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In this issue:

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A Follow-up Study of Using Remote Desktop Applications in Education

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Abstract

In traditional classrooms and in online courses, students frequently need help with their academic work. Instructors have traditionally given face to face assistance during class times and during office hours, and more recently using email or tools in course management systems such as BlackBoard and WebCT. Unfortunately, text-based or verbal instructions know many limitations. A simple activity like giving instructions for making a peanut butter sandwich clearly demonstrated the limitations of verbal instructions. Materials with pictures or prefabricated videos are static and may not address specific student questions, no matter how important. This paper describes the follow-up to a previously published study on using remote desktop applications. Like the previous study, it uses the Unified Theory of Acceptance and Use of Technology. In contrast to the former study, students now base their intent to use the technology on the expectation that it will help them in their academic work. Results also indicate that students with a more positive attitude towards using technology are more likely to use remote desktop assistance.

Keywords: virtual office hours, Remote Desktop Technology, education, assistance, computers, distance education, UTAUT, technology acceptance.

1. INTRODUCTION

The educational field continues to undergo major changes due to developments in demographics and technology. Students increasingly have fulltime jobs or family obligations. Time limitations and conflicting demands can negatively affect students' opportunity to use traditional office hours. Sharing computer desktops in shared sessions offers a great opportunity to assist students when they need help, potentially with limited or no extra burden on the instructor.

This paper briefly reviews the shift from traditional office hours to other forms of assistance, followed by a discussion of remote desktop applications and the major Information Systems theory used to study technology acceptance. Based on the theory and the results of our first study, we conducted a follow-up study of the acceptance of Remote Desktop Sharing (RDS) in education. Results are presented and discussed. The paper closes with recommendations and a discussion of future follow-up.

2. LITERATURE REVIEW

In this section, we first review changes in education and technology, explain the concept of remote desktop sharing, and conclude with a review of technology adoption

theories in Information Systems as they have developed over the years.

Educational Changes

Education is going through major changes at a rapid pace. The "traditional" undergraduate student, defined as having earned a high school diploma, enrolled full time immediately after high school, dependent on financial support of parents, and either not working during the school year or working part time—is the exception rather than the rule. Only 27% of students meet all these criteria (NCES, 2002). In 2005, two percent of adults aged 55-64 participated in a part-time degree or diploma program, and 27 percent participated in work-related courses (American Council on Education, 2007). Non-traditional students in higher education may not have the opportunity to be on campus at specific times. Not only can personal and professional obligations conflict with attending class, but the increased commitments outside education can interfere with meeting instructors face to face, especially during office hours. Traditional face to face office hours are limited by the location of the instructor and scheduled times when the instructor is available (Wallace and Wallace, 2001).

At the same time, the Department of Education reports rapid growth in the number of online students. In 2002, Director of Education, Workforce, and Security Issues Cornelia Ashbey testified before the GAO that the number of students involved in distance education had tripled in just four years (US-GAO, 2002). Moreover, evidence emerges that the performance of online students may be lower than their counterparts in face-to-face courses. Corrected for college experience and ACT scores, online students in one study scored 9.7 percent worse than face-to-face students (Carnevale, 2002). The increase in the number of nontraditional and distance education students combined with the increasing challenges of the online environment requires a re-evaluation of the concept of office hours. Students with the highest need for assistance tend to fall, in the B- to C+ range, not in the A, D or F ranges (Karabenick & Knapp, 1988). Especially these students may be at risk if the issue of better access to assistance is not addressed.

Technological Changes

Like society at large, colleges increasingly use technology in education. Comparing IT spending in 2007 and 2006, 51.4 % of responding institutions reported an increase, compared with a decrease for only 16.5% (McCLure, 2007). This trend influences the traditional concept of office hours. As early as 1984, Turner (1984) proposed electronic hours. Marsh and Wells (1996) reported that E-mail, ListServs, electronic bulletin boards, and other synchronous electronic interactions were replacing traditional office hours. According to Atamian and DeMoville (1998), students actually preferred using Email over visiting the instructor in the office. In 2001, both Wallace & Wallace (2001) and McKeage (2001) discussed their real-life experiences with electronic office hours. Similarly, many students prefer online homework systems due to their convenience and ease of use (Johnson & Conrad, 2001). Clearly, the discussion has started and is ongoing.

Electronic office hours differ from the traditional practice of scheduled availability on campus. Whereas traditional face-to-face meetings have high information richness, electronic media tend to be primarily text-based. Wallace and Wallace (2001) list six distinct types of computer-based communication tools; 1) E-mail, 2) newsgroups, 3) text-based computer conferences, 4) video-based computer conferences, 5) computer-based voice communication, and 6) shared applications. With the exception of shared applications, none of these provide an efficient means of giving real-time, graphics-intensive individualized assistance. The first three tools rely on typewritten text only, videoconferencing merely adds a face to the voice, and VOIP and prerecorded messages do not offer visual cues. Even shared applications are very limited in their usefulness, since they cover only part of the desktop and do not allow fast switching between applications. The recent advances in RDS technologies offer an opportunity to fill this gap.

Remote Desktop Sharing

Using RDS, instructors can offer students assistance on their own computer, using their own applications, and using the student's own partially completed files. Students can demonstrate the problem, and

allow instructors to demonstrate solutions on the student's machine.

Early RDS technologies focused on remote computer management. Increased networking of distributed computers created a need for the ability to remotely start and stop services, install software, and supervise the use of machines without physical presence of Information Technology (IT) professional. Early remote administration involved command line interfaces and access through web pages, which did not allow the IT professional to share the same view with a local user. With increasing computational power, more intensive graphics processing, and a surge in available bandwidth, sharing the complete computer desktop has become feasible.

A wide variety of commercial and free RDS programs is now available. All rely on the use of a server on the local machine and the use of a remote client application. In some cases, the same software acts as server and as client, depending on whether it is used to share the local desktop or to view a distant desktop. Some programs use a shared third server to establish the connection, to facilitate locating the target computer and to establish the connection. Finally, some applications can use a web browser as the client, eliminating the need to install software if only remote viewing is needed. For this study, we used the Crossloop application (http://www.crossloop.com) which can be used without charge.

Technology Adoption in Information Systems

A critical element in the process of technology adoption is acceptance by the prospective user. The predominant model of technology adoption in Information Systems has developed in several stages.

The first technology adoption theory in Information Systems specifically developed for IS was the Technology Acceptance Model (TAM) (Davis, 1989). Based on the Theory of Reasoned Action (Fishbein and Ajzen, 1975) and the Theory of Planned Behavior (Ajzen, 1991), TAM presents the intent to adopt a technology as influenced by Perceived Ease of Use and Perceived Usefulness. Thus, the adoption decision was considered only in the realm of individual decision making, independent of outside social influences and differences between individuals (Figure 1).

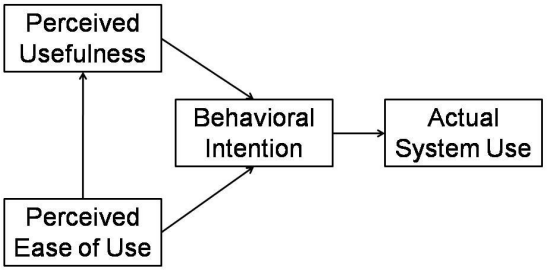

Figure 1 - Technology Adoption Model (TAM)

After slightly more than a decade, Venkatesh and Davis (2000) augmented the model by including social influences of people significant to the adopter (Subjective Norm) and status (Image) on Perceived Usefulness. Other non-social additions include applicability to work (Job Relevance), quality of results (Output Quality), and visible results (Result Demonstrability) (Figure 2).

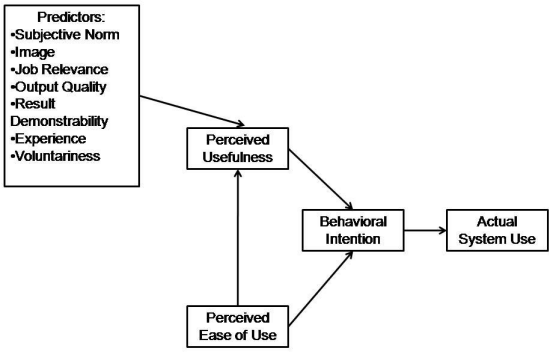

Figure 2 - Technology Adoption Model 2

Only three years later, in 2003, Venkatesh et al. incorporated several more models into the comprehensive Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT combines technology factors, (Performance Expectance, Effort Expectance), social factors (Social Influence, Facilitating Conditions, Voluntariness of Use), and personal factors (Age, Gender, and Experience). Performance Expectancy (PE) is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance. In general, PE relates to any anticipated external reward or advantage as a result of using the system. In previous studies using the Technology Acceptance Model, PE was generally the strongest predictor of Behavioral Intention

(e.g. Agarwal & Prasad, 1997). Effort Expectancy (EE) is defined as "the degree of ease associated with the use of the system", and is phrased in positive terms. Social Influence (SI) is defined as "the degree to which an individual perceives that important others believe he or she should use the new system", and whether it should be considered as a positive or a negative experience depends on the viewpoint of the individual adopter. If compliance with the social influence leads to pleasing results, SI can be considered as a reward and something to be sought. If, on the other hand, social influence focuses on the avoidance of disapproval from someone else, it would be a punishment. In an academic setting, both could apply. Finally, Facilitating Conditions (FC) is "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system". Together, these four constructs influence either the Behavioral Intention to Use (BI) and/or the Use Behavior (USE). A decision to act will precede a deliberate act, but intentions are not consistently followed by action. For the purposes of this study, we will focus on BI and not yet analyze actual use. Finally, the effects of the four main independent constructs are modified by the factors of AGE, GENDER, Experience with Technology (EXP) and Voluntariness of Use (VOL). EXP and VOL are not explicitly defined in the UTAUT model itself, and the measurement of the construct in the seminal UTAUT studies is not specified. Interestingly, several other constructs are modeled in UTAUT as not having an influence on BI. The first is Attitude toward Using Technology (ATUT), which is defined as "an individual's overall affective reaction to using a system" (Venkatesh et al., 2003). As such, the reaction to the specific system in a study – which is distinct from the response to technology in general – can be expected to overlap with other constructs, such as Effort Expectancy. The second and third constructs from previous research which are expected not to have an influence on intention or behavior, are presented as Self-Efficacy (SE) and Anxiety (ANX). Again, these two constructs have previously been proven to be non-significant influences due to their variance being captured by especially Effort Expectancy (Figure 3).

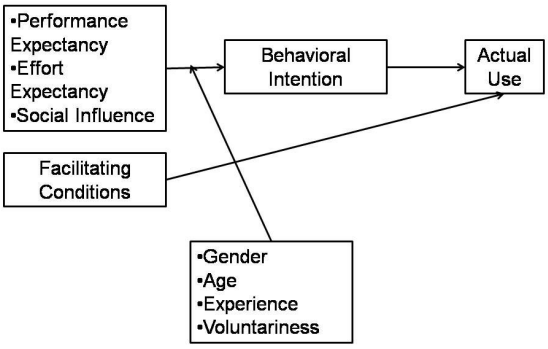

Figure 3 - Unified Theory of Acceptance and Use of Technology

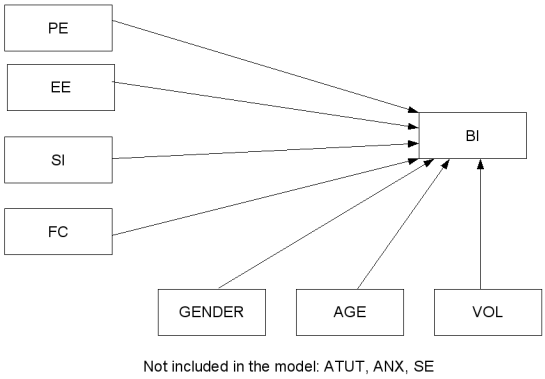

Figure 4 - Research Model

The preceding model has been used for our exploratory study (Hutchison and Bekkering, 2007), and will now be used as a basis for the follow-up study in this paper. In the previous limited study with only 25 subjects, the only statistically significant influence on the intent to use was attraction to the RDS technology, whereas Effort Expectancy and especially Performance Expectancy failed to show any effect. At the time, no explanation of this lack of result could be given. One theorized cause was the students' expected lack of availability of the instructor for remote sessions.

In the following section, we will describe how we used these adoption theories in our study of adoption of RDS in education.

3. METHODOLOGY

This section presents the research model in the study, the hypotheses, and the data collection. As in our previous study, the research model stated in UTAUT was modified as follows. The original four major constructs (PE, EE, SI, and FC) were retained but all

were modeled as independent constructs influencing one dependent construct, BI. USE was not included in the model. GENDER, AGE, and VOL were included, but as independent constructs influencing BI directly. EXP was not included in the model, since participants in the study were introduced to the technology for the first time. The model is again presented in **Error! Reference source not found.**.

In addition to the items in the original study based on UTAUT items, we included open-ended questions regarding use during the semester, perceived advantages, and perceived disadvantages. As before, the constructs ATUT, ANX, and SE were included in the study to examine if they would show any effect. The same hypotheses were used and tested as before:

H1: Performance Expectancy will have a significant positive influence on Behavioral Intent

H2: Effort Expectancy will have a significant positive influence on Behavioral Intent

H3: Social Influence will have a significant positive influence on Behavioral Intent

H4: Facilitating Conditions will have a significant positive influence on Behavioral Intent

H5: Gender will have a significant influence on Behavioral Intent

H6: Age will have a significant influence on Behavioral Intent

H7: Voluntariness will have a significant influence on Behavioral Intent

H8: Attitude Toward Use of Technology will not have a significant influence on Behavioral Intent

H9: Anxiety will not have a significant influence on Behavioral Intent

H10: Self-Efficacy will not have a significant influence on Behavioral Intent

Sample

Data collection was repeated at the same regional university in the Midwestern USA as before. We recruited volunteers from our classes taught in the Fall 2007 and Spring 2008 semesters. In contrast to the first study, an orientation session to the RDS software was a mandatory assignment in the course rather than an optional extra credit opportunity. In the description of the assignment, we emphasized that a special Skype telephone number had been created, and that students could call at any time. If the phone was answered, this signaled that the instructor was willing and ready to assist. Extra credit could only be earned by completing the survey at the end of the semester, and students could only participate in the extra credit survey if the RDS assignment at the beginning of the semester had been completed. Students enrolled in more than one section could only participate once, but received the extra credit points in all courses in which they were enrolled. This eliminated multiple submissions for the same subject. Students, who did not have their own Windows based computer with administrative privileges, could use one of our office desktop computers to complete the assignment. All participants received the same written instructions distributed by email and posted on the BlackBoard website. Instructions included an explanation that the software could not be used as spyware, the promise of confidentiality rather than anonymity because university IDs were needed to award the extra credit, the need to have administrative access to a Windows computer, the right to withdraw, and the restriction of availability to only those students who had completed the RDS assignment.

Procedures

First, students installed the Crossloop remote desktop application on their own computer from the website at http://www.crossloop.com . Instructions for installation, complete with screen shots, were available on BlackBoard. After installation, which generally took less than five minutes, students dialed the Skype number for remote assistance. This allowed the authors to answer the phones hands-off and concentrate on working with the students with both hands available. The audio quality of the VOIP connection was good throughout. A script of the sessions is included in our previous study (Hutchison and Bekkering, 2007). Students started the Crossloop application. We talked the participants through setting up the joint session on the student's computer and alternated with the students in working on their desktop following the protocol. At the end of the session, we disconnected the phone call and the remote desktop. The link to the survey was only

available during the last two weeks before finals week, and the new list of questions is included as an appendix.

4. DATA ANALYSIS

A total of 119 students participated in the study. Distribution by gender was equal with 61 male and 58 female participants. The mean age was 24.6 years (s.d. = 8.01). Missing values for scale items were replaced with the average for the other construct items. Reverse item scores were corrected and the average scores for constructs analyzed with Regression Analysis in SPSS 10.5. Stepwise Regression demonstrated a statistically significant model (p = .000) with Performance Expectancy, Attitude Toward Use of Technology, and Self Efficacy as significant factors. The Beta coefficients for PE (.276) and ATUT (.279) were virtually identical, and the Beta coefficient for Self Efficacy was still relatively strong at .162 . Contrary to our first study where the Beta coefficient for Effort Expectancy was negative, Effort Expectancy in our larger sample did not show any statistical significance (.856). We regard the negative Beta for EE in our previous study as a statistical artifact of the small sample size. All other constructs did not show any statistical significance. The total model accounted for an adjusted R2 of .315, thereby explaining 31.5% of variance.

During the semester, only a few students actually tried to solicit our help using RDS. Examples of actual use included assistance with programming in Visual Basic when students could not find the cause of errors, and difficulties using an Access database. Considering the positive results on the survey, the lack of actual use is a little surprising. The explanation may lie in the responses to our open-ended question: "Have you used the software during the semester? If you did, please discuss your experiences. If you did not, please discuss why you did not use it". Some typical results include:

> *I didn't use the software during the semester because any work that I needed help in I was in class to ask for any concerns that I had.*
>
> *I didn't use the software this semester besides the first assignment because I didn't have anything this semester that would require someone to get on my computer to show me anything But I am keeping it on there just in case It will come in handy I am sure*
>
> *I used Crossloop at the beginning of the semester to complete the required assignment. I have not used it any other time for help with an assignment, but that is simply because I have never required help with any issue that would benefit from Crossloop. I really liked the idea of Crossloop. I think if I ever did need help with a something such as getting stuck when working on an Access database then this software would be extremely helpful, I would definetly (sic) use it if that situation ever arised (sic).*
>
> *No, I just haven't felt the need to.*
>
> *No. I didn't use Crossloop ever after the first assignment (sic) because I did not need to use it. Other assignments needed just typing with Word or Excel.*

Other students reported use of RDS with family or friends, or to help other students

> *Received help in visual basic from a peer. This was a great experience.*
>
> *Yes I have used it with my sister. We have been working on some music projects and it seems to help*

Other clues emerge from answers to the question: "Have you used other methods of obtaining support from your instructor? If yes, in which ways did you seek help, and what were your experiences? If no, why did you not seek support or why did you only get support with the remote desktop?"

> *I prefer face to face conversations, maybe I am just old fashioned! Have not had the need to use crossloop yet.*
>
> *Yes I always just went to his office; it is more hands on and easier for me to ask questions.*
>
> *No. My policy is asking my friends in class first, and then ask my instructor.*
>
> *I usually just find the professor or email him with concerns. Sometimes I look to other students for assistance.*

The results of the quantitative analysis combined with answers to the qualitative questions suggest that RDS is considered to be something that can be useful (PE), is attrac-

tive (ATUT), and something that students can master with or without assistance (SE). However, with the plethora of communication tools available, there may just not be a perceived urgent need on the students' part to use it.

Finally we used the answers to the questions regarding advantages and disadvantages to synthesize a list of both. Both authors reviewed the answers iteratively, grouped answers together, and discussed wording and content of each item. The results are listed in Table 1.

Table 1 - Advantages and Disadvantages of RDS Use

Advantages	Disadvantages
The software allows me to get assistance without having to travel	The software can only be used when an internet connection is available
The software allows me to get assistance without having to wait for the next meeting	The software needs a high-speed internet connection
The software allows me to get one-on-one assistance outside regular hours	The software can not be installed on the computer I use to do most of my work
The software allows me to get assistance with problems specific to my computer	I need administrative privileges on a computer before I can install the software on it
The software allows me to demonstrate a problem without having to rely on explanation only	To use this software, all users have to be available at the same time
The software allows the person who helps to demonstrate and explain the solution to a problem	The time to use this software has to be available for both users
The remote user can see what I do as I demonstrate	It is hard to find out if help is available when I need it
The remote user can take control and help solve a problem for me	This software is difficult to install
The software allows me to give assistance to friends or family	Other ways of getting assistance are sufficiently available
The software allows me to get assistance from friends or family	The remote user could continue to work on my computer without my knowledge
This software allows students to help each other	The remote user could do things on my computer without my knowledge
The software allows students to work remotely on group projects	This software could make my computer vulnerable to viruses, hackers, or spyware
The software is easy to install	I don't want to install yet another piece of software on my computer
The software is simple to use	A remote user could accidentally cause damage to my computer
The software is secure	I have difficulty using a telephone and a computer at the same time
Using this software decreases the risk of miscommunication about computing problems	Simple questions can be answered more easily with other methods
Sessions can be disconnected by any user at any time	Having a remote user type and use the mouse on my computer scares me
	This software can not be used by more than two people at a time

5. CONCLUSIONS AND FUTURE RESEARCH

Based on the new results in this larger sample, some findings of UTAUT could be reproduced.

As in many studies, Performance Expectancy was a significant factor. On the other hand, factors like Self Efficacy and Attitude Toward Using the Technology which usually do not yield significant results, did appear as significant factors in this study. A summary of the

results of hypotheses testing is provided in Table 2.

Table 2 - Summary of Hypotheses Test Results

H_1: Performance Expectancy will have a significant positive influence on Behavioral Intent	Supported
H_2: Effort Expectancy will have a significant positive influence on Behavioral Intent	Not Supported
H_3: Social Influence will have a significant positive influence on Behavioral Intent	Not Supported
H_4: Facilitating Conditions will have a significant positive influence on Behavioral Intent	Not Supported
H_5: Gender will have a significant influence on Behavioral Intent	Not Supported
H_6: Age will have a significant influence on Behavioral Intent	Not Supported
H_7: Voluntariness will have a significant influence on Behavioral Intent	Not Supported
H_8: Attitude Towards Use of Technology will not have a significant influence on Behavioral Intent	Not Supported, does have effect
H_9: Anxiety will not have a significant influence on Behavioral Intent	Supported
H_{10}: Self-Efficacy will not have a significant positive influence on Behavioral Intent	Not Supported, does have effect

We also found a significant difference between the reported intent to use and the actual use. This could be seen as a social desirability bias caused by the extra credit for completing the survey, but we feel that this may be more an effect of a choice between multiple communication channels, the absence of a compelling need to get assistance, the reluctance to contact instructors during odd hours, and perhaps most of all, conflicting time schedules and other priorities which interfere with the time spent in the learning process.

Like our previous study, our current study has limitations. We do use students, which is appropriate for an educational study, but not for generalization to the population at large. As such, the results could be very different in business environments. The sample size is now much larger, which lends credence to the validity of the results. On the other hand, the positive effect Behavioral Intent could be (partially) due to a social desirability bias based on the extra credit reward.

The most important factors in the limited actual use could be based on lack of actual need, and the ease of other communication channels – especially face to face for traditional classes. In this respect, it would be instructive to compare the effects for face-to-face classes and online classes. Another intriguing comparison might be the type of course in which students are enrolled. Some courses do not require much technical assistance, because the work can easily be verbally or textually communicated.

In our follow-up studies, we plan to increase the sample size so that we can compare traditional and online classes, and include courses with varying levels of technical complexity in the analysis. The list of advantages and disadvantages in Table 1 may be used to develop another scale through Factor Analysis, and the results of both the UTAUT instrument and the new scale compared to establish which instrument might better measure perceptions and use. We hope that the results of this and future research will help to identify strategies to offer students more and better assistance between class sessions.

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APPENDIX: SURVEY QUESTIONS

1 PE - Performance expectancy
   i I would find remote desktop technology useful in my studies.
   ii Using a remote desktop technology enables me to accomplish tasks more quickly.
   iii Using a remote desktop technology increases my productivity.
   iv If I use a remote desktop technology, I will increase my chances of getting a better grade
2 EE -Effort expectancy
   i My interaction with remote desktop technology would be clear and understandable.
   ii It would be easy for me to become skillful at using remote desktop technology.
   iii I would find remote desktop technology easy to use.
   iv Learning to operate remote desktop technology is easy for me
3 ATUT - Attitude Toward Using Technology
   i Using remote desktop technology is a good idea.
   ii Remote desktop technology makes work more interesting.
   iii Working with remote desktop technology is fun.
   iv I like working with remote desktop technology.
4 SI -Social influence
   i People who influence my behavior think that I should use remote desktop technology.
   ii People who are important to me think I should use remote desktop technology.
   iii The administration of the university has been helpful in the use of remote desktop technology.
   iv In general, the university has supported the use of remote desktop technology
5 FC -Facilitating conditions
   i I have the resources necessary to use remote desktop technology.
   ii I have the knowledge necessary to use remote desktop technology.
   iii The system is not compatible with other remote desktop technologies I use (reverse scored)
   iv A specific person (or group) is available for assistance with difficulties
6 SE -Self-efficacy
   i I could use remote desktop technology if there was no one around to tell me what to do as I go.
   ii I could use remote desktop technology if I could call someone for help if I got stuck.
   iii I could use remote desktop technology if I had a lot of time
   iv I could use remote desktop technology if I had just the built-in help facility for assistance.
7 VOL – Voluntariness
   i Although it might be helpful, using remote desktop technology is certainly not compulsory in my studies.
   ii My instructor does not require me to use remote desktop technology.
   iii My instructors expect me to use remote desktop technology (reverse scored)
   iv My use of remote desktop technology would be voluntary
8 ANX - Anxiety
   i I feel apprehensive about using remote desktop technology.
   ii It scares me to think that I could lose a lot of information using remote desktop technology by hitting the wrong key.
   iii I hesitate to use remote desktop technology for fear of making mistakes I cannot correct.
   iv Remote desktop technology is somewhat intimidating to me.
9 BI - Behavioral Intention to use the system
   i I intend to use remote desktop technology in the next 12 months
   ii I predict I would use remote desktop technology in the next 12 months.
   iii I plan to use remote desktop technology in the next 12 months

10 SETUP – Setting up the Sessions
   i I would prefer setting up remote desktop sessions by using: (A telephone call / An email message / An Instant Message / Other:)
11 Please describe at least three advantages to using remote desktop technology for remote assistance of students
12 Please describe at least three disadvantages to using remote desktop technology for remote assistance of students
13 Have you used the software during the semester? If you did, please discuss your experiences. If you did not, please discuss why you did not use it
14 Have you used other methods of obtaining support from your instructor? If yes, in which ways did you seek help, and what were your experiences? If no, why did you not seek support or why did you only get support with the remote desktop?
15 Should using the remote desktop be more convenient? If not, what do you find convenient about its use? If yes, what would have to be more convenient?
16 GENDER (Male / Female)
17 AGE (numerical, not grouped)
18 University ID – necessary to award extra credit