other (Please elaborate) _____

.

14. When looking for information with your teammates, what is your primary motivation for choosing the source? (Please rank order from 1-4, where 1 is lowest and 4 is the highest)

- a. ___ Convenience
- b. ___ Reliability
- c. ___ Ease of access
- d. ___ Other (Please elaborate)

15. How often are you in contact with your teammates when working on a team project (Please choose one)

- a. ☐ Only during class time
 - b. ☐ usually just before or just after class meetings
 - c. ☐ Daily
 - d. ☐ Once a week
 - e. ☐ 2 or 3 times a week
 - f. ☐ Other (Please elaborate)
-

Tools

16. What tools are you most likely to use when sharing information with your teammates? Please rank order from 1-5

- a. ☐ Email
- b. ☐ Instant Messaging
- c. ☐ Telephone
- d. ☐ Blogs
- e. ☐ Other (Please elaborate)_____

17. If you do use instant messaging as a sharing tool (if not please skip to 17), which features do you find most useful for collaborating on team projects? (Please check all that apply)

- a. ☐ Real time chat
 - b. ☐ File sharing
 - c. ☐ Chat History/Logs
 - d. ☐ All of the above
 - e. ☐ Don't use instant messaging as a sharing tool
 - f. ☐ Other (Please elaborate)
-

18. Which features of email (e.g. Gmail) as a collaboration tool for team projects do you find most useful? (Please check all that apply)

- a. ☐ File sharing
- b. ☐ Saved emails (e.g. searching through past emails)
- c. ☐ Fast communication
- d. ☐ All of the above
- e. ☐ Don't use email for team projects

f. ____ Other (Please elaborate)

19. On a scale of 1-7, how comfortable are you with using a course management system?

Very Uncomfortable

Very Comfortable

1	2	3	4	5	6	7
*	*	*	*	*	*	*

20. When collaborating with your teammates, do you prefer using a system that integrates multiple applications (e.g. email, file sharing, and creating workspace) into one or a separate application for each?

- a. Multiple applications integrated into one
- b. Separate Application

21. If you were to design an integrated system for collaboration. Please rank the top 3 features you would like to see.

- a. ____ Email
- b. ____ Instant Messaging
- c. ____ Real time document editing
- d. ____ Search Engine
- e. ____ Ability to 'see' other users (see what they are searching, or have already searched)
- f. ____ Ability to save the work

Challenges

22. On a scale of 1-7, how much does competition between different teams working on the same project affect collaboration within your own team?

Not affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

23. If a project has multiple deliverables and there is a delay in submission, how much does that affect collaboration within your team?

Not affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

24. When your team lacks a shared vision (i.e. different goals for them) how much does that affect your level of collaboration with your team?

Not affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

25. When there is lack of communication within your team, how much does that affect collaboration?

No affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

26. When there is an issue of presence within your team (i.e. team member never there) how does that affect your level of collaboration with your team?

No affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

27. When there is lack of caring for each other within your team, how much does that affect your level of collaboration?

No affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

28. When time is a big constraint, how does that affect your level of collaboration within your team?

No affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

29. When teammates are dispersed over many locations, does that affect your level of collaboration with your teammates?

No affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

30. When there is a lot of pressure from your professor (i.e. pressure for quality) how much does that affect your level of collaboration?

No affect						Significant Affect	
	1	2	3	4	5	6	7
	*	*	*	*	*	*	*

31. Depending on the culture of your team (team is laid back, or team is stern) how does that affect your level collaboration with your teammates?

No Affect						Significant Affect	
	1	2	3	4	5	6	7
	*	*	*	*	*	*	*

32. If there are power struggles within your team, how much does that affect your level of collaboration with your teammates?

No affect						Significant Affect	
	1	2	3	4	5	6	7
	*	*	*	*	*	*	*

33. When there is lack of integration with your teammates, how much does that affect your level of collaboration with your teammates?

No affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

34. When there is conflict in your team, how does that affect your level of collaboration with your teammates?

No affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

35. On a scale of 1-7, how often do outside factors (e.g. mandatory meetings, trips home) influence your level of collaboration with your teammates?

No affect

Significant Affect

1	2	3	4	5	6	7
*	*	*	*	*	*	*

36. On a scale of 1-7, how would you work on completing your team project when each team member has different understanding of what the project is about?

Work individually

Work together

1	2	3	4	5	6	7
*	*	*	*	*	*	*

37. On a scale of 1-7, how is working on a team project where most of the members are experts in the project area?

Always easier

Always harder

1 2 3 4 5 6 7

38. On a scale of 1-7, do you find that most team members typically share their expertise in team communications?

Never

Always

1 2 3 4 5 6 7

39. On a scale of 1-7, assuming you are an expert in the area, would you rather work with other experts in the area or novices

Work with novices

work with experts

1 2 3 4 5 6 7

40. On a scale of 1-7, do you find that all the team members participate equally in team discussions?

Not at all

Everytime

1 2 3 4 5 6 7

41. On a scale of 1-7, do you believe that communication technology helps or hinders sharing of information and expertise among team members?

Always hinders

Always helps

1 2 3 4 5 6 7

42. On a scale of 1-7, do you believe that novices on a team typically rely on the experts to carry the team?

Always no

Always yes

1 2 3 4 5 6 7

Demographics

43. Please select your school standing

- a. Sophomore
- b. Junior
- c. Senior
- d. Other _____

44. What is your gender?

- a. Male
- b. Female

45. Is it okay to contact you for a follow up interview to elaborate on some of these points?

- a. No
- b. Yes (Please provide an email address)
