

**From Digital Divide to Digital Opportunity:
the Adoption of e-Tutoring by a Rural School District**

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Abstract

The ubiquity of Web 2.0 technologies has led to a seismic shift in the way educational services are delivered. It comes as no surprise then that e-tutoring—otherwise known as electronic or online tutoring—is quickly supplanting face-to-face tuition for reasons of both cost and convenience. While e-tutoring is an effective form of academic support for many students, its efficacy remains tenuous for those confronted with a digital divide that figures predominantly around geographic barriers, socio-economic status, and educational levels. Premised on diffusion research, this master’s dissertation explores the implementation of an e-tutoring service known as Homework Help that has effected relatively low adoption rates. It uses a concurrent mixed-methods approach—including surveys, interviews, and focus groups—to examine the factors that have led to this low adoption rate. The results are presented via two journal articles situated within a larger meta-talk: The first article contrasts the adoption patterns apparent between rural and urban students, while the second article looks at the utility of diffusion research in examining educational technologies, as it explores the use of e-tutoring for applied-stream students. The findings of this study suggest that rural and urban, as well as applied and academic student subgroups, differ in terms of their perception and adoption of e-tutoring. Implications for educational policy, especially in regards to rural education, are discussed.

Table of Contents

ACKNOWLEDGEMENTS	I
LIST OF FIGURES.....	VII
LIST OF TABLES.....	VIII
LIST OF APPENDICES	IX
CHAPTER ONE	1
INTRODUCTION	1
PURPOSE STATEMENT AND RATIONALE.....	4
MANUSCRIPT STRUCTURE	7
CHAPTER TWO	10
THEORETICAL FRAMEWORK.....	10
APPROACHES TO DOI.....	14
STRENGTHS AND LIMITATIONS OF DOI	16
CHAPTER THREE.....	20
LITERATURE REVIEW	20
INTRODUCTION	20
BACKGROUND INFORMATION ABOUT E-TUTORING	20
FACTORS HELPING THE ADOPTION OF ONLINE TUTORING.....	21
FACTORS HINDERING THE ADOPTION OF ONLINE TUTORING.....	25
<i>Summary</i>	29
CHAPTER FOUR	30
GENERAL METHODOLOGY	30
INTRODUCTION	30
RESEARCH QUESTIONS	30
OVERVIEW OF RESEARCH DESIGN	30
RESEARCH DESIGN RATIONALE	31
QUANTITATIVE PHASE.....	33
THE SUBJECTIVE <i>I</i>	42
CHAPTER FIVE	45
ARTICLE 1	45
THE E-TUTORING E-DIVIDE:	45
FACILITATING THE ONLINE ACADEMIC SUPPORT SERVICES IN RURAL SCHOOL DISTRICTS.....	45
ABSTRACT	45
INTRODUCTION	46
<i>The Digital Divide</i>	46
<i>The Present Study</i>	49
THEORETICAL FRAMEWORK.....	50
METHOD	51

<i>Participants</i>	52
<i>Materials & Procedure</i>	52
RESULTS	53
<i>Data Screening</i>	53
<i>Independent-Groups t Test</i>	54
<i>Factor Analysis</i>	55
<i>Regression Analysis</i>	56
<i>Discussion</i>	57
CHAPTER SIX	60
ARTICLE 2	60
THE IMPLEMENTATION OF E-TUTORING IN SECONDARY SCHOOLS: A DIFFUSION STUDY	60
ABSTRACT	60
THEORETICAL FRAMEWORK.....	65
<i>Diffusion of Innovations (DoI) Model</i>	66
<i>Technology Acceptance Model (TAM)</i>	68
<i>Uses and Gratifications Expectancy (UG) Theory</i>	69
<i>The Current Study</i>	71
METHOD	72
<i>General Overview</i>	72
<i>Participants</i>	74
<i>Procedure</i>	74
RESULTS	76
<i>Quantitative Results</i>	76
<i>Qualitative Results</i>	82
DISCUSSION	89
<i>Limitations of the Study</i>	91
<i>Conclusion</i>	91
CHAPTER 7	93
CONCLUSION	93
IMPLICATIONS.....	97
LIMITATIONS AND FUTURE DIRECTIONS FOR RESEARCH	101
CONCLUDING REMARKS	104
REFERENCES	106
APPENDICES	115
APPENDIX A: HOMEWORK HELP SURVEY	116
APPENDIX B: INTERVIEW PROTOCOL	126
APPENDIX C: FOCUS GROUP PROTOCOL	127

List of Figures

Figure 1: Screenshot of a Session in Homework Help	3
Figure 2: A Comparison and Overview of the Two Articles Presented in this Study.....	8
Figure 3: Theoretical Rates of Diffusion of Three Different Innovations	11
Figure 4: Rogers' (2003) Model of the Five Stages in the Innovation-Decision Process	12
Figure 5: Data Collection Process	30
Figure 6: Concurrent mixed methods triangulation design	33
Figure 7: Rogers' (2003) Diffusion of Innovations Model	71
Figure 8: Pie Chart Demonstrating Percentage of Responses in the Dependent Variable, Adoption of Homework Help	99
Figure 9: Survey responses concerning why students passively rejected Homework Help	102
Figure 10: Survey Responses Concerning Students' Perceptions after Using Homework Help	103

List of Tables

Table 1: Eight Typologies of Diffusion Research	13
Table 2: Order (by Size of Loadings) in Which Variables Contribute to Factors	55
Table 3: Standard Multiple Regression for Factor Scores of Total Sample on DV with Severe Positive Transformation	57
Table 4: Overview of Mixed Methods Used in the Present Study	73
Table 5: Factor Loadings, Communalities (h^2), and Percent of Variance for Principal Factors Extraction and Varimax Rotation on Academic Data	80
Table 6: Standard Multiple Regression of Factor Scores on HH Rate of Adoption within the Academic Subgroup	81
Table 7: Standard Multiple Regression of Factor Scores on HH Rate of Adoption within the Applied Subgroup	81
Table 8: Themes and Subthemes from Qualitative Analysis	83

List of Appendices

Appendix A:	
Homework Help Survey	117
Appendix B:	
Interview Protocol	119
Appendix C:	
Focus Group Protocol	120

CHAPTER ONE

Introduction

As I sit here typing, I notice the letters QWERTY at the top row of my keyboard, and I am reminded why I began this study in the first place. In 1873, Christopher Latham Sholes invented the QWERTY keyboard.¹ What most people do not realize is that this keyboard is incredibly inefficient, having been “anti-engineered” to slow typists back in the days where typewriters frequently jammed if two keys were tapped rapidly in succession. Further, a much more efficient keyboard known as the Dvorak exists, but hardly anyone uses it. Sholes rearranged the keys of the QWERTY keyboard so that the most common letter sequences were awkward in order to prevent jamming. He also ensured that all the letters for the word “typewriter” could easily be pecked out using only the top row (QWERTYUIOP)—a gimmick that enabled salesmen to wow their potential customers. As typewriters became mechanically more efficient, there was increasing disfavour with the awkward QWERTY keyboard.

Then, in 1932, Prof. August Dvorak of the University of Washington entered the scene. Dvorak spent a decade analyzing time-and-motion studies in order to create a more efficient keyboard, and he succeeded. Dvorak’s new keyboard featured the most commonly used letters in the home row, while less frequent letters were situated in the top, then bottom, rows. It allowed for the most frequently used letters to be assigned proportionally to the fingers with the most strength and dexterity. Another feature was that a greater proportion of typing could be done with the right hand (the opposite of the QWERTY) as 90% of the population is right-handed. Finally, it allowed for successive keystrokes to fall to the reverse hand allowing the

¹ The facts from this anecdote have been taken from Rogers’ (2003) account of the non-diffusion of the Dvorak keyboard.

other hand to move into place for a subsequent letter. This was achieved by putting a majority of the vowels on the left side of the keyboard while the consonants were placed mainly on the right. Despite the fact that secretaries caught on to the new keyboard in less than a week, despite speed tests confirming the superiority of the Dvorak key arrangement, and despite the relative technical ease to switch a Dvorak with a QWERTY on almost any computer, Dvoraks have gone the way of the Dodo bird.

The preceding anecdote illustrates that, despite an innovation's seemingly advantageous qualities, a novel idea or technology may still face non-adoption. In the case of the Dvorak, numerous contextual variables contributed to its lack of success. By the time the Dvorak keyboard was invented, many people had grown comfortable and complacent, blissfully unaware that anything could compare with their QWERTY. Typing teachers had their lessons set. Manufacturers had perfected their process. And, do not forget those salesmen who could impressively type the name of their product with astonishing speed.

This study seeks to understand an innovation that, like the Dvorak, has achieved relatively low adoption. Also like the Dvorak, the innovation is, as this study will illustrate, well designed and well conceived, although the context of the adoptees was not sufficiently addressed prior to implementation to maximize the innovation's adoption. The study examines the implementation of an e-tutoring service known as Homework Help in a predominantly rural school board in Ontario, Canada. The study is premised on Rogers' (first published in 1962, and most recently in 2003) diffusion of innovation (DoI) theory², which for decades has enabled stakeholders to effectively and efficiently position innovations to reach their critical mass.

² This theory is further explained in the *Theoretical Framework* section.

Homework Help uses e-tutoring—otherwise known as electronic or online tutoring—to provide assistance to Grades 7 to 10 students with their mathematics homework. The program was first piloted by the Ontario Ministry of Education (OME) in 2008 by the Hamilton-Wentworth District School Board, located in Ontario, Canada. The pilot project has since expanded to include 31 school boards with a combined population of approximately 236,000 students, and plans are underway to launch the service province wide (OME, 2011). The service works by providing free, confidential, one-on-one tutoring to students five nights a week from the privacy of their own homes. Ontario certified mathematics teachers provide their tutees with synchronous (real-time) assistance in grade-specific chat rooms equipped with virtual whiteboards (see screenshot in Figure 1), useful for graphing and equations. The site is also equipped with video tutorials and interactive exercises on a variety of core mathematics topics.

Figure 1. Screenshot of a Session in Homework Help

The screenshot displays the Homework Help interface. At the top, a blue header bar contains 'Welcome to TUTOR's Room.', 'Glossary', 'Calculator', and 'v.2.13'. Below this, a timestamp reads '2011-01-17 19:57:04'. The interface is divided into three main sections:

- Queue/Chat:** On the left, a 'Queue' tab is active, showing a list of users. Below it, a 'Chat' window displays a conversation about a trigonometry problem. The problem text is: 'From a point 5m from base of a building, Lance measures the angle of elevation to the top of the building. The angle of elevation is 20°. How tall is the building, to one decimal place? I do not understand what they are asking me'. The chat history shows several student messages and a tutor response.
- Whiteboard:** The central area is a whiteboard where a problem is being solved. It features a hand-drawn diagram of a right-angled triangle. The horizontal base is labeled '5m' and 'adj'. The vertical side is labeled 'x' and 'opp'. The angle of elevation is labeled '20°'. To the right of the diagram, the following calculations are written:

$$\tan 28^\circ = \frac{x}{5}$$

$$x = 5 \tan 28^\circ$$

$$x = 2.7$$
 Below these calculations is a smaller, cleaner diagram of the same triangle with a vertical side of '2.7', a horizontal base of '5', and an angle of '28°'.
- Audio:** At the bottom left, there is an 'Audio' section with a play button and a progress bar showing '00:00'.

Note: Tutor's comments are not visible because they are in audio, not text.

Though tutoring, whether online or conventional, has been shown to be an effective intervention in the area of numeracy achievement (Biesinger & Crippen, 2008; Fuchs et al., 2008a; Fuchs et al., 2008b; Means, Toyama, Murphy, Bakia, & Jones, 2009; Merriman & Coddington, 2008; Song, 2005), questions remain concerning its potential adoption by certain subgroups of the population, such as rural and at-risk³ students. Some of the primary concerns are those factors attributed to the digital divide including geographic and socio-economic barriers (Hannum, Irvin, Banks & Farmer, 2009; Looker & Thiessen, 2003; Miller & Weber, 2003; OECD, 2001), which studies have shown to hinder the diffusion of digital technologies. Given that an “urban–rural digital divide persists in Canada with the odds of using the Internet being almost one-and-a-half times greater for someone who lives in an urban area” (Noce & McKeown, 2007, p. 462), caution must be exercised by policy makers seeking an urban fix to a rural problem. Equally as concerning are academic interventions that are appealing to only academically-inclined students, further expanding the divide between them and at-risk students.

Purpose Statement and Rationale

The purpose of this concurrent mixed-methods study is to explore the implementation of Homework Help in one of the 31 school boards involved in the pilot project, a board with a predominantly rural population located in Eastern Ontario, Canada. Specifically, the study used surveys to measure factors that correlate most closely with Homework Help’s adoption—especially as these might differ between rural and urban students, as well as academic and

³ At-risk students are defined as those students who “are performing significantly below the provincial standard, earning marks in the 50's and low 60's and who do not have the foundations to be successful in the new curriculum” (O'Connor, 2003).

applied student subgroups. Concurrently, the factors underlying Homework Help's adoption, or lack thereof, were explored using qualitative interviews and focus groups conducted with various stakeholders of the e-tutoring service.

I was motivated to conduct this study for a variety of reasons. In 2009, I taught my school district's pilot e-learning class in the same district in which I conducted this study. I knew first-hand the frustrations associated with using online technologies in this rural school district. As an instructor, I bemoaned the excruciatingly slow Internet connectivity at my home on the outskirts of town as I uploaded content to the course's Learning Management System, or downloaded students' assignments for evaluation. I heard from rural students who struggled to complete the course using dial-up Internet, finding access to the course's synchronous learning opportunities impossible unless they travelled into town where high speed Internet was more readily accessible. When I first heard about the Homework Help pilot project in our school district, I thought it would be a great opportunity for students to receive extra help with mathematics homework. However, I also questioned the service's applicability to rural students as it, like sections of the online course I had taught, uses primarily synchronous communication, which is severely hindered by slow Internet connectivity.

Further, I questioned the equality issues surrounding a service that assumes that all, or at least the majority, of students' families can afford a home computer and high speed Internet access. Having lived in this area for most of my life, I know that in many small towns, hamlets, and remote areas, the only way to get high speed Internet is via satellite reception, and that can cost upwards of \$70 a month. This would surely make Internet affordability tenuous for the 12.3% of the school district's children 17 and under who live below the Low Income Cut-Off (LICO). Even more alarming is the LICO rate for the town where I taught at 26.2% (Child

Poverty Action Network, 2001). From my teaching experience, I was also aware that a number of students did not have a personal computer in their home and would type their assignments in the library at lunch or submit them handwritten. This informal awareness was confirmed by data collected by Education Quality and Accountability Office (EQAO). According to a 2010 EQAO report of the school district under study, 52% of applied stream students and 34% of academic stream students indicated that they did *not* have a computer at home to use for mathematics school work.

Lastly, I questioned the relevance of Homework Help for our district's at-risk students who are most in need of help. Would this be the clientele who would go out of their way to seek help in the evening on their own time, the only time the service is offered? From my eight years of teaching experience, I expected not. I was especially concerned about the applied-stream students, whom studies have shown to be at greater risk of dropout than their academic counterparts (Ferguson, Tilleczek, Boydell, & Rummens, 2005). As I elaborate in chapter 6, applied stream students in the province of Ontario are, in general, those who wish to pursue community college or enter the workforce upon graduating from high school, while academic-stream students typically enter university. My personal teaching experience suggested that academic students were more likely to have the motivation and external supports (i.e., parental involvement) to complete homework and seek help after hours; applied students, conversely, seldom were assigned homework, and if they were, many lacked the motivation or support to actually complete it. This informal observation was once again corroborated by EQAO (2010) data that found that while only 13% of academic students were typically *not* assigned mathematics homework on a daily basis, the percentage jumps to over 40% for applied students. While I understand that Homework Help is not intended to be a panacea for all academic issues,

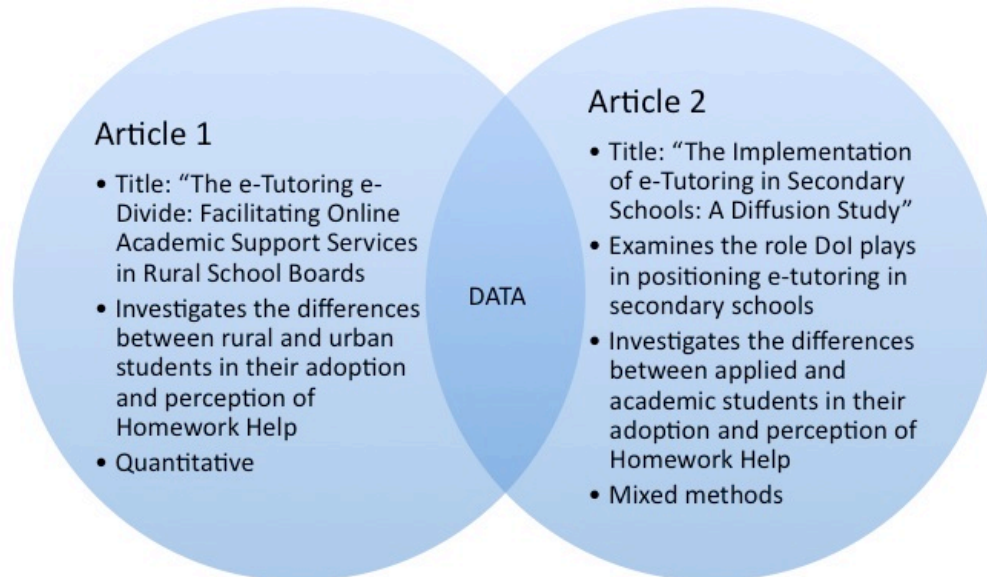
I worried that it would become yet another tool designed to fix something that does not really need fixing (services for academic, urban students), while that which needs to be fixed (services for applied, rural students) remains broken.

Grounded in these experiences, I set out to formally validate something of which I was informally aware: although Homework Help may be an appropriate form of academic intervention for the average student, it would likely fall short in its ability to reach certain subsets of the student population, namely rural and at-risk students. The following questions guided my thinking during this research project: Are there significant differences in the rates of adoption of Homework Help between urban and rural, as well as applied and academic students? If so, what factors might explain these differential rates of adoption? Knowing the answers to these questions may help policy makers address issues pertaining to the quality and equality of educational support, and lead to innovative practices to better meet the needs of those who most need help.

Manuscript Structure

The approach that I have taken to present my master's thesis is that of a dissertation comprised of two interrelated articles intended for eventual publication in peer-reviewed journals. These articles are contextualized within a larger meta-talk. To that end, I have set up the articles with an introductory piece, followed by a discussion of the theoretical framework, a review of the literature, and a general methodology common to them both. In the methodology chapter, I also offer a reflection of my personal connection to the project, with the goal of elucidating the personal biases inherent in my research; though like any researcher my goal was to remain objective, I recognize that this an ideal, not a reality.

Figure 2. A Comparison and Overview of the Two Articles Presented in this Study



The core of this manuscript lies in the next segment, the articles. Though both articles drew from the same data source, I used different subsets of the data in order to frame two unique and novel articles. The first article is entitled “The e-Tutoring e-Divide: Facilitating Online Academic Support Services in Rural School Boards.” I presented this paper at the International Conference on Education this July, 2011, in Samos, Greece. The paper was also published as a part of the conference proceedings and is being considered for publication in the journal affiliated with the conference, the *Journal of Social Sciences*. The second paper, “The Implementation of e-Tutoring in Secondary Schools: A Diffusion Study,” was presented at the Canadian Society for the Study of Education this May, 2011, in Fredericton, Canada. I will also endeavour to have this article published in a journal, perhaps one relating to educational

technologies or mixed methods research. Figure 2 gives a comparison and an overview of the two articles.

This thesis manuscript will conclude with a overall discussion intertwining both articles. This especially will be the segment of the document that unites the studies into one corpus. Implications and future directions for this research will be discussed.

CHAPTER TWO

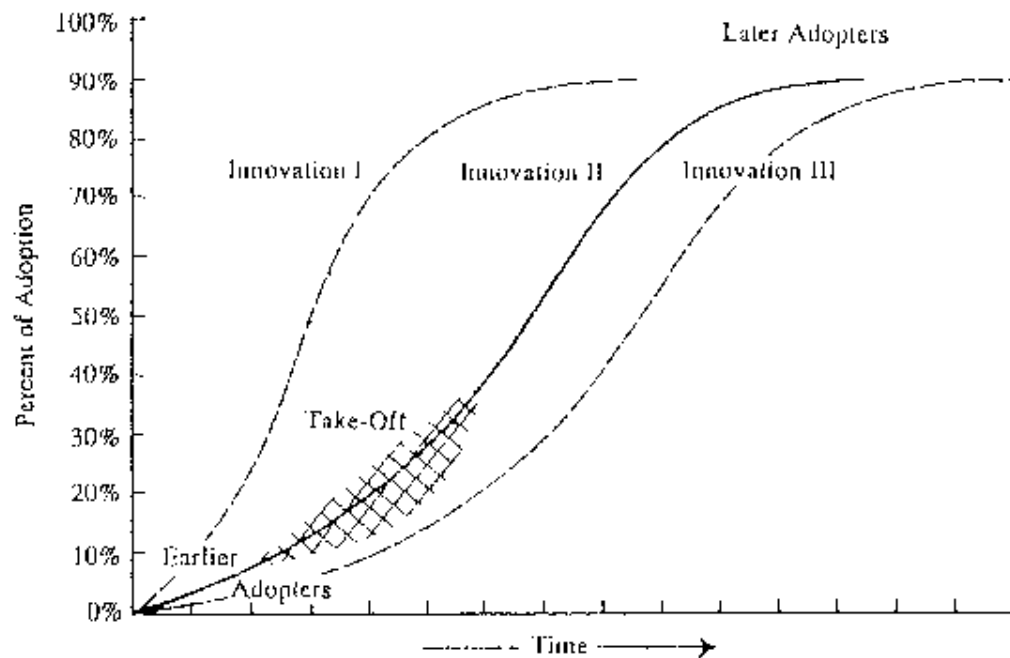
Theoretical Framework

Using diffusion of innovations theory (DoI), this study seeks to understand what motivates people to adopt some innovations quickly, others slowly, and some not at all. The theory is the product of Everett Rogers (2003) who synthesized research from over 508 diffusion studies and wrote the seminal work on the subject, *Diffusion of Innovations*, now in its fifth edition. As defined by Rogers, diffusion is defined “as the process by which an innovation is communicated through certain channels over time among members of a social system” (p. 5). To Rogers, any object, idea, or practice that is perceived as novel is considered an innovation. Perhaps Rogers’ broad definition of innovation helps to explain just how multi-disciplinary diffusion research has become as the word “innovation” has been applied to such diverse entities as HIV education (Kelly et al., 1997) and hybrid corn (Ryan & Gross, 1943).

Traditionally, diffusion is measured in terms of an innovation’s rate of adoption. As illustrated in Figure 3, this rate follows the classic “S” curve. Initially, the rate of an innovation’s adoption takes off slowly as it is adopted by only a small group of people, aptly named the *innovators*. Then, generally speaking, the rate of adoption experiences a quick rise, as the *early adopters*, the *early majority*, and the *late majority* adopt. Finally, the curve levels off as the *laggards* adopt, leaving fewer and fewer people who have not yet adopted (Rogers, 2003). Many studies have researched the characteristics of early versus late adopters, and the findings are that those who adopt earlier tend to be better educated, have more resources, be more cosmopolite, and have a higher social status (Deutschman & Fals Borda, 1962). While Rogers can be credited with popularizing diffusion research and applying it to a variety of fields, the original diffusion research was done as early as 1903 by the French sociologist Gabriel Tarde

(1903, reprinted in 1969). Tarde plotted the original S-shaped diffusion curve, which according to Rogers, has been shown to characterize the adoption patterns of most innovations.

Figure 3. Theoretical Rates of Diffusion of Three Different Innovations
(Source: Rogers, 2003)

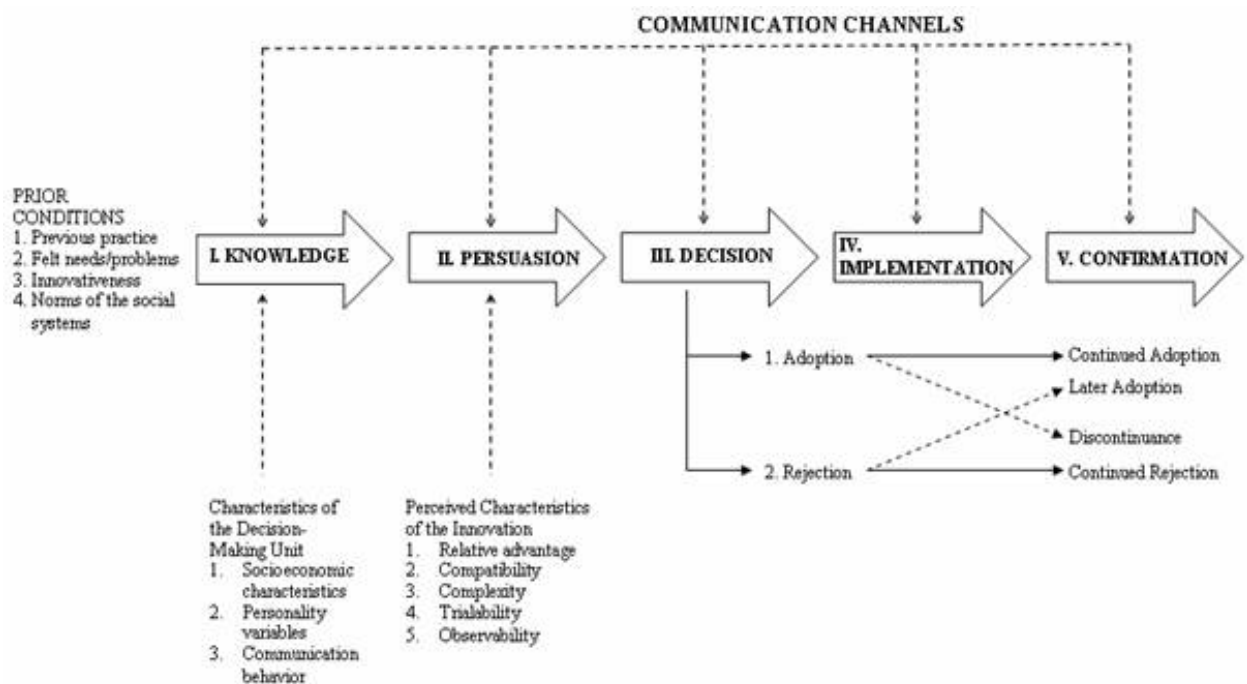


Two central goals of diffusion research are firstly, to speed up the rate of adoption, as illustrated in Figure 1 by Innovation 1; and secondly, to encourage more people to choose adoption over non-adoption or rejection. In the strictest sense, *adoption* refers to an individual's decision to make use of an innovation as the best course of action available, while *diffusion* refers to a collective of adoption decisions by a social system (Rogers, 2003). However, these terms are often used interchangeably, with Rogers himself using the term diffusion as an umbrella topic under which adoption falls. Rejection, also known as active rejection, occurs when an individual fully considers the pros and cons of adoption, but decides against it

nevertheless, perhaps after a trial period. Non-adoption, or passive rejection, occurs when an individual never fully considers using the innovation in the first place.

Rogers' DoI theory provides a comprehensive model encompassing many complex and dynamic psychological and sociological processes that have been empirically verified over the decades to explain the process of diffusion. Figure 4 illustrates this process and its accompanying stages. Researchers (Ryan & Gross, 1943, as cited in Rogers, 2003) describe the process through which an individual comes to an innovation-decision, the decision to either adopt or reject an innovation, in five steps.

Figure 4. Rogers' (2003) Model of the Five Stages in the Innovation-Decision Process



The first stage is *knowledge*, which occurs when an individual learns about an innovation for the first time, either through the mass media or interpersonal communication. Take, for example, my recent purchase of a smartphone: I both read about its features in advertisements (mass media) and heard about them through my brother-in-law (interpersonal) who had

previously purchased one. Diffusion studies have shown that early adopters (my brother-in-law) generally first hear about an innovation via mass media, whereas late adopters (me) hear through interpersonal connections (Rogers, 2003).

During the second stage, called the *persuasion* stage, individuals try to reduce their uncertainty about an innovation by discovering more about its advantages and disadvantages, which Rogers grouped into five categories, also known as innovation attributes: relative advantage, compatibility, complexity, observability, and trialability. Being able to try the innovation in a risk-free manner (*trialability*) is important to help move individuals beyond this stage, though it should be noted that these stages are fluid and *persuasion* continues to occur, even after an individual has opted to try the innovation. Innovations that are initially offered on a trial basis have been shown to be adopted more quickly (Rogers, 2003). In the case of the smartphone that I purchased, I was able to try out my brother-in-law's and try one out at the store where I eventually purchased the smartphone.

The third stage is the *decision* stage, which takes place when an individual actively chooses to either adopt or reject an innovation. Rejection can even occur after an individual's previous decision to adopt, for example if one forgot about the innovation. As hitherto mentioned, rejection can be classified as either active or passive, and although they are seldom discussed in literature (Rogers, 2003), it is important for researchers to distinguish between the two. A year prior to the purchase of my smartphone, I had previously considering purchasing one; however, after trying out my brother-in-law's smartphone at my house, I realized it could not pick up a cell phone signal in such a rural area, so I actively rejected the innovation at that time. It was not until I moved to a larger city that I adopted the innovation. My spouse,

conversely, could not be bothered with trying out a smartphone as he does not like to be interrupted during his personal time; this would be an example of passive rejection.

The fourth and fifth stages are *implementation* and *confirmation*, during which point individuals who have chosen to adopt the innovation put the idea, practice, or product into use. Following this, they seek reinforcement to ensure the correct decision was made. Even if adoption occurs at this point, problems can lead to subsequent rejection of the innovation if, for example, the innovation is difficult to obtain or use. Continued support must be provided during this stage to ensure this does not happen.

Approaches to DoI

Rogers' DoI theory offers eight distinctive typologies of diffusion research—depending on the intended unit of analysis, as well as the independent and dependent variables being studied (as outlined in Table 1). The diversity of methodological approaches lends to the theory's robustness, and demonstrates why DoI has achieved such prominence in diffusion research, in comparison with other theoretical approaches to diffusion.

Table 1: Eight Typologies of Diffusion Research (Source: Rogers, 2003)

Type	Dependent Variable	Independent Variables	Unit of Analysis	Percentage of Representation in Publications
1	Earliness of knowing about an innovation by members of a social system	Characteristics of members (e.g., cosmopolitaness, communication channel behaviour)	Members of a social system (usually individuals)	5%
2	Rate of adoption of different innovations in a social system	Attributes of innovations (e.g., complexity, compatibility, etc.)	Innovations	1%
3	Innovativeness of members of a social system (members may be individuals or organizations)	Characteristics of members (e.g., cosmopolitaness, communication channel behaviour, social status, resources, contact with change agents); system-level variables	Members of a social system (individuals or organizations)	58%
4	Opinion leadership in diffusing innovations	Characteristics of members (e.g., cosmopolitaness); system norms and other system variables; communication channel behaviour	Members of a social system (usually individuals)	3%
5	Diffusion networks	Patterns in the network links between two or more members of a social system	Dyadic network links connection pairs of individuals (or organizations) in a system	Less than 1%
6	Rate of adoption of innovations in different social systems	System norms; characteristics of the social system (e.g., concentration of opinion leadership); change agent variables (e.g., their strategies of change); types of innovation-decisions	Social systems	2%
7	Communication channel use (e.g., whether mass media or interpersonal)	Innovativeness and other characteristics of members of a social system (e.g., cosmopolitaness); system norms; attributes of innovations	Members of systems (or the innovation-decision)	7%
8	Consequences of an innovation	Characteristics of members; the nature of the social system; the nature and use of the innovation	Members or social systems or innovations	0.2%
			Others Total	22% 100%

Strengths and Limitations of DoI

Despite its popularity across many disciplines, DoI has its detractors. According to Fliegel and Kivlin (1966), “Diffusion of innovation has the status of a bastard child with respect to the parent interests in social and cultural research: Too big to ignore but unlikely to be given full recognition.” Fliegel and Kivlin were reacting to some incontrovertible shortcomings of DoI, ones that have been, and continue to be, addressed by researchers to this day. Like any good model, DoI is fluid, adapting and improving in response to the latest research and perspicacious thinking.

One of the strongest objections to DoI is the one levered by Dohms and Mohr (1976) who claim that there can be no integrative theory regarding the diffusion of innovations as the heterogeneity of people and organizational cultures is simply so immense that it is fruitless to construct typologies surrounding the perceived attributes of innovations. Or, put more prosaically, we are more different than we are alike when choosing whether or not to adopt an innovation. According to Dohms and Mohr, depending on an organization’s size, wealth, complexity, decentralization, and so forth, each organization would conceivably perceive an innovation’s attributes quite differently. For example, while a small business might consider an innovation too costly to implement, a larger organization might actually achieve savings through such implementation. However, others suggest that the problem is not necessarily with the DoI itself, but rather with the rigour of the methodology used by the thousands of researchers who have attempted this type of research (Tornatzky & Klein, 1982). Further, a meta-analysis of DoI research done by Tornatzky and Klein demonstrated that there is indeed a statistically significant relationship between the perceived attributes of innovations and their adoption, despite the heterogeneity of the organizations being investigated.

Another key criticism is DoI's tendency towards pro-innovation bias, a bias held by many researchers who myopically insist that the adoption of an innovation is always the most advantageous decision. Those who do not adopt are considered laggards who simply need to be shaken from their ignorance. On the contrary, studies have shown that individuals usually have very good reasons for rejecting an innovation, such as the innovation being incompatible with a person's lifestyle or financial situation (Rogers, 2003). At other times, the change agents charged with disseminating the innovation have failed to take into account the behaviours and attitudes of their potential adoptees. A classic example of this can be demonstrated by a study done by Wellin (1955) of a public health campaign to promote the boiling of drinking water in a Peruvian village. Despite repeated attempts by public health authorities to convince villagers of the benefits of boiling water to prevent water-borne disease, only 11 of the 200 or so families in the village adopted this practice. Wellin later discovered through his research that boiling water was considered culturally taboo by many of the villagers, where it is custom to heat food and water only for the ill; superstition prevents those who are otherwise healthy to engage in this practice. Further, many villagers were unconvinced of germ theory, the idea that microscopic bacteria and parasites live in water. It seemed illogical to many of the villagers who had never heard of, much less seen, a microscope.

The pro-innovation bias is not surprising, considering much adoption research is funded by the change agencies themselves (Rogers, 2003). Further, little research goes into innovations that have been rejected, as it is more difficult for researchers to trace this process. Thus, diffusion research can—if care is not taken—tend toward this bias. However, pro-innovation bias can be curtailed. In the case of the failure of the Peruvian water boiling campaign, much was learned through interviews with the villagers—a methodological approach that is often

ignored by diffusion researchers who use primarily quantitative methods. Further, more diffusion research needs to be done independently of the change agency so as to add greater clarity and objectivity to the findings. Also, as most diffusion research is done towards the end of a diffusion cycle, much more is known about successful, rather than unsuccessful adoptions (Rogers, 2003). Research into innovations that have been rejected might prove much more valuable, from an academic standpoint.

Another shortcoming of DoI that Rogers (1962) contended with during the development of his earlier model was the tendency of DoI to emphasize individual versus system blame for non adoption, which was especially prevalent in public health and safety campaigns. An often cited example of this would be the road safety campaigns from the 1960s and earlier. Despite national campaigns to “Buckle up” and “Don’t drink and drive,” motor vehicle accidents continued to climb. Ralph Nader’s (1965) book *Unsafe at Any Speed* helped redefine the problem from being that solely of the individual to that of the system at large. Federal legislation followed to make both roads and cars safer: laws soon required padded dashboards, air bags, and cars designed to maintain their integrity in the case of a crash. Roads were straightened, guard rails installed, and impact absorbers placed before road-side concrete columns. All of these changes led to the gradual reduction of deaths from motor-vehicle accidents. Referring to Table 1, it is evident that DoI has broadened beyond studying diffusion as simply that of an individualized process. In order for a diffusion campaign to be successful, change must be effected community wide.

A final limitation commonly cited in DoI research has been its over-reliance on cross-sectional instead of longitudinal studies. As previously mentioned, most diffusion research transpires towards the end of the diffusion process, long after most individuals have made their

decision regarding adoption or non-adoption. Although this is convenient from a methodological standpoint, it creates issues for participants who are asked to recall their thought process regarding their innovation-decision, sometimes months or years after it has taken place. A more rigorous diffusion study would use a longitudinal instead of a cross-sectional research design, as advocated by Tornatzky and Klein (1982), and more recently by Rogers (2003).

CHAPTER THREE

Literature Review

Introduction

In this literature review, I endeavour to provide a background into the history and growth of e-tutoring. Then, I examine the academic incentives for the provision of e-tutoring, and how these compare to those of traditional tutoring. Finally, and most importantly, I examine the literature in order to explore the factors that both help and hinder the adoption of online tutoring, especially in terms of the digital divide. I use this information to situate my study in the literature, and additionally to provide guidance during my development of the survey used in this study.

Background Information about e-Tutoring

E-tutoring is much like traditional tutoring in the sense that there is a tutor who provides academic remediation, or even enrichment, to a single or small group of tutees. What differs is the environment in which the tutoring is offered. As its name implies, e-tutoring—otherwise known as electronic or online tutoring—takes place in an online environment, typically using a Web site or Learning Management System⁴ as its platform. The advent of digital technologies has brought with it a host of interactive and collaborative features that have made e-tutoring especially popular. From synchronous (real-time) video or voice chat rooms to interactive white boards with graphing and equation functions, the possibilities are seemingly endless. Further, when the tutoring session is complete, a student may revisit it to reinforce learning as many e-

⁴ A Learning Management System, or LMS, is a software application used to administer a variety of online learning and training programs.

tutoring platforms offer a recording function. These features, coupled with the convenience of not needing to leave the comfort of one's home, mean that conventional tutoring is quickly being supplanted by its online counterpart. With all of these benefits, it is no wonder that e-tutoring is growing at a rate of 15% annually, its market share worth over \$132 million per annum in the United States alone (George & Dykman, 2009). Public, private, and not-for-profit groups alike are capitalizing on this technology in order to offer cost-effective academic support to students the world over.

Factors Helping the Adoption of Online Tutoring

E-tutoring seems to be a good fit for what Prensky (2001) calls a generation of digital natives; today's students, kindergarten through college, represent the first generations to grow up surrounded by digital technology. To illustrate this, "today's average college grads have spent less than 5,000 hours of their lives reading, but over 10,000 hours playing video games (not to mention 20,000 hours watching TV). Computer games, email, the Internet, cell phones and instant messaging are integral parts of their lives" (p. 1). For digital natives, using the Internet, video games, and cell phones, for example, is a natural extension of the digital world in which they live (Lissaman, et al., 2009). Thus, according to Prensky's theory, students in the Homework Help pilot project should transition seamlessly from conventional to online tutoring, perhaps even preferring e-tutoring to face-to-face tuition.

As digital natives naturally gravitate towards the Internet for help, e-tutoring may provide one important venue in fulfilling that need, especially in mathematics. Numerous studies have validated tutoring as an effective intervention strategy to support gaps in numeracy achievement (Biesinger & Crippen, 2008; Fuchs et al., 2008a; Merriman & Coddington, 2008). Fuchs et al. (2008a) concluded that tutoring is highly correlated with success in mathematics, noting a math

difficulty prevalence rate of 6.8% without tutoring, a figure that drops to 3.9% for students who received tutoring. Biesinger and Crippen (2008) found that students who used an online tutorial prior to taking the Nevada High School Proficiency Examination in Mathematics significantly outperformed those who did not ($p = .024$). Song (2005) noted similar findings with an introductory physics class supported by an online, homework related message board; students' posting and retrieving of content on the online message board was found to be positively correlated to students' final grades in physics. Basille (2001) actually found that students who experienced e-tutoring performed better on final accounting achievement scores than those who had traditional tutoring, though this difference was found to be small and statistically insignificant.

Aside from the few previously mentioned studies, there is a paucity of research specifically comparing e-tutoring to conventional tuition. However, a fairly extensive amount of research has been conducted comparing face-to-face education and distance education. While these studies are not specifically in the area of e-tutoring, they do speak to online instruction in general. For instance, one meta-analysis found no significant difference in academic achievement between online and face-to-face learning (Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004). More recently, a meta-analysis was commissioned by the U.S. Department of Education that examined more than a thousand empirical studies on online learning between 1996 and 2008 (Means, Toyama, Murphy, Bakia, & Jones, 2009). Surprisingly, it was found that "on average, students in online learning conditions performed *better* [emphasis added] than those receiving face-to-face instruction" (Means et al., 2009, p. ix). The study was certain to add, however, that the improved performance does not imply that online learning is superior to traditional per se, but is likely the result of a combination of factors including additional time

spent on task, additional learning materials, and additional opportunities for collaboration (Means et al., 2009). Means et al. caution that these findings should not be used to generalize in the area of K-12 education, however, as so few rigorous studies on this cohort have been conducted. Technological developments in the area of e-tutoring, such as many collaborative and interactive features offered by Web 2.0, may account for the different conclusions reached by the earlier and latter meta-analyses.

Given that the majority of studies find that students perform the same or better in an online environment, for reasons of cost and convenience, conventional learning and tutoring is now often supplanted with learning facilitated by the World Wide Web. According to Song (2007), an increasing number of educational institutions are “enabling students to access an Internet learning opportunity regardless of geographical, time, social, physical and economical constraints” (pp. 4-5). This verity may hold special significance when rurality is a factor, such as with the school district in this study. Whereas rural parents might find it burdensome to drive a child into the nearest town or city for a face-to-face tutoring session, the opportunity to receive tutoring online within the comfort of one’s home would eliminate that inconvenience. As the 2010 *Horizon Report* suggests, “People expect to be able to work, learn, and study whenever and wherever they want to. Life in an increasingly busy world where learners must balance demands from home, work, school, and family poses a host of logistical challenges with which today’s ever more mobile students must cope” (Johnson, Levine, Smith, & Stone, 2010, p. 2).

In addition to the convenience factor offered by e-tutoring, the fact that Homework Help is being offered free of charge will be likely be another major incentive. When confronted with the option of paying \$15 to \$70 an hour for a conventional tutor (George & Dykman, 2009), who may or may not be a certified teacher, it seems logical that most parents would opt for the free

services provided by Homework Help. Furthermore, the fact that Homework Help is free does not necessarily equate to lesser overall value of services. In fact, e-tutoring offers some benefits simply not possible with conventional tutoring. Homework Help, as well as other online tutoring platforms, allows for study sessions to be recorded and viewed at a later date to reinforce learning. Lissaman et al. (2009) noted the same feature with Elluminate, the live mathematics tutorial offered for 16-18 year-old mathematics students in England.

A final benefit of online tuition over conventional tuition may be that the lack of physical embodiment may lead to a less intimidating environment inasmuch as it may offer an opportunity for reticent students to overcome their unwillingness to seek assistance (Myers et al., 2004). The fact that e-tutoring services like Homework Help are anonymous may be especially appealing to these types of learners. In Song's (2005) study of an online physics message board where students could get help from a tutor or one another, 84% of students preferred to remain anonymous, even stating that if the service were not anonymous, it would diminish their use of it. Similar findings were found in Rabinovich's (2009) study of online tutorials at the Campus Writing Center at Queensborough Community College, a member institution of the City University of New York (CUNY): "The (online tutoring) system also provides tutees with the additional benefit of anonymity as student-author identities are not known to e-tutors. This anonymity ensures that even the most reluctant students feel safe to explore their writing options in a risk-free environment" (Rabinovich, 2009, p. 5).

While online tutoring offers many benefits, however, caution is advised in that "even the best computer based supplemental instruction systems cannot enhance student performance in isolation, and the most effective programs offer a comprehensive approach to include an optimal balance of enrichment and discovery activities, cooperative learning activities, and implicit

instruction” (Corbett et al., 2002, as cited in Biesinger & Crippen, 2008, p. 13). E-tutoring is by no means a panacea for all issues with the educational system, but rather should be conceived as another tool in the arsenal of educators.

Factors Hindering the Adoption of Online Tutoring

Despite the numerous seemingly advantageous qualities of online tutoring, such as the Ministry’s Homework Help, many barriers might prevent its adoption, especially given the constraints of rurality. Among these barriers are geography, socio-economic status, Internet accessibility, computer ownership, and motivational factors, both intrinsic and extrinsic.

The Organisation for Economic Co-operation and Development (OECD, 2001) defines the digital divide as “the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities” (p. 5). There is consensus among global and national leaders that this so-called digital divide compromises both equity and economic development issues (Looker & Thiessen, 2003; OECD, 2001). Divisions figure most predominantly around income, education levels, age, disability, minority status, and geographic location (Looker & Thiessen, 2003; OECD, 2001). What is especially disconcerting is that many of these groups overlap, leaving some doubly or triply disadvantaged; even more troublesome is that the digital divide in Canada is only widening (Looker & Thiessen, 2003).

The digital divide, ostensibly, should be a paramount policy concern for any organization desiring the adoption of digital technologies, which are known to contribute to economic development (OECD, 2001). It is the goal of the following section to address the major factors of concern with digital divide, especially where rural school districts are concerned.

Study after study corroborates rurality as an impeding factor in access to education, economic opportunities, and technology (Hannum, Irvin, Banks, & Farmer, 2009; Looker & Thiessen, 2003; Noce & McKeown, 2007; OECD, 2001). Rurality seems to be a barrier that encompasses many of the other barriers including socio-economic status, computer ownership, Internet accessibility, and participation in the digital culture. Other potential barriers to the adoption of online technologies include gender and motivation, both intrinsic and extrinsic. Each of these factors will be looked at in turn.

In terms of socio-economic status, a study by Miller and Weber (2003) of the rural-urban continuum in the United States shows that “persistent poverty is overwhelmingly rural and it is very concentrated geographically” (p. 1). Various studies (McCracken & Barcinas, 1991; Miller & Weber, 2003) attribute poverty in rural areas to higher unemployment rates, lower per capita income, higher rates of primary sector employment, and lower educational levels. Although studies comparing the Canadian rural-urban continuum and poverty are more limited, it appears that rural poverty levels have levelled while urban poverty levels are rising due to skyrocketing housing costs (Burns, Bruce, & Marlin, 2007). Regardless of whether rural or urban poverty is more predominant, low socio-economic status results in negative outcomes in terms of academic attainment, academic achievement, and access to technology (Miller & Weber, 2003).

As mentioned, a general income disparity exists between rural and urban centres. Coupled with Foy’s (2005) findings that the relationship between income and computer ownership is significant, it becomes evident that many rural, low-income families within the study’s school district might find home computer ownership and Internet access unaffordable. Further, a study commissioned by Statistics Canada examining the inequities in access and use of ICT (Information Communication Technology) among Canadian youth showed that while only

8% of students in major urban centres said they had no computer in the home, the number jumped to over 18% for students from villages⁵ (Looker & Thiessen, 2003, p. 11).

Another concern specific concern to rural populations is the availability of high speed Internet. Typically regions that rank high on the rurality index rank low on bandwidth availability, as is evidenced by the aforementioned study by Noce and McKeown. Although the presence of an adolescent in a household increases the likelihood of having Internet access, data from the Program for International Student Assessment survey concerning Canadian students still show that those students in rural and remote areas are less likely to have Internet access, or at least, quality access (Looker & Thiessen, 2003). Mackey and Ho (2006) counter that, although response time is an issue with online learning, from a global perspective this barrier is shrinking considerably with the Organisation for Economic Cooperation and Development (OECD) reporting that “the number of broadband subscriptions throughout the OECD continued to increase in the first half of 2005 from 119 million to 137 million” (p. 389). According to Looker and Thiessen (2003), “as more and more resources become available via the Internet this may become more of a policy imperative” (p. 15). This issue has already been recognized by the provincial government and measures have been considered to address it (i.e., Ontario Speech from the Throne, 2010).

Aside from physical barriers, there are also psychological ones. It is likely that both a student’s intrinsic and extrinsic motivation will play a role in Homework Help’s adoption, especially since its use is not mandatory. In terms of differences of intrinsic motivation between urban and rural students, “rural students are less likely to aspire to a university education”

⁵ Statistics Canada defines villages as having a population of less than 3000 (Looker & Thiessen, 2003).

(Burns, Bruce, & Marlin, 2007, p. 22). To compound matters, as students advance across grade levels, achievement levels decrease as course material becomes more difficult in turn leading to decreased motivation (Gottfried, Marcoulides, Gottfried, Oliver, & Guerin, 2007). This decline in achievement, coupled with a decline in motivation, is most prevalent in the subject of mathematics (Fredericks & Eccles, 2002; Gottfried, Fleming, & Gottfried, 2001; Gottfried, et al., 2007). With each advancing grade level, as students' performance in mathematics declines, so too does their enjoyment (Middleton & Spanias, 1999). With declining intrinsic motivation as a result of worsening achievement and enjoyment, extrinsic motivators might then come into play.

While there are several barriers to extrinsic motivation in online learning—such as administrative support, social interaction, academic skills, technical skills, time, support, costs, Internet access, and technical problems (Hannum et al., 2009)—parental involvement and educational attainment seem to play a leading role. One study suggests that parental involvement is positively correlated with higher grades, better attendance, higher graduation rates, and greater enrolment in post-secondary education (Henderson, Mapp, Johnson, & Davies, 2007, as cited in Stout, 2002). Another mitigating factor is parents' educational attainment, which has shown to be key in youth access to ICT. Young people from families with relatively low levels of education tend to use computers less than those from more educated families (Looker & Thiessen, 2003). While only a small percentage (3%) of youth say that they have never used a computer, “these few tend to come from families in which one or both parents have low education (Looker & Thiessen, 2003, p.16). Additionally, data suggest that those from more highly educated families are more likely to report increased feelings of competence with regards to computer use than those from lesser educated families (Looker & Thiessen, 2003).

A final barrier to the adoption of online technologies is gender. Looker and Thiessen

(2003) found that males are more likely to use computers everyday and for a wider variety of activities than females, and that males perceive computer usage as more important than females. In addition, the study concluded that males find using computers more enjoyable and, not surprisingly, feel more competent when using them. This, Looker and Thiessen state, offers males a definitive advantage in the job market where computer usage is becoming increasingly ubiquitous.

Summary

In summary, literature suggests the following: conventional and online tutoring have a direct positive correlation to numeracy achievement; online tuition offers many advantages over conventional tuition with no significant difference in achievement; the implementation of online tutorial services still faces many obstacles in rural and remote areas; and finally, e-tutoring has potential as a means to bridge some of the challenges of access to services in rural areas. Furthermore, it appears a gap in the literature remains in regards to online education at the K-12 level, with a dearth of data on the subject of e-tutoring in general.

CHAPTER FOUR

General Methodology

Introduction

This chapter describes the research questions guiding this study, and then outlines the data collection and analysis procedures that were undertaken to answer them. Concurrently, the theoretical framework will be interwoven.

Research Questions

In order to assist rural school districts in fully capitalizing on Ministry-funded initiatives such as Homework Help, this study seeks to understand the following:

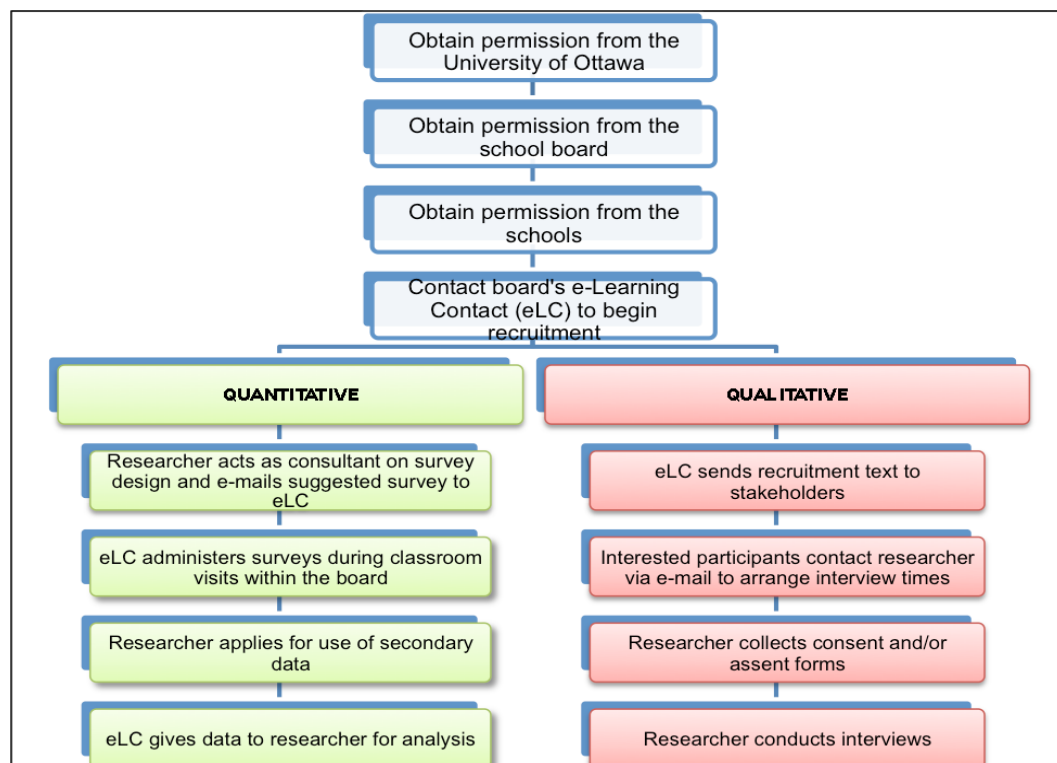
1. Does the DoI model logically fit both the qualitative and quantitative data?
2. To what extent do Rogers' (2003) perceived attributes of innovations—namely relative advantage, compatibility, complexity, trialability, and observability—collectively and individually, relate to Homework Help's adoption?
3. Are there differences between rural and urban students in their adoption and perception of the online tutoring service?
4. Are there differences between applied and academic students in their adoption and perception of Homework Help?

Overview of Research Design

Grounded in Rogers' (2003) diffusion of innovation theory, this mixed methods study used a concurrent triangulation approach to analyze the adoption of Homework Help by Grades 7 to 10 students (the grade levels to which Homework Help is currently available) within a

predominantly rural school district in Eastern Ontario, Canada. In terms of the quantitative aspect of the study, I analyzed data from surveys that were administered by an Ontario Ministry of Education (OME) appointed official in June of 2010. Following this, in January of 2011, semi-structured interviews were conducted with adult stakeholders including the district's e-Learning Contact (eLC), a mathematics department head, and a Homework Help tutor, while focus groups were conducted with student participants. Figure 5 offers a flow chart detailing the data collection process.

Figure 5. Data collection process



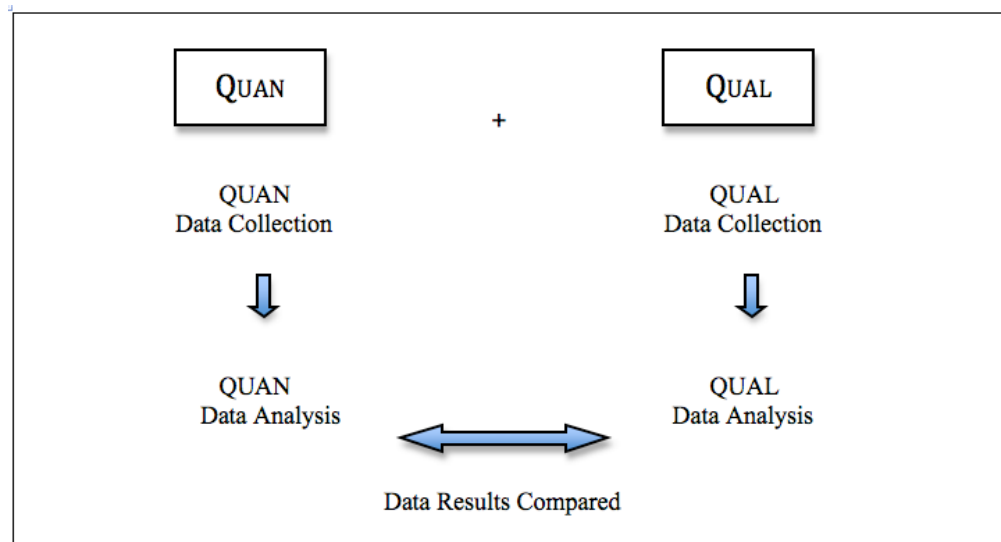
Research Design Rationale

Though the DoI conceptual framework is applied mostly to quantitative approaches, the intent to investigate this research question using a mixed methods approach conceptually draws from the diffusion research posited by Rogers (2003) who suggests that a more holistic

understanding can be reached via a mixed-methods approach. In addition, Rogers suggests that using a qualitative perspective coupled with a quantitative one will generally highlight any pro-innovation biases inherent in the study. These biases are created when researchers simply label those who do not adopt an innovation as laggards; in reality, a person may choose not to adopt an innovation for very practical and economic reasons that have nothing to do with a person's degree of innovativeness. In response to Rogers' argument, a pragmatistic paradigm was applied to this study. With a mixed methods approach, I was able to focus on whatever approach worked best to solve the problem—not the method itself—without the constraints imposed by the normally dichotomized approaches of both qualitative and quantitative research (Creswell, 2009).

While there are various approaches to mixed methods research, this study used a concurrent triangulation design, as previously mentioned, illustrated in Figure 6. The concurrent triangulation approach is one of the most familiar mixed methods designs as it enables researchers to simultaneously collect and analyze both qualitative and quantitative data in order to determine if the two databases offer confirmation, disconfirmation, cross-validation, or corroboration (Greene, Caracelli, & Graham, 1989). In addition, the concurrent approach enabled me to spend less time in the field gathering data as the qualitative and quantitative data collection periods occurred (more-or-less) simultaneously. Creswell (2009) states that, when using the concurrent triangulation design, the weight given to the qualitative and quantitative methods will ideally be equal with the two databases being integrated during the discussion section.

Figure 6: Concurrent mixed methods triangulation design



Source: Creswell, 2009

Quantitative Phase

Quantitative rationale. The benefit of conducting a cross-sectional survey (Appendix A) was to make generalizations about a population (Grades 7 to 10 students across Ontario) from a sample (all Grades 7 to 10 students in the school district were invited to participate in the survey) at a certain moment in time (in this case, 2010). The quantitative data from these surveys were used to determine the correlation between certain independent variables—namely relative advantage, compatibility, complexity, trialability, and observability—and the dependent variable, the rate of adoption of Homework Help. Additionally, the rates of adoption between both rural and urban, as well as applied and academic students, were compared using independent groups *t*-tests in order to determine whether a statistically significant difference exists. Survey questions were modeled after those done in DoI research and reflect the five perceived innovation attributes hitherto mentioned.

The survey provided answers to each of the research questions, at least in some capacity. The survey answered research question 1 as survey items were grouped using Principal Components Analysis (PCA) in order to see whether they logically fit into Rogers' innovations attributes. Once the survey items were grouped (if they logically fit) under components coinciding with innovation attributes, these components were used in a subsequent analysis to address research question 2, as described below. Survey question 6 provides the data for the dependent variable: "How often do you (students) use the online math tutorial Homework Help?" In regards to research question 2, components identified in the PCA (corresponding with participants' perceptions of an innovation's attributes) were used in a regression analysis to determine whether the individual attributes, and the attributes as a whole (and thus the DoI model), could adequately predict Homework Help adoption. Research questions 3 and 4 relate to survey questions 4 and 8 respectively; with the data from these survey questions, I was able to split the data during latter analyses into rural and urban, as well as applied and academic subgroups in order to determine whether these groups varied in terms of their perception and adoption of Homework Help.

The quantitative phase of the study was conducted during June 2010. By this time, all of the students in the study had had the opportunity to hear about and potentially try Homework Help, as it was nearing the end of the semester. Secondly, the eLC, who was responsible for administering the surveys, found it to be a convenient time to both collect data about the program and remind students of the service prior to the commencement of final examinations.

Quantitative participants and procedure. The quantitative component of the study focuses on the adopters themselves: the students. Students in Grades 7-10, the target age of the Homework Help initiative, were recruited by the Ministry-appointed eLC to participate in the

survey throughout the month of June 2010. The OME appointed an eLC for each of the 32 school districts involved in the pilot project to promote and assist in the evaluation of the initiative. I consulted on the design of the survey, while the eLC agreed to share the data with me, following the school district's ethical approval for the release of the data. The eLC agreed to take the necessary steps to ensure that the data were collected in a way that meets stringent ethical requirements, especially in regards to privacy and to free and informed consent. As mentioned, those invited to participate in the survey were Grades 7 to 10 students across this predominantly rural school district in Eastern Ontario. The district consists of two high schools, one with a population of approximately 1100 and another with a population of 400, located in the district's urban centres. The high schools cater to students in Grades 8 to 12, and thus were the primary source of participants for the study. Grade 7 participants were also invited from the district's 20 feeder schools, which cater to children in kindergarten up until Grade 7. Though some feeder schools are in more populated areas, many of them are located in small towns and villages throughout the school district. This particular school district was selected partially for convenience (in that I worked in this district and have established many connections), but also because it is one of the few school districts involved in the pilot project that has a large enough rural population to be used for a comparison with its urban population.

The goal of the quantitative data collection was to have a minimum sample size of $N=200$, the minimum requirement to perform statistical analyses such as PCA and standard multiple regression (Tabachnick & Fidell, 2007), which were used during the subsequent data analysis phase of the study. The actual number of surveys collected surpassed the goal, being greater than 300. After the eLC obtained the appropriate assent and consent, students were invited to complete either an online or pencil-and-paper survey of approximately 30 questions.

Due to one of the study's intents to see if perceived ease of use of computers contributes to a student's decision to adopt Homework Help, a non-computer option of the survey was made available.

As alluded to, the survey items were modeled after those used in other DoI studies and can be theoretically grouped under the following innovation attributes: relative advantage, compatibility, complexity, trialability, and observability. Most survey questions were designed to fit into one of the five innovation attribute categories, as per the tradition in DoI research; PCA in the subsequent analysis phase of this study was used to determine if this was actually the case. Most of the survey items were quantitative in nature and used a four point Likert-like scale, though the survey also had some demographic and short answer questions.

Quantitative data analysis. The quantitative data collected from the surveys were analyzed using SPSS statistical software. Initially, PCA was used to reduce the numerous survey items down to a few components. PCA was conducted only on the data derived from survey items pertaining to innovation attributes. PCA has the benefit of determining whether or not survey items designed to test the same measure are actually testing the same thing, thus adding to the study's validity (Tabachnick & Fidell, 2007, p. 607). Additionally, when the survey items aligned themselves under Rogers' (2003) innovation attributes, DoI theory could not be disconfirmed; additionally, it acted as a confirmation that the survey is measuring its intended constructs. Following PCA, standard multiple regression was used in order to determine which innovation attributes predict Homework Help's adoption or failure to adopt. Once components were established by PCA, the students' component scores were then used as independent variables in a regression analysis with rate of adoption (determined by survey question 6, "How often do you use the online math tutorial Homework Help?") acting as the dependent variable.

This allowed the researcher to determine whether several survey items grouped together by PCA were significant when predicting Homework Help's adoption. Lastly, independent groups *t*-tests were performed to calculate whether there were significant statistical differences between rural and urban, as well as applied and academic students' rates of adoption.

Qualitative Phase

Qualitative rationale. The qualitative interviews and focus groups, coupled with the short-answer feedback from the surveys, also served to answer each of the research questions. Having a qualitative component to the study was most certainly advantageous as it elicited a holistic understanding of the quantitative data by offering a more thorough explanation and interpretation of the survey results. While the quantitative survey data helped answer *what* variables contributed to Homework Help's adoption and to *what extent*, the qualitative interview data answered not only *what* variables are important, but *why*. The rationale behind the selection of a case study approach for the qualitative portion of the study was informed by Creswell's (2009) depiction of case studies as useful when a researcher explores in depth a program (Homework Help) bounded by time (the length of the pilot project) and activity (the adoption of Homework Help).

Qualitative participants and procedure. First I will provide a description of the adult participants, followed by a description of the student participants. Adults who participated in interviews included the eLC, the mathematics department head, and the Homework Help tutor. Though the primary focus of the study is the adopters themselves, the students, DoI research also places significance on the change agents, those responsible for promoting the innovation. In the case of Homework Help, the eLC, department heads, and tutors are those primarily charged with

promoting Homework Help (it should be noted that the department heads and tutors are also mathematics teachers, which is doubly advantageous). Furthermore, interviewing adult participants offered more textured and nuanced responses simply due to the maturity of the participants. In addition, parents and friends were hypothesized to influence a student's innovation decision, as per the findings in the literature previously mentioned (Henderson, Mapp, Johnson, & Davies, 2007). Though these people were not directly interviewed due to time limits of this study, it is hoped that their influence was at least partially revealed by the survey results, especially survey questions 10 and 11 in the "Demographic Information" section, and questions 4 and 5 in the "Preferences" section (refer to survey in Appendix A).

In terms of student participants, two student focus groups were arranged, one with five and the other with six people. Focus group 1 consisted of four Grade 10 students and one student in Grade 11 (who had used Homework Help the previous year), while focus group 2 consisted of five Grade 9 students and one Grade 10. Ideally the focus groups would have involved some Grade 7 and 8 students; however, none responded to the recruitment. Despite this, many of the Grade 9 participants commented on their experience with the service in the previous year.

Recruitment of qualitative participants was once again facilitated through the eLC. I e-mailed the eLC recruitment text for participants in the interviews and focus groups, which the eLC distributed to teachers and students during his regularly scheduled classroom visits. Interested participants were invited to contact me directly in order to schedule a convenient interview time and location.

The interviews and focus groups all took place during January of 2011, immediately upon my receiving ethics approval from the university. Ideally these would have taken place in June

2010, at the same time as the surveys, but the ethics approval process was quite lengthy.

However, I do not feel that this had any serious negative impact on the results as the collection of the data occurred towards the end of the semester preceding exams, just like the surveys (though one semester later).

Interviews and focus groups were conducted during lunch hour in the library conference room at the larger of the two high schools. There were three adults interviewed including the eLC, a mathematics department head, and a Homework Help e-tutor. The interviews approximately followed the protocol outlined in Appendix B. The focus groups lasted approximately 45 minutes and followed the semi-structured format outlined in Appendix C. A pizza lunch was offered to student participants.

In terms of the design of the interview and focus group protocols, a rationale will now be provided for each question. Firstly, the adult interview protocol questions will be addressed. (1) *What is your role in the implementation of Homework Help?* This question simply established the capacity by which the participant is a stakeholder in Homework Help, but it also spoke to the role that the participant played in the initiative's adoption. (2) *Do you think this school district is a good candidate for the Homework Help pilot project? Why or why not?* Addressing research question number 3, this interview question had participants elaborate on the appropriateness of the school district, given its rural nature, for such a project. It also provided some insight into local issues that would have conceivably impeded Homework Help's adoption. (3) *What benefits can you see from the adoption of online tutorials such as Homework Help?* This question, relating to research question number one, asked the participants to focus on the positive aspects of the initiative that might help its adoption. (4) *What barriers can you see in implementing Homework Help in this school district?* This question related to research questions

three and four and sought to discover reasons why Homework Help may not have diffused in the desired manner, especially to particular subgroups. (5) *Do you think the rural nature of the school district will play a role in the tutorial's implementation?* Finally, this interview question served to answer research question number 3 concerning how rural and urban students in the district might adopt and perceive Homework Help differently.

Next, a rationale for the inclusion of the questions in the student focus group protocol will be discussed. (1) *Why did you decide to use/not to use Homework Help?* This question addressed research question one; it was posed so that students could elucidate their reasons for choosing whether or not to adopt Homework Help. (2) *What most influenced your decision to use/not to use Homework Help?* According to Rogers (2003), a variety of factors (i.e., compatibility, trialability, etc.) come into play when a person decides whether or not to adopt an innovation. This question, with reference to research questions one, three, and four sought to explore some of those factors. (3) *What are the features of Homework Help that you most like and/or dislike (if you had the opportunity to try it during the in-class presentation)?* Again, this question helped answer research question one, but focused most specifically on Rogers' concept of complexity and relative advantage. (4) *What could be done to make Homework Help better?* This will elaborate on Rogers' concept of perceived ease of use (research question two), though it may touch on other factors as well. *Or, are there better alternatives to Homework Help that could help students wanting help with homework?* The goal of this question was to elicit responses regarding the appropriateness of the initiative for certain subgroups and to provide alternative ideas for services.

Qualitative data analysis. The interviews and focus groups were recorded for accuracy, and then were transcribed and coded. The coding procedure was adapted from Tesch's (1990)

eight-step process for coding data. (1) I read through the transcripts several times, jotting down notes as ideas came to mind. (2) Next, I went through the transcripts yet again, this time taking more extensive marginal notes in response to the question, “What is this about?” Taking marginal notes and reflecting upon them is a strategy proposed by Miles and Huberman (1994). (3) Once the data were repeatedly reviewed from all focus group and interview transcripts, and once marginal notes were taken, I made a list of all topics that emerged, clustering similar topics together. Topics were then placed in a table with the following columns: major topics, unique topics, and leftovers. (4) I then formed abbreviations for the topics that acted as codes. The transcripts were then reread and codes were assigned next to their appropriate segment in the text. With the text that remained after this process, the researcher returned to step 2. (5) Then I turned each coded topic into a category by finding wording that accurately portrayed this grouping. At this point, I looked for similarities amongst topics and attempted to reduce them under a common category. (6) Then, the abbreviation for each category was finalized and their associated codes were alphabetized. (7) Once this had taken place, I assembled the data belonging to each category in a common place to make analysis easier. (8) Lastly, I recoded existing data where necessary.

In reference to step five, I attempted to group the codes under the innovation attributes as suggested by Rogers, those being relative advantage, compatibility, complexity, trialability, and observability. This strategy is consistent with Wolcott’s (1994) qualitative data analysis strategy of relating and contextualizing categories to those found in literature. I then determined if the codes logically fit under Rogers’ innovation attributes. Codes were not forced to fit into these preconceived themes; rather, the themes that emerged from the data were used to confirm or contradict Rogers’ innovation attributes.

Triangulation of Quantitative and Qualitative Data: In order to facilitate the analysis and interpretation of the data, both quantitative and qualitative data sources were merged at the end of the study. The side-by-side integration of the data occurred as quotations from the interviews and focus groups were paired with statistical results in order to either support or contradict the quantitative data. In the subsequent Discussion sections of the second article, I attempt to explain any discrepancies that exist between the findings of the quantitative and qualitative aspects of the study by revisiting the data and, where necessary, by revisiting the literature. Furthermore, triangulation of data is a strategy recommended to increase the validity of the research (Creswell, 2009). Triangulation of data augments validity as the data are derived from multiple sources—in this case, surveys, focus groups, and interviews—which means that weaknesses from one data source can be mitigated by the strengths of the other data sources. Themes then are not derived from a solitary data source, but from the converging of data sources.

The Subjective *I*

As I approached this project, I found it beneficial to acknowledge the subjective selves that I brought to this research, as suggested by Peshkin (1988). According to Peshkin, our subjectivity operates throughout the entire research process and has the “capacity to filter, skew, shape, block, transform, construe, and misconstrue what transpires from the outset of a research project to its culmination in a written statement” (1988, p. 17). Thus, the process of systematically delineating our own subjectivity enables us to examine those aspects of our own experience that intersect with our research. The following *I* statements reflect the intertwining of my life experiences and my research.

The rurally disadvantaged *I* is one that has followed me since I moved from a large city to a farm as I entered Grade 3, up to my recent employment as a teacher in a rural school board. Even as a young child, I acknowledged that I would no longer have access to the same resources as I had in the city such as the gymnastics club, the swimming pool, the movie theatres, and even the huge libraries. In high school, I acutely felt this marginalization when I visited urban high schools in the province during various competitions for sports or scholastics. I complained about the lack of books in the library when writing essays and, by Grade 13, would often drive two hours to the city to get these resources (this was, evidently, in the days before most people had Internet). My small town high school simply did not have what city high schools had. This rurally-disadvantaged *I* is one of the main catalysts behind my research.

The technologically-optimistic *I*, formed by my experience as an e-learning educator and by books such as Friedman's (2005) *The World is Flat*, is the notion that technology can help level the playing field giving those in rural settings some of the same access to resources as those in urban centres. I believe that technology is a two-edged sword that has the capacity to both free us and constrain us, depending on how it is used and by whom. Although I acknowledge the barriers in accessing technology faced by those who are economically and geographically disadvantaged, I feel that, with the right supports, technology has the capacity to help make our lives easier, more efficient, and more fulfilling. In acknowledging this, I must also be aware that technology is not a panacea: it is but one means to a solution, but by no means is it the only solution. There will be those for whom technology is not the answer; I must remember that each student learns differently.

The pro-innovation biased *I* is one that, according to Rogers (2003), tempts many diffusion researchers. When studying the diffusion of an innovation, it is often natural to side

with the innovation and label those who do not adopt it as laggards. On the contrary, many who choose not to adopt an innovation may do so for very practical and logical reasons. Factors that motivate people not to adopt an innovation may be equally important as those factors considered in adoption. As will be discussed in subsequent sections, one way of reducing pro-innovation bias is to consider a mixed method approach that incorporates not only the statistics behind an innovation's adoption, but the stories of the potential adopters as well. These stories might expose the reasons behind an innovation decision, that is, a person's decision concerning whether or not an innovation should be adopted.

Lastly, I would like to acknowledge the teacher advocate *I*, which comes from my desire to help students obtain their greatest potential. I am not satisfied with the students in class being satisfactory; I want them to be the best they can. It is my hope that this research helps students move in that direction, however small that step might be.

CHAPTER FIVE

Article 1

The e-Tutoring e-Divide:

Facilitating the Online Academic Support Services in Rural School Districts

Abstract

Secondary and post-secondary educational institutions are increasingly using e-tutoring, otherwise known as electronic or online tutoring, as a cost-effective strategy to offer academic support to their students. This study explores the adoption of e-tutoring in a predominantly rural Canadian school board. Results demonstrate that a digital divide exists for its students resulting in minimized adoption of the service. Rogers' (2003) diffusion of innovation model, synonymous with diffusion research and widely utilized for predicting barriers to adoption, provided the theoretical framework. A cross-sectional survey was administered to 308 students in order to determine which factors correlate most strongly with e-tutoring's adoption. In general, results indicate that rural students had significantly lower rates of e-tutoring adoption than urban students, and that Rogers' diffusion model is effective at predicting adoption. Implications for the implementation of online academic support services, especially in rural school districts, are discussed.

Keywords: e-tutoring, e-learning, rural education, mixed methods research, diffusion of innovations, online academic support services

Introduction

E-tutoring, otherwise known as electronic or online tutoring, is seeing unprecedented growth as school administrations seek ways to balance their decreasing budgets with increasing public accountability over standardized test scores (George & Dykman, 2009). Public, private, and not-for-profit institutions alike are engaged in the provision of online academic support services, such as e-tutoring, and provide a cost-effective and efficient way to provide academic intervention (George & Dykman, 2009; Gewektz, 2005; Lissaman, De Pomerai, & Tripconey, 2009). While both traditional and online tutoring are proven methods of bolstering student achievement (Biesinger & Crippen, 2008; Fuchs et al., 2008a; Fuchs et al., 2008b; Means, Toyama, Murphy, Bakia, & Jones, 2009; Merriman & Coddington, 2008; Song, 2005), e-tutoring provides cost savings as both tutor and tutee can work from their own homes. Additionally, while traditional tutors generally meet with students one-on-one, e-tutors may simultaneously tutor a number of tutees from various locations. However, while the benefits of e-tutoring are numerous, in some cases ministries of education are implementing e-tutoring without first considering their demographic. Albeit online services may achieve high adoption in urban centres, the same approach has shown to be less effective in rural and remote demographics, as this study will demonstrate. Further, despite e-tutoring's burgeoning growth, fewer than a half dozen studies have been conducted in this field to date; this study addresses that dearth in research.

The Digital Divide

Numerous studies demonstrate that rural and remote areas in Canada—and for that matter, around the world—are systemically underserved (Burns, Bruce & Marlin, 2007; Looker

& Thiessen, 2003; Noce & McKeown, 2007; OECD, 2001). Of primary concern are those factors attributed to the digital divide including geographic and socio-economic barriers discussed forthwith, which studies have shown to hinder the diffusion of digital technologies. Given that an “urban–rural digital divide persists in Canada with the odds of using the Internet being almost one-and-a-half times greater for someone who lives in an urban area” (Noce & McKeown, 2007, p. 462), certain impediments must be mitigated before implementing online academic support services in rural areas.

The Organisation for Economic Co-operation and Development (OECD, 2001) defines the digital divide as “the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities” (p. 5). There is consensus among global and national leaders that this so-called digital divide compromises both equity and economic development issues. Divisions figure most predominantly around income, education levels, age, disability, minority status, and geographic location (Looker & Thiessen, 2003; OECD, 2001). What is especially disconcerting is that many of these groups overlap, leaving some doubly or triply disadvantaged; even more troublesome is that the digital divide in Canada is only widening (Looker & Thiessen, 2003). The digital divide, ostensibly, should be a paramount policy concern for any organization desiring the adoption of digital technologies, which are known to contribute to economic development (OECD, 2001). Therefore, the goal of the following section is to address the digital divide, especially where rural school boards are concerned.

Study after study corroborates rurality as an impeding factor in access to education, economic opportunities, and technology (Hannum, Irvin, Banks, & Farmer, 2009; Looker &

Thiessen, 2003; Noce & McKeown, 2007; OECD, 2001). Rurality seems to be a barrier that encompasses many of the other barriers including socio-economic status, computer ownership, Internet accessibility, and participation in the digital culture.

In terms of socio-economic status, a study by Miller and Weber (2003) of the rural-urban continuum in the United States shows that “persistent poverty is overwhelmingly rural and it is very concentrated geographically” (p. 1). Various studies (McCracken & Barcinas, 1991; Miller & Weber, 2003) attribute poverty in rural areas to higher unemployment rates, lower per capita income, higher rates of primary sector employment, and lower educational levels. Although studies comparing the Canadian rural-urban continuum and poverty are more limited, it appears that rural poverty levels have levelled while urban poverty levels are rising due to skyrocketing housing costs (Burns, Bruce, & Marlin, 2007). Regardless of whether rural or urban poverty is more predominant, low socio-economic status results in negative outcomes in terms of academic attainment, academic achievement, and access to technology (Miller & Weber, 2003).

As mentioned, a general income disparity exists between rural and urban centres. Coupled with Foy’s (2005) findings that the relationship between income and computer ownership is significant, it becomes evident that many rural, low-income families might find home computer ownership and Internet access unaffordable. Further, a study commissioned by Statistics Canada examining the inequities in access and use of ICTs among Canadian youth showed that while only 8% of students in major urban centres said they had no computer in the home, the number jumped to over 18% for students from villages (Looker & Thiessen, 2003, p. 11).

Another concern specific to rural populations is the availability of high-speed Internet. Typically, regions that rank high on the rurality index rank low on bandwidth availability, as is

evidenced by the aforementioned study by Noce and McKeown (2007). Although the presence of an adolescent in a household increases the likelihood of having Internet access, data from the Program for International Student Assessment (PISA) survey concerning Canadian students still show that those students in rural and remote areas are less likely to have Internet access, or at least, quality access (Looker & Thiessen, 2003). Mackey and Ho (2006) counter that, although response time is an issue with online learning, from a global perspective, this barrier is shrinking considerably with the OECD reporting that “the number of broadband subscriptions throughout the OECD continued to increase in the first half of 2005 from 119 million to 137 million” (p. 389). According to Looker and Thiessen (2003), “as more and more resources become available via the Internet this may become more of a policy imperative” (p. 15). This issue has already been recognized by Canadian provincial and territorial governments, and measures have been considered to address it (i.e., Ontario Speech from the Throne, 2010).

The Present Study

Given the urban-rural divide faced by Canadian students, as well as their counterparts around the world, how might these disparities be addressed? Pulitzer prize-winning author Thomas Friedman (2005) hypothesized that cheap, ubiquitous digital technologies are helping to create a “flat world” in which economic and geographic barriers are levelled, allowing all those with access to technology to compete on level footing. Many Canadian provinces are beginning to capitalize on these digital technologies in response to concerns over the equity and quality of education; however, they are not necessarily supporting these programs with the requisite infrastructure (e.g., increased broadband capability, financial assistance for laptops, etc.). For example, in 2008, the Ontario Ministry of Education (OME) launched a pilot project called Homework Help, which has since expanded to include 31 school districts that have a combined

population of nearly 236,000 students (OME, 2011). It works by providing free, synchronous (i.e., real-time) e-tutoring by Ontario certified mathematics teachers to students in Grades 7 to 10. Five evenings a week, students can log on to the Homework Help Web site and receive confidential one-on-one tutoring. Students and tutors interact in grade-specific chat rooms where students can pose a question to their tutor either in text or equation form using an interactive white board. The site also features video tutorials and interactive activities covering an array of topics.

The purpose of this study is to explore the adoption of Homework Help in one of the 31 school districts involved in the pilot project, a district with a predominantly rural population located in Eastern Ontario, Canada. More specifically, the study addresses the following research questions: (1) What factors correlate with the adoption of online academic support services? (2) Is there a difference between rural and urban students in their adoption of these services?

Theoretical Framework

This study was guided by the work of Rogers (2003, first published in 1962) who synthesized research from over 508 diffusion studies and produced the diffusion of innovations theory. Diffusion theory draws from the fields of psychology and sociology and is used in order to predict whether or not an innovation will achieve adoption. The term diffusion specifically refers to how a social system communicates regarding the attributes of an innovation over a given time frame. In the case of the current study, the social system includes the stakeholders within the school district—such as students, teachers, and parents—who communicate the advantages and disadvantages of the innovation, the e-tutoring service Homework Help. Adoption, on the other hand, refers to a conscious decision to make use of an innovation as the

best course of action available, often times over the innovation that it supersedes. In the case of Homework Help, an individual might choose to use e-tutoring over conventional tutoring or, say, seeking help from a teacher at lunch. The current study measures students' adoption of Homework Help on a five-point scale: never, rarely, monthly, weekly, or daily.

According to Rogers (2003), an individual's decision to adopt or reject an innovation is primarily influenced by five factors: relative advantage, compatibility, complexity, trialability, and observability. Thus, the survey was formulated with these categorizations in mind. (1)

Relative advantage: This is the degree to which an innovation is perceived to be better than what it supersedes, or is possibly something that previously never existed but meets a recognized need. Examples of Likert statements in this category are, "Using Homework Help would improve my mark in mathematics" or "Using Homework Help makes doing homework easier." (2)

Compatibility: This refers to the innovation's consistency with an adopter's existing values, past experiences, and needs. For example, "I think doing homework is important" and "I think using computers is important." (3) *Complexity:* This is the extent to which an innovation is difficult to understand and use. An example would be, "I think using computers is easy" or "I find it easy to use the interactive white board in Homework Help." (4) *Trialability:* This is the degree to which an innovation can be experimented with. As high-speed Internet connectivity is a prerequisite of using Homework Help, students were asked about their Internet connectivity, computer availability, etc. (5) *Observability:* Lastly, this factor relates to the visibility of an innovation's results. For example, do students' parents monitor their homework? And, do students perceive that using Homework Help has improved their grades?

Method

The cross-sectional survey was administered to $N = 308$ students. Statistical analyses

included the following: (1) an independent groups *t* test to determine whether rural and urban rates of adoption differed significantly; (2) a factor analysis on survey variables to validate Rogers' categorizations; and lastly, (3) a standard multiple regression analysis to determine which of Rogers' five factors correlate most strongly with the adoption of e-tutoring.

Participants

The study involved a survey with $N = 308$ Grades 7 to 10 students in a predominantly rural school district located in Ontario, Canada. Surveys were administered in June 2010, which was the first year that the pilot project was expanded beyond its initial single school district. The sample was 45.5% male and 55.5% female. The distribution of participants in each grade was as follows: Grade 7, 15%; Grade 8, 27%; Grade 9, 36.5%; and Grade 10, 21.5%. Nearly 61% were in the academic (university bound) stream, 35.8% in the applied (community college bound) stream, and 3.3% identified as being from the locally-developed (workplace) stream. Of those surveyed, 81.9% indicated that high-speed Internet was available where they lived, 14.6% said only dial-up was available, while 3.6% of the participants did not know what type was available.

Materials & Procedure

The cross-sectional survey was developed by the author based upon previous diffusion studies (Rogers, 2003). Both an online and paper version of the survey were made available. The survey included three question types: demographic, predictive, and postdictive. Demographic questions included questions regarding grade level, gender, rurality, high-speed Internet access, stream in mathematics, and so fourth. Predictive and postdictive questions were based upon Rogers' adoption categories hitherto discussed—namely relative advantage, compatibility, complexity, trialability, and observability (see Table 2 for examples). While all N

= 308 students could answer the first two parts of the survey, only students who responded that they used Homework Help monthly, weekly, or daily were prompted to answer the postdictive segment of the survey. As the majority of survey participants responded that they never (79.7%) or rarely (15.0%) used Homework Help, very few responses were collected for postdictive analysis. As such, data obtained from the postdictive section of the survey did not meet the sample size assumption required for factor or regression analyses and were excluded from subsequent analyses.

Results

Data Screening

Prior to analysis, all 63 demographic and predictive variables were screened using SPSS descriptive statistics for accuracy of data entry; the range, means, and standard deviations were all found to be plausible. Next, the variables were screened by conducting a Missing Values Analysis (MVA) using SPSS. Little's MCAR (Missing Completely At Random) test on all $N = 308$ cases revealed a significant result of $p = .04$, indicating that the probability that the pattern of missing data is not due to randomness. After deleting five cases from recalcitrant respondents where missing data exceeded 50%, Little's MCAR test revealed a statistically non-significant result of $p = .14$; therefore, MCAR may be inferred (Tabachnick & Fidell, 2007). Next, t tests using an $\alpha = .05$ were requested in SPSS for each variable missing data greater than the generally acceptable level of 5% in order to determine if missingness is related to any other variable. SPSS output indicated that no variable was missing more than 5% after the deletion of the aforementioned cases; thus, t tests were not produced. Missing data on the remaining $N = 303$ cases were imputed using SPSS Expectation Maximization. While some univariate and multivariate outliers were detected in less than 2% of the cases, a decision was made not to

delete any cases as this number of outliers could be expected from a sample of this size. Lastly, to improve pairwise linearity and to reduce severe negative skewness and leptokurtosis, the dependent variable (DV) frequency of Homework Help usage was transformed. By doing a severe positive transformation ($1/x$) of the DV, skewness was reduced from 2.197 to -1.595 and kurtosis from 4.291 to .738.

Independent-Groups t Test

In order to determine whether the means of rural and urban students' rates of adoption vary significantly, independent-groups t tests were performed. According to Statistics Canada, urban areas are defined as having a minimum population of 1000 people and a population density of at least 400 people per square kilometre. By default, any population not classified as urban is considered rural (Statistics Canada, 2001). The survey asked students to classify the area in which they live as either a city ($> 100,000$ people), town (15,000 to 100,000), small town (3,000 to 15,000), village (< 3000), or as a hamlet / rural setting (sparsely populated). Using the Statistics Canada definitions, participants who selected hamlet / rural setting are considered rural while those who selected small town, town, or city are considered urban. As the definition of a village is too broad for classification (i.e., it is not known whether the population is greater or less than 1000 people), this category was omitted from the t test analysis. Since the survey was conducted in a predominantly rural district, no one selected city, 49.7% selected town, 27.1% selected small town, 11.0% selected village, and 12.3% selected hamlet or rural setting.

Participants who live in urban areas ($M = 1.29$, $SD = .59$) had significantly higher Homework Help adoption rates than those living in rural areas ($M = 1.14$, $SD = .35$), $t(69.98) = -2.19$, $p < .05$, $d = .39$. According to Cohen's (1998, as cited in Yockey, 2008) guidelines, an effect size of $d = .39$ lies between a small and medium effect size.

Factor Analysis

In the next phase, factor analysis was used to reduce numerous survey variables down to a few factors for the purpose of a subsequent multiple regression analysis. In addition, factor analysis was used to test the validity of survey question subsets designed to measure the same category in Rogers' (2003) attributes of innovations. Principal factors extraction with varimax rotation was performed on the 26 predictive survey variables; as hitherto mentioned, there were insufficient data to include postdictive variables. All variables loaded on at least one factor, despite using a cutoff of .30 for inclusion of a variable for interpretation. The number of factors was fixed at five to coincide with Rogers' characteristics of innovation adoption. The factors formed coherent subsets aligning with Rogers' innovation attributes, as demonstrated by Table 2. Additional factor analyses were performed using the aforementioned rural and urban subsets, as well as academic versus applied subsets; the factor groupings resembled those of the total data set, as shown below.

Table 2

Order (by Size of Loadings) in Which Variables Contribute to Factors

Factor 1 <i>Relative Advantage</i>	Factor 2 <i>Observability</i>	Factor 3 <i>Complexity</i>	Factor 4 <i>Compatibility</i>	Factor 5 <i>Trialability</i>
Using HH would make doing homework easier.	My parents encourage me to use HH.	I think using computers is important.	My parents think math is important.	Mean technology usage score
Using HH would make it easier to understand math.	My friends encourage me to use HH.	I think using computers is easy.	I think math is important.	Internet accessibility
Using HH would improve my math mark.	My parents remind me to use HH	I think using computers is fun.	My parents think homework is important.	Rurality index

Using HH would make doing homework faster.	My teacher reminds me to use HH.	My parents think computers are important.	I think homework is important.	# of people sharing computer where I do homework
	My teacher encourages me to use HH.		Educational aspiration	# of people sharing Internet connection where I do homework
	HH was well promoted at my school.		My parents monitor my homework.	
			Mark in math	

Note: Principal factors extraction with varimax rotation

Regression Analysis

In order to determine which of Rogers' five factors best predicts adoption of Homework Help, a standard multiple regression analysis was performed using the factor scores calculated in the aforementioned factor analysis. Overall, the regression model was significant, $F(5, 297) = 7.00, p < .05, R^2 = .11$. Of the predictors investigated, the following were significant: relative advantage ($b = -.18, t(297), p < .05$), observability ($b = -.22, t(297), p < .05$), and trialability ($b = -.11, t(297), p < .05$). Table 3 summarizes these results. Additionally, a separate regression analysis was run using factor scores of the subset of academic students. In this analysis, the same three predictors were found to be significant and the R^2 increased to .18 suggesting that these factors play an even more important role in the adoption of Homework Help for the academic stream.

Table 3

Standard Multiple Regression for Factor Scores of Total Sample on DV with Severe Positive Transformation

Variables	Pearson <i>r</i> HH Frequency of Usage Transformed (DV)	<i>B</i>	β
1. Relative Advantage	-.20	-.04	-.18*
2. Observability	-.22	-.05	-.22*
3. Complexity	-.05	-.01	-.04
4. Compatibility	.10	-.03	-.10
5. Trialability	-.12	-.03	-.11*
<i>R</i>			.33
<i>R</i> ²			.11*
Adjusted <i>R</i> ²			.09
Std. Error of the Estimate			.21

* Indicates significance at $p < .05$

Discussion

Following data screening and checking to ensure that the data meet the assumptions necessary for multivariate data analyses, three types of analyses were conducted: an independent-groups *t* test, a factor analysis, and finally, a standard multiple regression.

The independent-groups *t* test served the purpose of ascertaining whether rural and urban students' rates of adoption varied. Results indicate that there is small to medium ($d = .39$), albeit significant, difference between the means of rural and urban students' rates of adoption. This significant result was not surprising given that 14.6% of respondents indicated that they had access to only dial-up Internet where they do their homework, while another 3.3% indicated that they had no Internet at all. While research previously mentioned shows that broadband capacities are rapidly expanding around the world, this does not negate the fact that, for those in certain socio-economic and geographic groups (i.e., low socio-economic status and rural), the digital divide is actually worsening (Looker & Thiessen, 2003). Yes, high-speed Internet is

becoming ever more ubiquitous, but not for everyone. Policy makers would do well to follow the initiatives of innovative school districts and non-governmental organizations that are finding ways to make both computers and Internet connectivity affordable. One solution might lie in the provision of computers and Internet access to families below the low-income cut off, as is being piloted by the Sudbury Catholic District School Board (C. McCullough, personal communication, October 23, 2009). Sudbury is not alone in this venture; a Google search of “free laptops for students” garnered over 49 million hits. However, further research is needed to evaluate the cost versus outcomes of initiatives such as this.

Next, five factors were revealed using factor analysis. All variables were internally consistent and well defined by Rogers’ (2003) categorizations. As identified in Table 2, these categories included the following: relative advantage (e.g., Homework Help makes homework easier); observability (e.g., parents encourage the use of Homework Help); complexity (e.g., using computers is easy); compatibility (e.g., math is important); and lastly, trialability (e.g., Internet accessibility). These results indicate that diffusion research provides a valid model for the adoption of online academic support services; additionally, Rogers’ model of innovation diffusion could be used to position Homework Help, as well as future online academic support services, to obtain the most significant impact. The value of the model becomes even more apparent when used with multiple regression analysis, as this helps identify which factors contribute most strongly to adoption, and thus which factors to focus on when positioning the innovation in a given population.

The regression analysis revealed that, overall, this diffusion model was significant in predicting students’ rates of adoption. Moreover, the factors that correlate most strongly with Homework Help’s adoption were found to be observability, followed by relative advantage and

trialability. These findings are inconsistent with diffusion literature in that the impact of relative advantage typically outweighs that of observability (Rogers, 2003). However, given the youth demographic of this study, this finding is not surprising. Since parental involvement plays an instrumental role in a student's academic success (Henderson, Mapp, Johnson, & Davies, 2007, as cited in Stout, 2002), it is not surprising that parents influence a student's decision to use Homework Help. This is made evident by the fact that parental encouragement to use Homework Help had the highest loading score within the factor of observability. Further studies are needed to determine whether the phenomenon of observability continues to play a key role in the adoption of online academic support services in demographics other than youth; it is speculated that observability will be more significant among youth populations compared to adults, thus keeping in line with previous diffusion studies (Rogers, 2003). In terms of Homework Help and other online academic support services offered at the secondary level, school administrators should consider the significant role of parental involvement. Thus far, at least in the school district involved in the study, efforts to market Homework Help have focused primarily on information sessions with students.

In conclusion, this study has made it evident that a digital divide exists between urban and rural students when it comes to the adoption of e-tutoring. Further, Rogers' (2003) diffusion of innovations model has been shown to be effective at predicting adoption. In order for e-tutoring to be truly successful, policy interventions are needed to support such online initiatives so as to ensure equitable access for rural and remote populations; educational bureaucracies cannot simply hope that a cookie-cutter approach will work for all students.

CHAPTER SIX

Article 2

The Implementation of e-Tutoring in Secondary Schools: A Diffusion Study

Abstract

While technology use is becoming ever more ubiquitous in society, there are times when even the most useful of technologies faces non-adoption for a variety of contextual reasons. Educational institutions are increasingly relying on online academic support services such as e-tutoring to balance rising demands for public accountability over standardized testing with decreasing budgets. This study explores the context of an e-tutoring service that has experienced a relatively low adoption rate in a school district in Eastern Ontario, Canada. The study proposes a model, based on the results of a mixed-methods diffusion study, for the effective implementation of the service. Implications for the integration of educational technologies, especially in relation to e-tutoring, are discussed.

Keywords: e-tutoring, diffusion research, mixed methods, e-learning, secondary schools

Online academic support services such as e-tutoring are burgeoning in the wake of increasing broadband connectivity and the emergence of Web 2.0 technologies, the properties of which are collaborative and thus ideal for online tutoring. During 2005, the e-tutoring market share was worth \$132 million in the United States alone, and it continues to grow at an annual rate of 15% (George & Dykman, 2009). Technology advocate Prensky (2003) even goes so far as to say that e-tutoring is more effective than traditional classroom teaching because of its frequency of interaction, immediacy of feedback, and personalized instruction style. Despite e-tutoring's remarkable growth and popularity, a recent literature review conducted in preparation for the writing of this article reveals that, while there have been a limited number of studies on the use of e-tutorials⁶ in library settings, fewer than half a dozen studies exist involving synchronous (real-time) e-tutoring (i.e., Biesinger & Crippen, 2008; George & Dykman, 2009; Johnson & Bratt, 2009; Lissaman, De Pomerai & Tripconey, 2009; Sulcic & Sulcic, 2007). Much is to be learned about e-tutoring, and this study hopes to address that dearth in the literature. Specifically, this study proposes a model, based on the results of a mixed-methods diffusion study, for the effective implementation of e-tutoring in the context of secondary schools.

To date, numerous studies have demonstrated the effectiveness of both conventional and online tuition as a valid form of academic intervention, especially in the area of mathematics (Biesinger & Crippen, 2008; Fuchs et al., 2008a; Fuchs et al., 2008b; Means, Toyama, Murphy, Bakia, & Jones, 2009; Merriman & Coddling, 2008; Song, 2005). Although tutoring has long been a way for students to get remediation, or even a competitive edge, e-tutoring is a relatively

⁶ E-tutorials are online, self-taught modules designed to teach people new skills using a step-by-step process. E-tutoring, conversely, is similar to traditional tutoring, but it is done in online chatrooms.

new phenomenon that exploded onto the scene with improvements in network bandwidth and the advent of Web 2.0 technologies. E-tutoring refers to individualized support from a tutor to a single or a small group of tutees that uses the Internet as its medium of communication (Flowers, 2007; Johnson & Bratt, 2009). Some of the Web 2.0 features made available through e-tutoring include the following: synchronous (real-time) communication such as chat rooms; asynchronous (time-delayed) communication such as discussion threads; VoIP (Voice over Internet Protocol) such as Skype; podcasts (the audio or video version of a blog); interactive white boards, often with graphing and mathematical equation functions; and of course, e-mail. Now e-tutoring is being offered around the world by public, private, and not-for-profit institutions alike (George & Dykman, 2009; Gewektz, 2005; Lissaman et al., 2009).

Although there is a paucity of research specifically comparing e-tutoring to conventional tuition, a fairly extensive amount of research has been conducted comparing face-to-face to distance education. For instance, one meta-analysis found no significant difference between the learning outcomes of online and face-to-face learning (Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004). More recently, a meta-analysis was commissioned by the U.S. Department of Education that examined more than a thousand empirical studies on online learning between 1996 and 2008 (Means et al., 2009). Surprisingly, it was found that students in e-learning environments actually outperformed their counterparts in the traditional classroom (Means et al., 2009). The study was certain to add, however, that the improved performance does not imply that online learning is superior to traditional learning per se, but is likely the result of a combination of factors including additional time spent on task, additional learning materials, and additional opportunities for collaboration (Means et al., 2009). Technological developments in

the area of e-learning, such as the many collaborative and interactive features offered by Web 2.0, may account for the different conclusions reached by the earlier and latter meta-analyses.

However, as the aforementioned results only compare e-learning to conventional modes of educational delivery, they cannot be generalized to an e-tutoring context without further research. While the two use many of the same online features, assignments done in e-learning environments are generally compulsory and evaluated; e-tutoring, conversely, is entirely extra-curricular. One of the reasons for higher student achievement in online learning suggested by the aforementioned study is that students in e-learning environments spent more time on task than their counterparts in traditional classrooms. As tutoring, whether online or traditional, is already extra time on task, it is unclear whether there would be any significant difference between the two groups if this were no longer a factor.

Clearly e-tutoring has become a viable alternative to conventional tuition, given that the majority of studies find that students perform the same or better in an online environment. Thus, for reasons of cost and convenience, conventional learning and tutoring are now often supplanted with learning facilitated by the World Wide Web. According to Song (2005), an increasing number of educational institutions are “enabling students to access an Internet learning opportunity regardless of geographical, time, social, physical and economical constraints” (pp. 4-5). As the 2010 Horizon Report, a publication of a not-for-profit consortium of more than 280 educational organizations suggests, “People expect to be able to work, learn, and study whenever and wherever they want to. Life in an increasingly busy world where learners must balance demands from home, work, school, and family poses a host of logistical challenges with which today’s ever more mobile students must cope” (Johnson, Levine, Smith, & Stone, 2010, p. 2).

In Canada, many provinces and territories across the country are beginning to capitalize

on these digital technologies as a way to provide students greater academic support and improve standardized test scores, especially in times of budgetary constraint. For example, in 2008, the Ontario Ministry of Education's (OME) unit e-Learning Ontario launched a pilot project called Homework Help, the subject of the current study. The service has since expanded to include 31 school districts that have a combined population of nearly 236,000 students (OME, 2011). It works by providing free, synchronous e-tutoring by Ontario certified mathematics teachers to students in Grades 7 to 10. Five nights a week, students can log on to the Homework Help Web site and receive confidential one-on-one tutoring. Students and tutors interact in grade-specific chat rooms where students can pose a question to their tutor either in text or equation form using an interactive white board. The site also features video tutorials and interactive activities covering an array of curricular expectations.

Despite the potential benefit to students, Homework Help is being underutilized, particularly by rural students (Corrigan, 2010) and applied stream (community-college bound) students, as this study will demonstrate. As in many countries around the world, students in this study from Ontario, Canada, are streamed according to their academic level or vocational goals when they reach high school (Grades 9-12). In general, students who wish to pursue university take academic level courses; those who wish to attend community college take applied level courses; while those who wish to enter the workplace enter that stream. Results from a pilot of this study revealed that it was primarily academic, not applied, students who were using Homework Help. While this was not surprising—academic students are typically assigned more homework than applied students—it was disconcerting. Studies show that students enrolled in

the applied and workplace streams are more at-risk⁷ than academic students (Ferguson, Tilleczeck, Boydell, & Rummens, 2005), thus it seems unpropitious that those who most need help are disinclined to use Homework Help. Further, research has shown that academic support activities like tutoring are one of the key protective factors in mitigating drop-out rates (Ferguson et al., 2005); therefore, it is imperative to find out why Homework Help is not being readily adopted by this sub-group, and also to discuss what strategies might prove more effective.

Theoretical Framework

Due to the low uptake of Homework Help in the particular district involved in this study (see the Results section for further details), a model was sought to improve the delivery of the service. Government, community, and commercial companies have successfully used diffusion research to understand the mechanisms by which innovations diffuse, and also to facilitate their adoption (e.g., Rogers et al., 1995; Wildemuth, 1992; Wollons, 2000). Though adoption and diffusion are closely related, there is a nuanced distinction: Adoption concerns an individual's decision to utilize a technology as the best course of action, whereas diffusion is composed of individual adoption decisions within a given social system. Depending on the theoretical framework employed, either adoption or diffusion, or sometimes a combination of the two, may be the focus. An adoption study, for example, could be one that looked at how individuals perceive the attributes of an innovation: Is it easy to use? How might it make doing one's job easier or faster? Etc. A diffusion study, on the other hand, could look at how awareness of an innovation was communicated through a social system. For example, what networks were

⁷ At-risk students are defined as those students who "are performing significantly below the provincial standard, earning marks in the 50's and low 60's and who do not have the foundations to be successful in the new curriculum" (O'Connor, 2003).

important in diffusing the innovation? What was the role of opinion leaders? Were mass media or interpersonal connections more significant in facilitating diffusion? This is just a cursory look at studies that could be conducted using either adoption or diffusion research, and it should be noted that other approaches are also available. Despite the distinction between these two terms—adoption and diffusion—many use the terms interchangeably, and the term diffusion is often used as an umbrella term under which adoption falls (Rogers, 2003).

The emergence of online technologies has brought with it a surge of diffusion research, in other words, research that is concerned with how organizations communicate new innovations to their target audience, as well as how that audience perceives and chooses to adopt or reject these innovations. The following are some of the most salient models utilized in current research on technology adoption: the diffusion of innovation (DoI) model (Rogers, 2003); the technology acceptance (TAM) model (Davis, 1989); and the uses and gratifications (UG) model (Katz, Blumler & Gurevitch, 1974). Though each model places different emphasis on which variables are most significant to an innovation's adoption, commonalities include the attributes of the innovation, the attributes of the adopter, and the social milieu within which the innovation is being diffused. Though it is not within the scope of this study to present a critical examination of all diffusion models, three of the most prevalent models found in the literature will be overviewed in order to demonstrate why one was selected over the others.

Diffusion of Innovations (DoI) Model

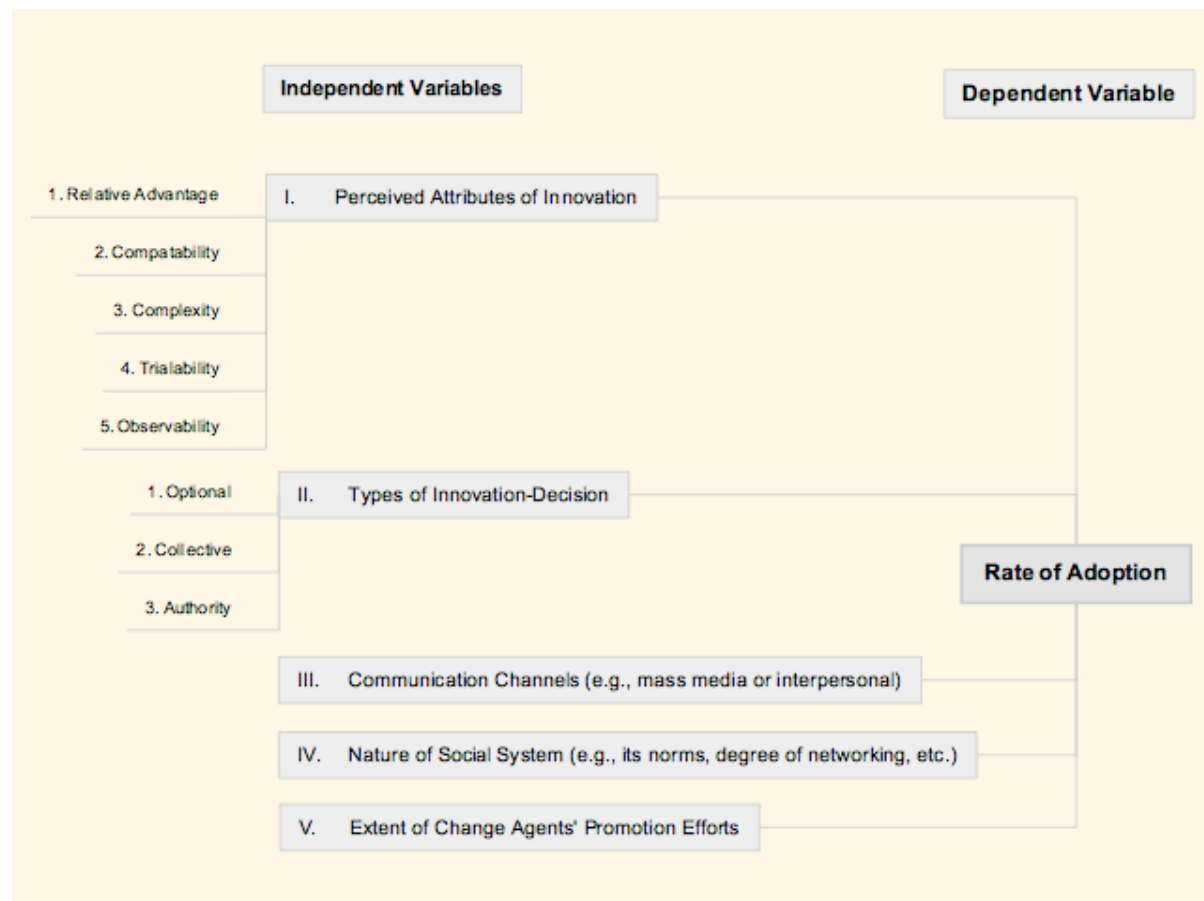
Rogers' (2003) DoI model, the one employed in this study, is arguably the most prominent of diffusion models. In his seminal work *Diffusion of Innovations*, first published in 1962, Rogers (2003) synthesized 508 studies in order to produce DoI. The appeal of DoI lies in its comprehensive approach to understanding innovation diffusion, drawing from both the fields

of psychology and sociology to explain the complex mechanisms involved in the spread of innovations through a population. In this case, innovations are broadly defined as any idea, practice, or object that is perceived as novel by an individual (Rogers, 2003). Rogers' model is by far the most comprehensive, taking into account the numerous stages involved before, during, and even after, a person's innovation-decision—the term Rogers uses to describe a person's eventual adoption or rejection of an innovation. In the DoI model, an individual passes through the following stages in the Innovation-Decision process: (1) *knowledge* of the innovation; (2) *persuasion*, when an opinion is formed regarding the innovation; (3) *decision* to adopt or reject the innovation; (4) *implementation* of the innovation; and finally, (5) *confirmation* of the individual's decision. For each stage of the process, Rogers poses various methodological approaches that researchers can use to frame their studies, each differing in terms of their dependent and independent variables, as well as their intended unit of study. The approach used in the current study will be outlined in the *Procedure* section of this article.

Some have criticized DoI as being overly broad and complex as to make it difficult to frame a single study (Straub, 2009), and looking at a graphic representation of the model in Figure 1, one can see why this position might be justified. However, paradoxically, the complexity of the model is one of its greatest strengths; in *Diffusion of Innovations*, Rogers outlines not one conceptual framework for diffusion research, but rather eight distinct methods to study diffusion, depending on the nature of the study. Another of the strengths of DoI is that it appeals to many disciplines and has been successfully used to understand diffusion in fields as diverse as education, agriculture, health care, business, and technology (Rogers, 2003). Yet, this strength can be construed as a weakness of DoI in that it is non-specific and needs to be adapted to meet the needs of a particular discipline, which is how the Technology Acceptance Model

came to be.

Figure 7. Rogers' (2003) Diffusion of Innovations Model



Technology Acceptance Model (TAM)

TAM was devised by Davis (1989) for application in computer sciences, though it has since been co-opted by many other disciplines due to the ubiquity of technology use in society. Based upon social cognitive theory and decision-making theories, TAM purports that technology adoption is premised on two key variables: (1) perceived usefulness, defined as “the degree to which a person believes that using a particular system would enhance his or her job performance”; and, (2) perceived ease of use, “the degree to which a person believes that using a

particular system would be free of effort” (Davis, 1989, p. 320). One of TAM’s greatest contributions was its novel approach in considering the saliency of an individual’s perceptions of a technology to adoption (Straub, 2009). While TAM has been used successfully in a multitude of studies to predict how an individual’s perception of a technology may affect its adoption, critics point out that TAM ignores differences amongst individuals—such as prior experience, age, and gender—which have been shown to influence adoption (Agarwal, Sambamurthy, & Stair, 2000; Straub, 2009). Further, TAM is prescriptive rather than descriptive, and although it may explain an individual’s decision to adopt a technology, it gives no guidelines for mitigating non-adoption. Rogers’ DoI, conversely, is much more comprehensive, viewing adoption as a process—one which can succeed or fail at different stages of the process for different reasons. Thus, it offers an innovation’s stakeholders greater clarity in establishing a framework from which to re-position an innovation in its market.

Uses and Gratifications Expectancy (UG) Theory

Originally conceptualized as a means to understand the use and adoption of media, UG has figured prominently in mass communication research to explain people’s media consumption habits. More recently, UG has been used to explain Internet adoption (Ruggiero, 2000) and its ancillary uses such as online bulletin boards (Rafeali, 1986), information gathering (Maddox, 1998), Web surveillance and voter guidance (Johnson & Kaye, 1998), and social activism (Pavlik, 1996). While many diffusion theories perceive the adopter as passive (i.e., the

hypodermic needle model, of late⁸), UG recognizes the active role adopters play in the diffusion process.

UG contends that individuals consciously consume media because they are either useful and/or gratifying (hence the name of the model). Katz, Blumler, and Gurevitch (1974) classified people's uses and gratifications into five *needs* categories. The first one is *cognitive needs*, which include acquiring information, knowledge, and understanding. For example, a student might decide to use Homework Help because she wants to learn how to find the volume of a sphere for a test the next day. The second category encompasses *affective needs*, as in those pertaining to emotion and pleasure. Perhaps a student is anxious about getting the wrong answer in class and getting laughed at, so he uses Homework Help to find the right answer, thus reducing his anxiety. Thirdly come *personal integrative needs*, including the desire for credibility, stability, and status. In this case, a student might desire a high mark in mathematics to impress her parents and use Homework Help to help accomplish that. Next are *social integrative needs*, which include social interaction. A student might opt to use Homework Help instead of using the back of the textbook to find the answer because there is greater social interaction. Conversely, a student might balk at online interaction because he deems it less personal than meeting a person face-to-face for help. The last category *tension release needs*, including the need for escape and diversion. Of all the needs, this one seems the least pertinent to the adoption of Homework Help, though one might imagine a teenager escaping online to get help with homework instead of asking her parents who are fighting downstairs.

⁸ Before the 1940s, communication theorists believed that an audience passively received media messages, or that the messages were 'injected' into the minds of the masses; this is how the concept of the "hypodermic needle model" was derived.

As popular as UG may be within communication research, it is not without its detractors: McQuail (1994) has noted that UG has failed to provide a causal explanation or a successful prediction of media choice, while others have cited its focus on individual psychological gratification as not being generalizable to groups (Wikibooks, 2011).

While each of the diffusion/adoption theories presented has its strengths and weaknesses, DoI was selected based on its prominence in the literature and its functionality for this particular study. TAM was primarily rejected because one of its two key variables, perceived ease of use, was not hypothesized to play a major role in a student's decision to adopt Homework Help; this is mainly because the online tutoring site has a straightforward and simplistic design, and would be akin to navigating any other Web site. Further, according to a meta-analysis of diffusion studies conducted by Tornatzky and Klein (1982), using two or fewer innovation attributes as independent variables has statistically less predictive value than using five, as DoI does. Meanwhile, it was decided not to use UG due to its being premised upon the active role the participant is thought to play in an adoption decision; as Homework Help is designed for adolescents, parental influence may mean that usage is not exclusively voluntary. Further, UG has been designed to study the diffusion of mass media, and more recently is being used to study social media; at this point, it seems too broad of a theory to be suitable for studying the diffusion of educational technologies due to its emphasis on social and diversion-type needs.

The Current Study

Guided by Rogers' (2003) DoI theory, the purpose of this mixed methods study was to explore the following: (1) Do Rogers' categorizations regarding the attributes of innovations—namely relative advantage, observability, complexity, compatibility, and trialability—logically fit the data, both quantitative and qualitative? (2) Does the DoI model adequately explain the

relationship between these attributes and Homework Help's adoption? (3) Do the mean rates of adoption vary between academic and applied student subgroups? If so, what attributes best predict adoption for each sub-group?

A concurrent triangulation approach was used for this mixed methods study, the benefits of which are numerous. Not only does the triangulation of survey and interview data increase the validity of the study, but using this method avoids the constraints imposed by the normally dichotomized qualitative and quantitative approaches (Creswell, 2009). While the quantitative survey data will help answer *what* variables contribute to Homework Help's adoption and to *what extent*, the qualitative interview and focus group data will answer not only *what* variables are important, but *why*. Further, diffusion research demonstrates that a more comprehensive understanding of an innovation's diffusion can be achieved, and that pro-innovation bias can be significantly reduced, via mixed-methods research (Rogers, 2003). Pro-innovation bias is created when researchers simply label those who do not adopt an innovation as laggards; in reality, a person may choose non-adoption for very practical and economic reasons that have nothing to do with a person's degree of innovativeness.

Method

General Overview

This concurrent mixed-methods study involved two distinct phases. The quantitative phase included a cross-sectional survey administered to Grades 7 to 10 students—the grades to which Homework Help is currently offered—in one of the school districts involved in the Ministry of Education's pilot project. While the survey involved solely student participants, the qualitative phase of the study involved focus groups with students, as well as interviews with

adult stakeholders. Details regarding the participants and procedures involved in these phases are offered forthwith and are summarized in Table 4.

The school district selected for the study was a predominantly rural school district in Eastern Ontario, Canada. The district consists of two high schools, one with a population of approximately 1100 and another with a population of 400, located in the district's urban centres. The high schools cater to students in Grades 8 to 12, and thus were the primary source of participants for the study. Grade 7 participants were also invited from the district's 20 feeder schools, which cater to children from kindergarten up until Grade 7. Though some feeder schools are in more populated areas, many of them are located in small towns and villages throughout the school district. This particular school district was selected partially for convenience (in that the researcher has established many contacts there), but also because this particular district is one of the few involved in the pilot project that has a large enough rural population to be used for a comparison with its urban population (see Corrigan, in press, for further discussion on rural versus urban adoption of e-tutoring).

Table 4
Overview of Mixed Methods Used in the Present Study

	Quantitative Component	Qualitative Component
Method	Cross-sectional survey	Semi-structured individual interviews and focus group interviews
Purpose	To generalize from a sample about why a population of students adopts or rejects Homework Help	To explore reasons why students adopt or reject Homework Help; to triangulate survey findings
Participants	• N = 308 students in Grades 7 to 10	• e-Learning Contact (eLC) • mathematics department head • Homework Help tutor • Two student focus groups with five and six students

Participants

For the quantitative phase of the study, a survey was administered to $N = 308$ students in June, 2010, which was the first year that the pilot project was expanded beyond its initial single school district. Survey participants were 45.5% male and 55.5% female. The distribution of participants in each grade was as follows: Grade 7, 15.0%; Grade 8, 27.0%; Grade 9, 36.5%; and Grade 10, 21.5%. Nearly 61.0% were in the academic stream, 35.8% in the applied stream, and 3.3% identified as being from the locally-developed (workplace) stream.

During the qualitative phase, interviews were used to collect data from adult participants while focus groups were used with student participants. The interview participants included the following: the eLC, who was appointed by the Ontario Ministry of Education to promote Homework Help in this school district; a mathematics department head, who is also a full-time teacher at the larger of the two high schools; and lastly, a Homework Help e-tutor, who is a Grade 7 and 8 teacher at the smallest rural elementary school in the district. There were two students focus groups; focus group 1 consisted of four Grade 10 students and one student in Grade 11 (who had used Homework Help the previous year), while focus group 2 consisted of five Grade 9 students and one Grade 10. Ideally the focus groups would have involved some Grade 7 and 8 students; however, none responded to the recruitment. Despite this, many of the Grade 9 participants commented on their experience with the service in the previous year. The interviews and focus groups all took place during January of 2011.

Procedure

The quantitative phase of the study involved a cross-sectional survey designed using Rogers' (2003) DoI model. Within the model, Rogers proposes eight distinctive typologies of diffusion research, each with unique units of analyses, as well as distinctive independent and

dependent variables. The DoI method chosen for this study utilizes the innovation itself as the primary unit of analysis, which in this case is the e-tutoring service known as Homework Help. The dependent variable is the rate of adoption of Homework within a given social system, the school district being studied. The independent variables are the attributes of the innovation—namely relative advantage, compatibility, complexity, trialability, and observability. According to Rogers, these five variables account for between 49 and 87 per cent of the variance in the rate of adoption of innovations. *Relative advantage* refers to the degree to which an innovation is perceived to be better than what it supersedes, or is possibly something that previously never existed but meets a recognized need. Examples of Likert statements in this category are, “Using Homework Help would improve my mark in mathematics” or “Using Homework Help makes doing homework easier.” *Compatibility* refers to the innovation’s consistency with an adopter’s existing values, past experiences, and needs. For example, “I think doing homework is important” and “I think using computers is important.” *Complexity* is the extent to which an innovation is difficult to understand and use. An example would be, “I think using computers is easy” or “I find it easy to use the interactive white board in Homework Help.” *Trialability* is the degree to which an innovation can be experimented with on a limited basis. As high-speed Internet connectivity is a prerequisite of using Homework Help, students were asked about their Internet connectivity, computer availability, etc. Lastly, *observability* relates to the visibility of an innovation’s results. For example, do students’ parents monitor their homework? And, do students perceive that using Homework Help has improved their grades?

The survey was modeled after those used in similar DoI studies and included three types of items: predictive (for those who use, or may use, Homework Help); postdictive (for those who use Homework Help); and demographic, which all participants could answer.

The interviews and focus groups were semi-structured, recorded for accuracy, and lasted between 20 and 40 minutes. Questions centred on the a-priori themes established via the DoI framework, paralleling those used in the survey (relative advantage, compatibility, complexity, trialability, and observability). Additionally, general demographic questions were posed, as well as reflective questions wherein participants were asked to consider the strengths and weaknesses of Homework Help, as well what could be done to make it more effective and/or what service might offer a better alternative.

Results

The results of this mixed-methods study are reported in two sections. First, the quantitative results, including analyses of the survey data, are reported. Then, the qualitative results from the interviews and focus groups are explored. During the Discussion, these two sets of results are integrated.

Quantitative Results

Following data collection and screening, an independent groups *t* test was performed in order to compare the mean rates of adoption between academic and applied student subsamples. Then, three factor analyses were performed on the overall sample, as well as the academic and applied subgroups, in order to either validate or invalidate Rogers' (2003) categorizations. Finally, a standard multiple regression analysis was run using the factor scores from the above analyses to determine which attributes of an innovation correlate most strongly with the adoption of e-tutoring, and whether or not the overall DoI model could successfully predict the adoption of Homework Help.

The statistical analyses in the following section use the same dependent variable (DV), the rate of Homework Help adoption. This rate was determined by the survey question, “How often do you use the online tutoring service known as Homework Help?” The distribution of the DV was as follows: never (78.9%), rarely (14.6%), monthly (4.9%), weekly (.3%), or daily (0%).

While all $N = 308$ students could answer the first two parts of the survey, only students who responded that they used Homework Help monthly, weekly, or daily were prompted to answer the postdictive segment of the survey. As the majority of survey participants responded that they never or rarely used Homework Help, very few responses ($n = 10$) were collected for postdictive analysis. As such, data obtained from the postdictive section of the survey did not meet the sample size assumption required for factor or regression analyses and were excluded from subsequent analyses.

Data screening.

Prior to treatment of the data, all 63 demographic and predictor variables were screened using SPSS descriptive statistics for accuracy of data entry; the range, means, and standard deviations were all found to be plausible. Next, the variables were screened by conducting a Missing Values Analysis (MVA) using SPSS. Little’s MCAR (Missing Completely At Random) test on all $N = 308$ cases revealed a significant result of $p = .04$, indicating that the pattern of missing data may not be due to randomness. After deleting five cases from recalcitrant respondents where missing data exceeded 50%, Little’s MCAR test revealed a statistically non-significant result of $p = .14$; therefore, MCAR may be inferred (Tabachnick & Fidell, 2007). After the deletion of the aforementioned cases, no variable was missing more than 5% of responses. Missing data on the remaining $N = 303$ cases were imputed using SPSS Expectation

Maximization. While some univariate and multivariate outliers were detected in less than 2% of the cases, a decision was made not to delete any cases as this number of outliers could be expected from a sample of this size. Lastly, to reduce the severe negative skewness and leptokurtosis of the DV and to improve the linearity of relationships between the DV and each of the predictors, rate of adoption was transformed using a severe positive transformation ($1/x$). Following this transform, skewness was reduced from 2.197 to -1.595 and kurtosis from 4.291 to .738.

Independent-groups *t* test.

An independent-groups *t* was performed in order to determine whether the mean rates of adoption (DV) varied significantly between the academic ($n = 109$) and applied ($n = 187$) student subgroups. Students in the academic stream ($M = 1.34$, $SD = .63$) had significantly higher Homework Help adoption scores than those in the applied stream ($M = 1.11$, $SD = .34$), $t(288.53) = -4.04$, $p < .05$, $d = .49$. According to Cohen's (1998) guidelines, $d = .49$ represents a medium effect size.

Factor analyses.

Three principal factors extractions with Varimax rotation were conducted on data from the overall sample, as well as data from the academic and applied student subgroups. In all three analyses, data from the 25 predictive survey items were included in order to generate evidence regarding the validity of Rogers' (2003) perceived attributes of an innovation. For the three analyses, despite using a cutoff of .30, all variables loaded on to at least one factor, and aligned logically under the a-priori categorizations. Loadings of variables on factors, communalities, and percent of variance are shown in Table 5 for the data subset for academic students. These results are representative of the factor analysis performed on the applied sub-group, though

somewhat different from the analysis of the overall dataset in that stream (applied, academic, or workplace) loaded onto its own factor. Otherwise, factor loadings of the academic sub-group resembled that of the overall dataset.

In each analysis, the factor groupings remained consistent with Rogers' categorizations of relative advantage, observability, complexity, compatibility, and trialability. Finally, factor analysis had the additional benefit of reducing numerous survey variables down to a few in order to facilitate regression analyses, which was the next step of the quantitative analysis.

Regression analyses.

Below, the results from two standard multiple regression analyses are shown including analyses of the academic and applied student subgroups. The analyses were performed between the rate of adoption (DV) and the factor scores (IVs) on each of the five factors derived in the aforementioned factor analyses.

As demonstrated in Table 6, the overall regression model for the academic sub-group was significant, $F(5, 178) = 7.53, p < .05, R^2 = .18$, which, according to Cohen (1988) corresponds to a medium to large effect size. Of the predictors investigated, the following had significant regression coefficients: relative advantage ($b = -.26, t(178), p < .05$), observability ($b = -.28, t(178), p < .05$), and trialability ($b = -.16, t(178), p < .05$). Controlling for the other factors, a one standard deviation increase in relative advantage is associated with a .26 standard deviation increase in Homework Help's adoption, while observability and trialability lead to a .28 and .16 increase respectively.

Table 5

Factor Loadings, Communalities (h^2), and Percent of Variance for Principal Factors Extraction and Varimax Rotation on Academic Data, coefficients > .30 suppressed

	Factors					
	h^2	1	2	3	4	5
1. Relative Advantage						
Using HH would make homework easier	.869	.916				
Using HH would improve mark	.753	.846				
Using HH would make math easier	.695	.813				
Using HH would make doing homework faster	.600	.755				
2. Observability						
Parents encourage using HH	.657		.755			
Teacher reminds me about HH	.620		.716			
Friends encourage using HH	.511		.658			
Parents remind me about HH	.523		.653			
Teacher encourages using HH	.534		.582			-.315
HH lesson was helpful	.422	.424	.432			
HH was well promoted	.221		.411			
3. Complexity						
I think computers are important	.613			.762		
I think using computers is easy	.585			.755		
I think using computers is fun	.519			.713		
Mean technology usage score	.440			.495		.412
Parents' opinion about computers	.195			.373		
4. Compatibility						
I think math is important	.468				.656	
My parents think math is important	.319				.553	
Math marks	.318				.479	
My parents think homework is important	.284				.416	
I think homework is important	.258				.399	
Educational aspiration	.228				.395	
My parents monitor my homework	.160				.393	
5. Trialability						
Rurality	.332					.553
Internet accessibility	.321					-.532
Percent Variance		11.93	10.56	9.16	7.09	4.78
Cumulative Percent Variance						43.52

Table 6

Standard Multiple Regression of Factor Scores on HH Rate of Adoption within the Academic Subgroup

Variables	Pearson <i>r</i> HH Rate of Adoption	<i>B</i>	b
1. Relative Advantage	-.26	-.06	-.261*
2. Observability	-.28	-.07	-.283*
3. Complexity	.01	.00	.01
4. Compatibility	.00	9.854-ES	.00
5. Trialability	-.16	-.040	-.16*
<i>R</i>			.42
<i>R</i> ²			.18*
Adjusted <i>R</i> ²			.15
Std. Error of the Estimate			.23

*Indicates significance at $p < .05$

Table 7 shows the overall regression model for the applied sub-group. Again, the overall regression model was significant, $F(5, 113) = 2.68$, $p < .05$, $R^2 = .11$, or, according to Cohen (1988), a medium effect size. However, this time only two of the predictors had significant b coefficients: relative advantage ($b = -.21$, $t(113)$, $p < .05$) and observability ($b = -.19$, $t(113)$, $p < .05$).

Table 7

Standard Multiple Regression of Factor Scores on HH Rate of Adoption within the Applied Subgroup

Variables	Pearson <i>r</i> HH Rate of Adoption	<i>B</i>	b
1. Relative Advantage	-.22	-.04	-.21*
2. Observability	-.20	-.03	-.19*
3. Complexity	-.10	-.01	-.09
4. Compatibility	-.13	-.02	-.11
5. Trialability	.02	.00	.02
<i>R</i>			.33
<i>R</i> ²			.11*
Adjusted <i>R</i> ²			.07
Std. Error of the Estimate			.16

*Indicates significance at $p < .05$

Qualitative Results

Once the focus group and individual interviews were complete, the data were transcribed, coded, and analyzed using Tesch's (1990, as cited in Creswell, 2007) eight-step process for coding data. This process involved the following: (1) taking marginal notes; (2) identifying and listing emerging topics; (3) creating codes for major, unique, and leftover topics; (4) forming abbreviations from the topics for use in coding; (5) rereading the transcripts and applying the codes; (6) looking for commonalities amongst the codes and then reducing them into categories; (7) assembling the data into a table with a column for each category; and lastly, (8) recoding any remaining data.

In reference to step six, the a-priori categories of Rogers' (2003) attributes of innovations were used as preliminary categorizations, while allowing for additional themes to emerge a-posteriori. This strategy is consistent with Wolcott's (1994) strategy of relating and contextualizing categories to those found in literature. It was then determined which codes logically fit under Rogers' categories of adoption, while remaining codes were used to create emergent categories thus enriching the DoI model.

The following section explores the themes from the focus groups with students (S#), and also from interviews with a mathematics department head (DH), the district's e-Learning Contact (eLC), and a Homework Help tutor (T). Table 8 summarizes the themes and sub-themes that emerged from this process, as well as literature that supports these themes, where applicable.

Table 8
Themes and Subthemes from Qualitative Analysis

Theme	Sub-theme	Support in Literature
<i>Relative Advantage</i>	Academic instruction	Biesinger & Crippen (2008); Fuchs et al. (2008a); Merriman & Coddling (2008)
	Immediacy of tuition	Prensky (2001)
	Anonymity	Myers et al. (2004); Rabinovich (2009); Song (2005)
	Convenience	Johnson, et al. (2010)
<i>Observability</i>	Promotion efforts	Rogers (2003)
	Parental supervision	Henderson, Mapp, Johnson, & Davies, (2007)
<i>Complexity</i>	Ease of use	Davis (1989); Rogers (2003)
<i>Compatibility</i>	Motivation	Fredericks & Eccles (2002); Gottfried, Fleming, & Gottfried (2001); Gottfried, et al., 2007)
	Academic stream	N/A
	Learning style	N/A
	Hours of availability	N/A
<i>Trialability</i>	Internet accessibility	OECD (2001); Looker & Thiessen (2003)
	Internet / computer affordability	Foy (2005); Looker & Thiessen (2003)
<i>Suggestions for Improving Homework Help</i>	Range of subjects	N/A
	Range of grades	Middleton & Spanias (1999)
	Appeal	N/A
	Mobile application	N/A
	Artificial intelligence	N/A

Relative Advantage.

Relative advantage was a popular theme that emerged during all of the three individual interviews and the two focus group interviews. One of the key sub-themes within relative advantage was the academic instruction received. For example, according to T, “Sometimes during what you call the parting comment, a student might thank you and say that they’ve been struggling with that concept for several days now, and you’ve just helped them understand it in a different way than their teacher did.” This message was echoed by the eLC: “The benefits of [Homework Help] are mainly numeracy related, namely having a tutor who is an Ontario certified math teacher online that they can get help with right away.”

On the negative side, many students, and even the DH, complained about the wait times associated with Homework Help. The DH recalled the following: “I remember last year I had an applied class and I had a couple of kids go on [Homework Help] and they got frustrated because they were in a cue of eight kids. After waiting so long and having that frustrating of an experience, I don’t think they ever used it again.” One student (S10) suggested that more tutors needed to be hired, stating, “Sometimes you have to wait 30 minutes just to get your question answered.” According to the eLC, the Ministry did in fact hire more online tutors in the second semester to meet the growing province-wide demand for the service.

One advantage that e-tutoring has over conventional tutoring is that the tutee can remain anonymous. “I actually feel more comfortable because the tutors don’t know your name. That way, they don’t judge you like a teacher or a friend might” (S8). In regards to the anonymity feature, there has been discussion about including an audio feature whereby students who struggle with the texting as communication (perhaps students with low literacy skills) would be

able to speak into a microphone instead (eLC). However, this has been put on hold to protect the anonymity of the students (T).

Lastly, one of the most popular advantages of e-tutoring over conventional tuition lies in its convenience. “Things get busy, and online is convenient. The tutors are there five nights a week for four hours each time. So whether it’s preparation for a test, or an assignment, or simply to do their homework, these students have access to someone who can help” (T).

Observability.

The theme of observability involved both how observable the promotion of the service was, as well as how its use was observed. According to the eLC and DH, Homework Help was promoted in numerous ways—specifically via the eLC’s visits to every Grades 7 to 10 mathematics classroom in the district, articles in local newspapers and the district-wide newsletter, as well as presentations at school council meetings and conferences. In terms of the quality of Homework Help promotion, there were mixed reactions. “I was reminded of it often. There were posters in our math class, and around the school. Also, [the eLC] has come in twice to give us a demonstration. And, my math teacher always tells us to use it if we need help” (S5). Whether or not students remembered to use the service seemed to depend upon the teacher’s promotion efforts: “Well, in my math class we had a poster, but the teacher didn’t encourage using it or anything. I totally forgot that we even had that site to use” (S9).

Another dimension of observability was the extent to which the results of using the service could be seen, whether by students or their parents. One student (S4) who uses the site occasionally is encouraged to use it by her mother who heard about the service at a school council meeting. Now when the student needs help at home with mathematics, her mother reminds her to use Homework Help.

Complexity.

For the most part, staff and students stated that Homework Help was easy to use: “You just log in, and it tells you where you need to go. It’s pretty simple really: You just type in your question and wait for the tutor to respond” (S11). While this sentiment was echoed by many of the students and the eLC, the T, who is also a Grade 7 and 8 teacher in a rural elementary school, had this to say: “One of the problems with Homework Help is that you need to be at least somewhat technologically oriented to use it [...] I’ve got students in my own class, for example, who don’t have computers at home. I think for them this technology is still intimidating.”

Compatibility.

Whether Homework Help was compatible with a student’s attitudes and practices seemed to be determined by the extent to which they were self-motivated: “Because it’s the students’ own initiative to go out and use it, that’s the biggest barrier. You know, when they go home, they have to turn on the computer, go to the Web site, log on, and check it out” (eLC). Or, in other words, “Well, like anything, Homework Help will take some getting used to. Many students have what you might call a math phobia. Students who aren’t strong at math tend to be intimidated. It’s like swimming: If you’re afraid of the water, and you aren’t willing to get wet, you’ll never get over that fear. It’s a matter of how much bait do we have to put out there for them to bite. If they do bite, they might realize math isn’t so bad after all” (T).

Students’ academic motivation may be tied to their academic stream. According to the eLC, “I see a lot of academic students using the Homework Help site, not so much the applied. Now, speaking with the applied students, and the teachers as well, they don’t necessarily give lots of homework, right?”

Compatibility was also seen in terms of the students' preferred learning styles; some preferred to learn face-to-face, while others appreciated the flexibility of online learning. Here is an example of a student who preferred learning online: "I don't mind that it's online. I already ask my friends for help over Facebook or I text them [...] People don't mind asking for help online. You don't jumble your words. Your thoughts are clearer when you type. Plus, you can save the conversation and come back to it later [in reference to the ability to record the e-tutoring session]" (S9). By contrast, another student only sought out online help as a last resort: "Most times if I needed help, I would ask my parents or teacher, but if I couldn't get them to help, I'd go on [Homework Help]" (S11).

Lastly, many of the students thought that the hours of availability (5:30 – 9:30 p.m.) were not compatible with their schedules. Some want Homework Help opened earlier: "We get off [school] at 2:30 p.m. and it doesn't open until 5:30 p.m., so if you want to use it to do homework right after school, you can't" (S2). Meanwhile, others want it open later, "I think they should leave it open even later for the older grades, maybe even until midnight" (S9), and "Even having it open until 10 p.m. would be helpful though [as some students work after school]" (S7).

Trialability.

A student's ability to experiment with Homework Help on a trial basis depended primarily on two things: Internet availability and Internet affordability. According to the T, Internet accessibility remains an issue where he teaches: "Well, honestly, I don't think my class is taking advantage of it too much. That's mostly because of the [rural] area we live in. Mostly the kids have dial-up, if they have Internet at all." The T also stated that the cost of high-speed Internet remains rather prohibitive in rural areas: "You see, the trouble up here is that Internet costs a lot more than in a city. Due to the area being so remote, it costs upwards of \$70 to \$100 a

month. Dial-up might be around \$20. To use Homework Help, [parents] might have to spend about three times the price of dial-up. They'd require Internet via satellite service as there's not enough population to warrant a fibre optic line." Conversely, many of the students interviewed lived in town, and they said that Internet accessibility and affordability were non-issues.

Suggestions for improving Homework Help.

While the adult participants did not have many suggestions for improving Homework Help, the students had many creative ideas. Some of the simpler enhancements suggested by students included having music playing while waiting in cue, being able to customize the colour and look of the site, being able to communicate with other students, as well as having access to math games while waiting for one's turn with the tutor.

Another more complex improvement that frequently arose during the interviews and focus groups was the idea of expanding Homework Help to higher grades and to a greater diversity of subject areas. "I think definitely opening it up to senior grades. Once you're in Grades 11 and 12 you're more focused, and I know that a lot of people in younger grades aren't really as concerned with their grades and how they're doing in the class. But once you're older, that changes. Whereas a lot of the younger students won't use it, if it were offered to older students, they'd use it. They want their marks to be strong for university" (S2). When asked what other subjects students would most like to see Homework Help used in, several students noted science and English.

Finally, students suggested innovative ways to make using Homework Help more advantageous including the development of a mobile phone application (S8), and even the use of artificial intelligence to help answer students' questions (S6). While these innovative approaches

are futuristic for the moment, it may not be long until e-tutoring catches up with students' imaginations.

Discussion

One of the questions that figures most prominently in diffusion research in general, and more specifically in this study, is what model can be used to explain the adoption of an innovation such as Homework Help? Factor analyses of various subsets of the data, in combination with qualitative data, show that Rogers' (2003) DoI model is significantly correlated with the adoption of the online tutorial. In both the regression analyses of the academic and applied student subgroups, the overall DoI model—comprised of the factors relative advantage, observability, compatibility, complexity, and trialability—was found to significantly predict the rate of Homework Help adoption. Individually, the factors of relative advantage, observability, and trialability were significant for the academic group; the same was true for the applied group, with the exception of trialability, which was not significant. One possible explanation for this might be that the trialability of Homework Help is not as great of a concern to applied students, who, according to the Department Head interviewed, are frequently assigned less Homework than their applied counterparts.

In terms of individual factors, Rogers' (2003) synthesis of diffusion studies has revealed that relative advantage is the single most important attribute contributing to an innovation's adoption. While discussion surrounding relative advantage was preeminent in the interview and focus group transcripts, it ranked second to observation during regression analyses. This may be in part due to the demographic under study; it is hypothesized that for adolescents, parental involvement may play a dominant role thus making the effect of observation higher than in the general population. Thus, the important role of parental influence in Homework Help's adoption

cannot be understated. That being said, relative advantage was, in its own right, significant. As revealed during the qualitative analysis, sub-themes contributing to this were convenience, immediacy (and the lack thereof), anonymity, and the quality of instruction. While students appreciated the convenience and anonymity of using Homework Help, concerns were expressed over the immediacy of tuition. The department head interviewed cited examples of students who decided to no longer use Homework Help after having to wait too long in the cue. In order for Homework Help to achieve greater adoption, wait times will have to continuously be addressed; that being said, according to the eLC, the Ministry is already aware of this concern and, in response, hired more tutors in the second semester.

As expounded in an earlier article from this study (Corrigan, 2011), trialability continues to impede the adoption of Homework Help, especially where rurality is concerned. Even as the digital divide narrows around the world (Mackey & Ho, 2006), it continues to worsen for certain demographic groups, namely for those of low socio-economic status and those who live in rural and remote areas (Looker & Thiessen, 2003). This study corroborates that evidence showing that, while Internet accessibility and affordability are mainly non-issues for students living in urban areas, the digital divide persists amongst many of the school district's rural students.

Lastly, the students' notions concerning how to improve Homework Help showed great prescience. Ideas for making Homework Help available as a mobile phone application, or using artificial intelligence to quickly answer students' questions at any time of the day or night were as compelling as they were plausible, though perhaps not anytime soon.

Limitations of the Study

One of the greatest limitations of the study was the lack of postdictive data collected. In the words of Rogers (2003), “Research on predicting an innovation’s rate of adoption would be more valuable if data on the attributes of the innovation were gathered prior to, or concurrently with, individuals’ decisions to adopt the innovation” (Rogers, 2003, p. 227). In diffusion research, predictive data are used in acceptability research, in other words, research concerned with determining whether or not an innovation will be successful in a given population. Postdictive data gathered after a person has had the opportunity to try the innovation are also important, for these data can be used to improve upon and better position the innovation to reach its target audience.

Another limitation, yet also a strength (for reasons previously mentioned), of the study is that its population is derived from a predominantly rural school district that does not have any cities within its boundaries. For this reason, the results cannot necessarily be generalized to school districts found in urban centres; further research in this area would be beneficial.

Conclusion

This study has demonstrated that Rogers’ diffusion of innovation model can be used to successfully predict e-tutoring adoption, at least in the context of this study. The model can be further extrapolated so as to best position Homework Help, and other online academic support services, to reach a higher level of diffusion. Further, this model may be applied to future educational technologies. Yet, understanding and controlling the factors that influence adoption alone is insufficient; even with a seemingly useful innovation, contextual factors may lead to non-adoption. This study elucidates that context, for one school district at least.

In closing, this quotation from Straub (2009) aptly summarizes the important message that, in order for the diffusion of technologies to be successfully achieved, an integrated effort is required:

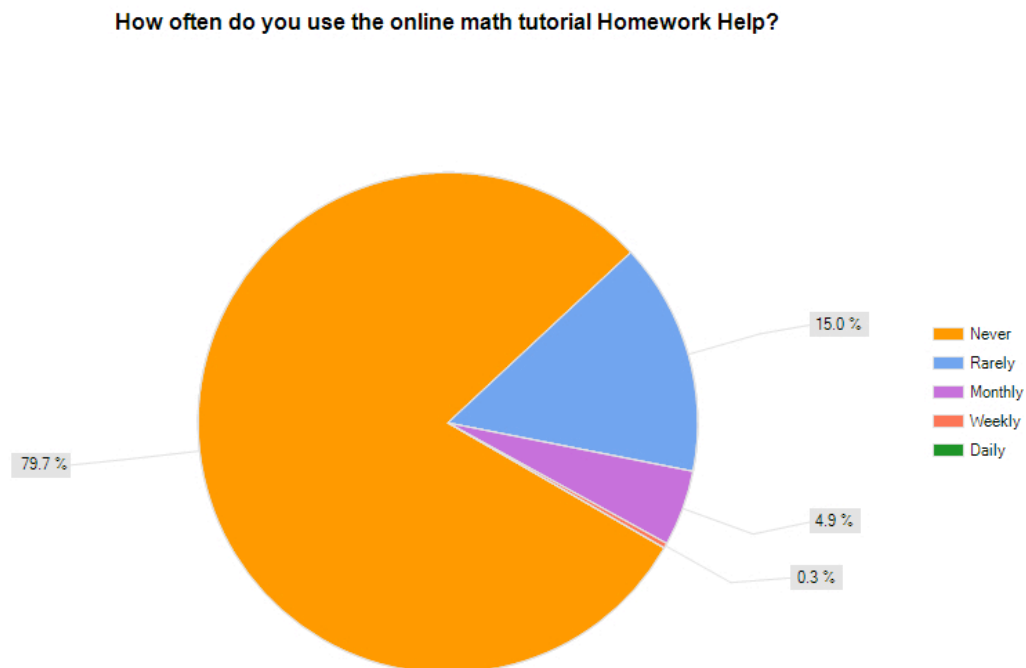
Evangelizing the benefits of a technology is only useful if the benefits are embraced by the environment. It is not only teachers' cognitive beliefs about perceived value but also the school and district's support that emerge as an important characteristic of adopting and maintaining innovation in schools (Barnes, 2005; Owston, 2007). Teachers need to believe not only that the innovation is important and useful but that the school district is flexible with the support of that change. (644-5)

CHAPTER 7

Conclusion

This study revealed some telling reasons why Homework Help has not been widely adopted by the general student population (see Figure 6), and in particular by certain subgroups such as rural and applied-stream students (see preceding articles). The themes that emerged during quantitative and qualitative data analyses logically fit the categories suggested by Rogers' (2003) perceived attributes of innovations, namely observability, relative advantage, compatibility, complexity, and trialability. Further, a regression analysis revealed that this overall model successfully predicts Homework Help adoption.

Figure 8. Pie Chart Demonstrating Percentage of Responses in the Dependent Variable, Adoption of Homework Help



While relative advantage has been shown to be the predominant factor in predicting the adoption of innovations in general (Rogers, 2003), this study revealed that observability played a larger role. As discussed in the articles, this may in large part be due to the fact that the study deals with an adolescent demographic still widely influenced by their parents. Some students who were interviewed suggested that they would be more likely to use Homework Help if their parents suggested it. Also, since parental involvement is shown to be a significant factor contributing to Homework Help's adoption, it is imperative that parents be made aware of this service; most of the students interviewed stated that their parents likely had never heard of Homework Help. At this time, marketing of the service is targeted primarily at the students themselves, though perhaps more of a priority should be placed on building awareness among parents.

After observability, relative advantage was the next most significant factor in predicting Homework Help's adoption. One of the barriers in this category included the inconvenience of the hours that the service is available. In this school district, the school day is finished at 2:30 p.m., yet Homework Help does not open until 5:30 p.m. Some students said this was unfortunate because they prefer to finish their homework as soon as they get home from school. Students were split over the online nature of the service; while some students avoided the service and sought instead face-to-face help, others appreciated the convenience of having a tutor's help from the comfort of their homes. During the focus groups I learned that, not surprisingly, students who use the Internet more regularly—namely students from the urban centres—are comfortable with online tutoring than those whose Internet use is limited.

Triability was another factor that predicted Homework Help's adoption. As alluded to in the first article, those who had dial-up versus high-speed Internet were discouraged, or even

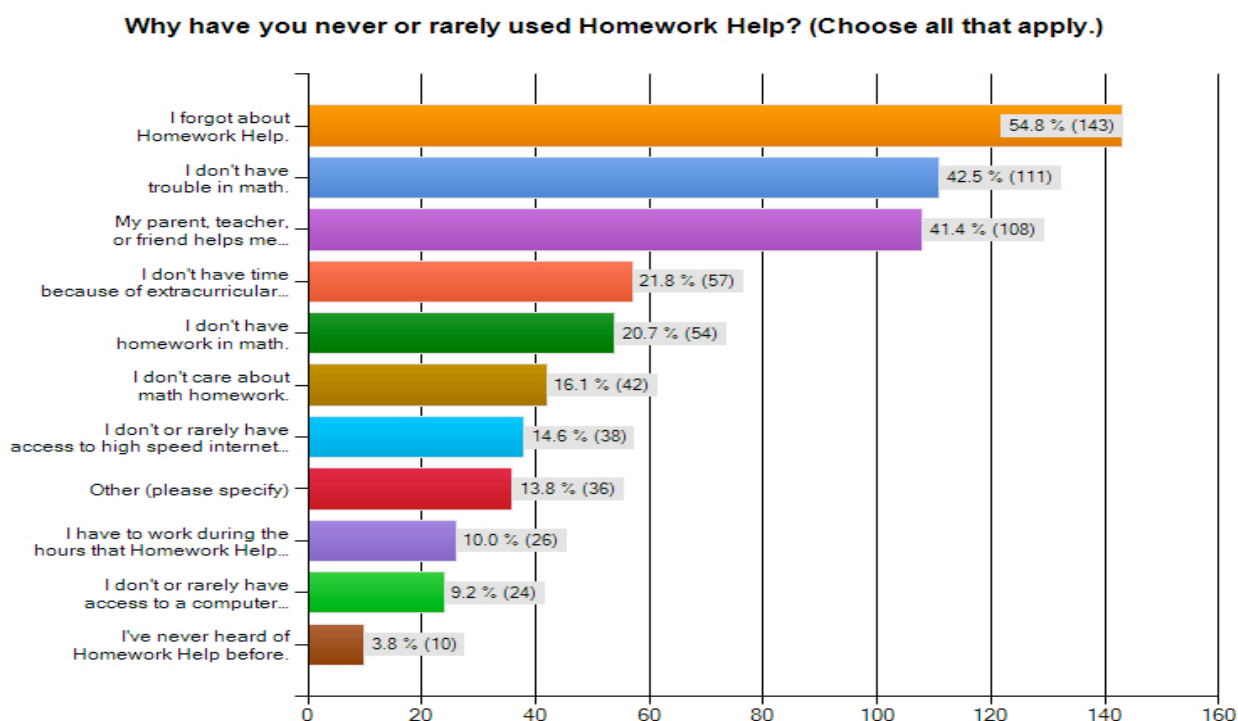
completely prevented from, trying Homework Help in the first place. Aside from that, many students who were able to try the service were discouraged from continuing to use it as the wait times were said to be too long. Clearly, the Ministry needs to frequently re-evaluate this issue and hire more tutors as the need arises.

The remaining factors discussed during the interviews and focus groups were complexity and compatibility. Most students whom I interviewed did not find Homework Help difficult to manoeuvre. However, one of the tutors interviewed, who also happens to teach at a rural school, mentioned that some of his students who do not have a computer at home still find basic online tasks challenging. Teachers in these rural and remote areas should take the time to familiarize their students with the World Wide Web so that the students become more comfortable using Homework Help and other online services and features. In terms of compatibility, both qualitative and quantitative results revealed that academic students were more likely to make use of the service than applied students. This suggests that the service is most compatible with students who place importance on their marks and take time outside of class to do their homework, while alternative academic interventions might be more appealing for applied students.

Finally, as discussed in the *Theoretical Framework* chapter, it is important to distinguish between the active and passive rejection of an innovation as the recourse for each of these outcomes would require different treatment. The most commonly cited reason for the passive rejection of Homework Help in both the surveys and during the focus groups was that the students had simply forgotten about it (see Figure 7). Second to that was that students simply did experience difficulty with their mathematics homework and thus had no need for the service. Many students in the focus groups said that, although they did not currently use Homework Help

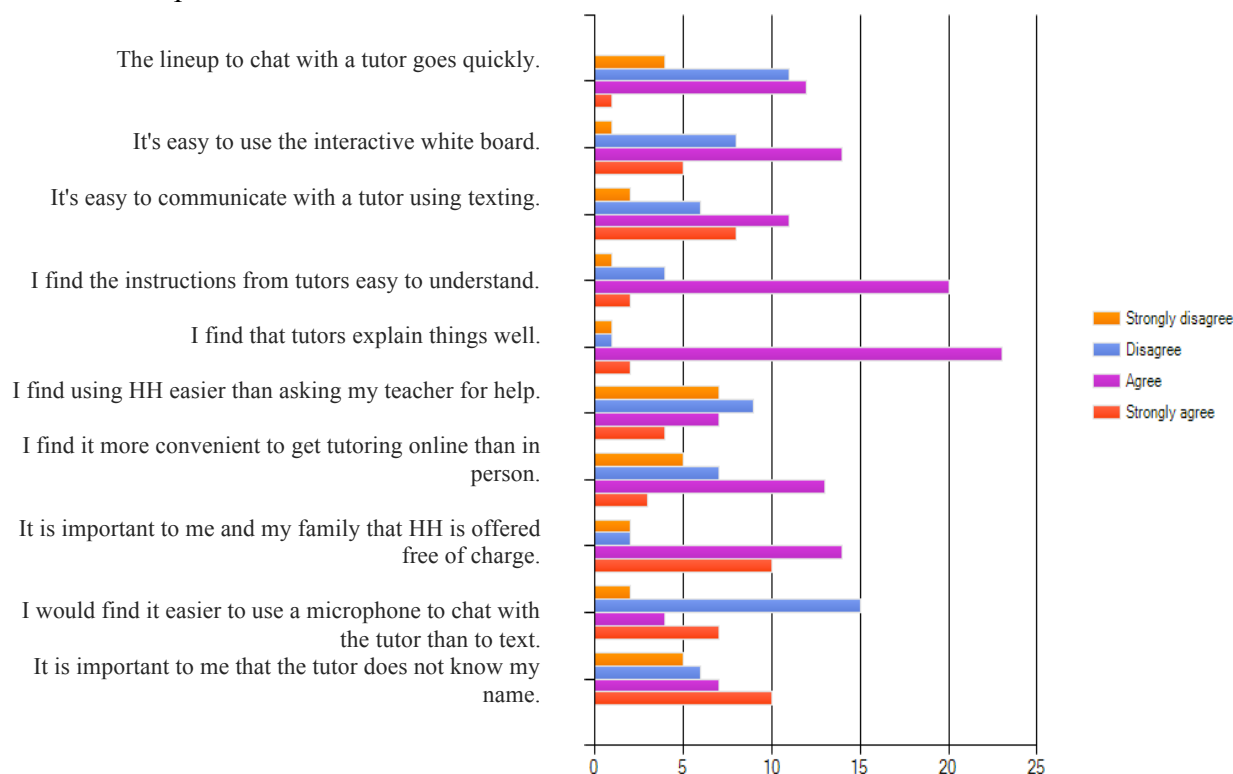
due to their lack of homework or the ease of their homework questions, they envisioned their needing a service like this in more senior grades where Homework Help is currently not available. Implications for these findings are discussed in the following section.

Figure 9. Survey responses concerning why students passively rejected Homework Help



In terms of students who actively rejected Homework Help—that is to say they tried it, but discontinued using it for a particular reason—many students cited the long line-ups they dealt with while waiting to chat with a tutor. As discussed in the second article, this was a popular theme of discussion during the focus groups, and the survey results seem to corroborate this finding (see Figure 8). Also, according to the survey and focus groups, opinions were divided about whether it was easier to get help from their teacher or go to Homework Help for assistance.

Figure 10. Survey Responses Concerning Students' Perceptions after Using Homework Help



Implications

The most successful innovations are those that are open to reconfiguration and repositioning. Like the QWERTY keyboard mentioned in the *Introduction*, Homework Help is an innovation that has been, as suggested by the focus group and interview data, well-conceived, though not well adopted for a variety of contextual reasons. Homework Help was first implemented in 2007, and the Ontario Ministry of Education has increased its usership simply by making it available to a greater number of school districts. However, if the school district examined in this study is any indication, the percentage of users per capita within each district may be quite small. According to Hillman (2011), the reconfiguration of such a technology is an ongoing, a-linear process influenced by a network of actors including the technology's

developers, its users, and even the technology itself. In order for an innovation like Homework Help to evolve and, concurrently, improve, this process should not be a one-way phenomenon but rather a series of complex, interconnected relationships amongst human and material actors (Hillman, 2011).

Since its inception, the Ministry has made minor adjustments to Homework Help, the result of feedback from its e-Learning Contacts (eLC). This resulted in hiring more tutors to reduce time in the cue, and also the provision of audio (as opposed to text) feedback by designated tutors. Aside from direct feedback from the eLCs, the Ministry has also received indirect feedback from the students, via the eLCs' efforts at surveying students. The problem with this approach, however, is that the eLCs received no formal training in survey design or in any type of program evaluation for that matter. Thus, the validity and reliability of the data obtained from the eLCs is questionable. The Ministry's approach to data collection and analysis was for each eLC to collect data as he or she saw fit. The eLCs are for the most part regular classroom teachers, not trained researchers. The eLC interviewed in this study, for example, periodically conducted polls using Survey Monkey, and also spoke to various stakeholders of the service. Though the results he obtained were of interest, they do not meet the rigorous standards of either quantitative or qualitative research methodologies. Prior to this study there had been no formal evaluation of the program, despite its having what must be a rather large price tag.⁹

It was the goal of this diffusion study to not only provide a framework to increase the rate of adoption and percentage of adopters, but also to identify populations not being served by the

⁹ Despite repeated attempts to discover the overall cost of Homework Help, I was unsuccessful. I asked the eLC whom I interviewed, and also sent e-mails to those at the Ministry who were responsible for implementing the program. Unfortunately, nobody knew the answer. What they could tell me is that the e-tutors get paid \$40/hour.

program. The rejection or non-adoption of Homework Help by these subgroups tells a more important story, in many ways, than its actual adoption. In the first article, I examined the non-adoption and rejection of the service by rural students, while in the second article I looked at what factors contribute to applied stream students' disinclination to using Homework Help.

The first article is foregrounded by literature in rural technology use. My study provides corroborating evidence that a digital divide does indeed exist for rural users of technology, in particular, the online tutoring service Homework Help. The study showed that there was a significant difference between the Homework Help adoption rates of rural and urban students. These findings are consistent with literature on the general use of digital technologies in rural areas: poverty rates are higher (Miller & Weber, 2003); computer ownership is lower (Foy, 2005; Looker & Thiessen, 2003); high speed Internet availability is lower (Noce & McKeown, 2007); and, as a result of the preceding factors, Internet use is lower (Noce & McKeown, 2007).

These findings do not, in my opinion, preclude rural students from using digital technologies, in particular e-tutoring, now or in the future. No: more accurately, the results suggest that Homework Help, in its current form, poses barriers to rural students who wish to use the service. To me, this presents two obvious solutions: either fix it or replace it. By fixing it, I mean offering various supports to rural students to remove barriers to accessibility. As stated in the first article, another school district in Ontario is providing a free lap top and Internet access to students entering high school who are from low-income families. Students whose families might struggle to afford a computer or pay for Internet access, whether rural or urban, could benefit from such a policy. However, this type of support is moot without high speed Internet. I speak from personal experience when I say how frustrating dial-up Internet can be. Without broadband access, those who wish Internet at a comparable speed are left with one option: satellite Internet.

As this costs upwards of \$70 a month, it is not even an option worth entertaining for most who live in rural areas.

Beyond the school district, government at all levels—alongside the private sector—needs to help finance and support broadband infrastructure investments in rural and remote areas. To do otherwise is myopic. Without these investments it is not only the students who will suffer—but the economy at large. Numerous studies cite the productivity gains, cost savings, and expanded consumer choice associated with the increase of broadband connectivity (e.g., Litan & Rivlin, 2001). What studies from the field of business suggest is that communities who make Internet connectivity a priority progress, while those who do not are left behind (Brookings Task Force, 2001).

These changes—financial support for laptops and Internet, as well as broadband infrastructure development—undoubtedly take time. In the meantime, it is incumbent upon the Ministry to provide academic support in an equitable manner to all of their students—rural and urban alike. This does not favour a cookie-cutter approach, but rather, targeted and informed support that meets the needs of all students in the province, not just those in cities. What might those alternatives to Homework Help look like? Likely, they will come in the form of tried and true methods that have been used for decades: traditional tutoring, as well as support from regular classroom teachers during or outside of classroom hours. Already schools in the United States offer students from low socio-economic backgrounds vouchers for free tutoring, a product of the No Child Left Behind Act (U.S. Dept. of Ed., 2002). In Ontario, why not give families who qualify vouchers for free traditional tutoring since the Ministry already provides free e-tutoring in the form of Homework Help?

As the second article illustrated, it is not only rural students who are disinclined to use e-tutoring services, but also applied stream students, and students in general. In the article I showed that there is a significant difference between the mean rates of Homework Help adoption between the academic and applied stream student subgroups. As revealed during the interviews and the previously cited EQAO data, applied students are less likely to be assigned homework than academic students, which likely explains the low uptake of Homework Help by applied students. Students whom I interviewed suggested that they would normally not seek out help during lunch hour, or before or after school, as this is generally the only time they might get to socialize with their friends (keep in mind that this is a rural school district, and many students live far apart from one another). Thus, for this subgroup of students, academic support would likely be most successful during class time. The study suggests that, for this subgroup at least, Homework is not the answer; the answer lies in a pedagogical shift within the classroom itself.

Limitations and Future Directions for Research

Following a meta-analysis of 75 studies in the field of DoI, Tornatzky and Klein (1982) advanced seven criteria that they posit would be found in an “ideal” diffusion study. For the purpose of discussing the limitations of my study, I will now contrast my study to their hypothetical optimal approach to diffusion research. I find this to be a productive metacognitive process, the findings of which will guide my future research in this area.

1. “The ideal study should be a predictive (not retrospective) study. Assessment of an innovation attribute should generally be obtained prior to, or concurrently with, a decision to adopt the innovation, and not after the fact. Perceptions of the attribute subsequent to the adoption/rejection decision may be affected by the perceiver's knowledge of that decision” (Tornatzky & Klein, 1982).

As my study occurred during the pilot phase of Homework Help's implementation, the study incorporated both predictive and postdictive elements. The survey was designed to specifically elicit responses both from students who had already used Homework Help, or who were considering its use. However, as discussed in the articles, the postdictive element of my survey was constrained by insufficient response numbers that negated any statistical analyses. Future studies could include a larger sample size so as to ensure sufficient postdictive responses.

2. "The ideal study should measure adoption *and* implementation as dependent variables.

This is necessary for the research to fully account for the adoption process, through utilization or routinization, not just the adoption decision" (Tornatzky & Klein, 1982).

My study went beyond adoption decision in that the survey question designed to elicit the dependent variable measured implementation rather than adoption. The question was worded as such: "How often do you use the online math tutorial Homework Help?" The students were asked to choose one of the following responses: Never, Rarely, Monthly, Weekly, or Daily. This is measure of the degree of the participant's actual implementation of the innovation, and, according to Tornatzky and Klein (1982) is more telling than a participant's hypothetical decision to adopt. Where my survey fell short is that I failed to ask participants whether or not their adoption decision included plans for delayed adoption, meaning that they intended to use the adoption in the future, but had not used it as of yet; this was, however, revealed during the focus groups. I would include adoption decision as a separate dependent variable in future surveys.

3. "The ideal study should utilize an appropriate research design, i.e., experimental, survey, or secondary data analysis (analysis of data collected by another person and/or for a

different purpose). Theoretical pieces and single site qualitative case studies cannot contribute significantly to the advancement of the empirical knowledge base at this time” (Tornatzky & Klein, 1982).

I disagree with Tornatzky and Klein on this point, and I think Rogers would too. In fact, Rogers argued for the perpetuation of qualitative diffusion studies, such as the aforementioned study by Wellin (1955) about water boiling in a Peruvian village. Traditional quantitative methods could not account for the lack of adoption of water-boiling practices; it was not until Wellin interviewed the villagers that he discovered the underlying reasons for the villagers’ rejection of the public health campaign. Despite my personal beliefs about Tornatzky and Klein’s inclusion of quantitative design as being a criterion for a diffusion study’s success, my study does surpass this standard as it used a mixed-method approach, as favoured by Rogers (2003).

4. “The ideal study should utilize replicable measures of innovation attributes, and data gathered from participants in the process. Simply inferring the level of certain innovation characteristics is not adequate” (Tornatzky & Klein, 1982).

As my survey directly elicited participants’ responses concerning their perceived attributes of Homework Help, and as my survey is replicable, I have met these criteria.

5. “The ideal study should study more than one innovation. Single innovation studies are not sufficiently robust to permit generalization to a population of innovations” (Tornatzky & Klein, 1982).

Due to the time constraints imposed by a master’s degree, I did not have time to investigate the adoption of other educational technologies, though this might be fodder for future studies.

6. “The ideal study must consider more than one innovation attribute so as to fully describe the innovation and also to allow for 'comparisons of the attributes’” (Tornatzky & Klein, 1982).

My study included the *five* perceived attributes of innovations—relative advantage, observability, compatibility, complexity, and trialability.

7. “The ideal study should focus on innovations in organizational (not individual) settings so that the studies will have implications for the organizational (and interorganizational) innovation process of most public policy concern” (Tornatzky & Klein, 1982).

My study was situated within the organizational structure of a school district, and thus the findings have far-reaching policy implications. A future study could compare the diffusion patterns of Homework Help among various school districts, seeking to identify the role of organizational factors such as opinion leadership and dyadic networks in diffusing innovations.

Concluding Remarks

This study suggests that a digital divide exists in relation to the adoption of online academic support services, a divide which is figures predominantly around geographical location and educational levels. The study has shown there to be significant statistical differences concerning the rates of Homework Help adoption between rural and urban, as well as applied and academic student subgroups. Further, this study suggests that diffusion research provides an effective model for predicting adoption. It is hoped that the results of this mixed methods study will clarify our understanding about rural and applied-stream students in regards to their perception and adoption of online academic support services. The study was a means to explore the limits and impacts of an academic service designed for an urban context but deployed throughout the province in urban and rural settings alike. Similarly, while the service was

implemented ostensibly to meet the needs of all students, the research suggests that it has done little to address the needs of applied-stream students. Only once the nuances of these subgroups are better understood can the potential of these students be truly mobilized in a world becoming increasingly flattened by the prospects of digital technologies.

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Appendices

Appendix A

Homework Help Survey

1. Demographic Information

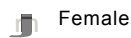
1. What is your name?

(Please note: you are only being asked your name for the purpose of collecting EQAO data. Complete confidentiality and anonymity is ensured.)

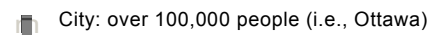
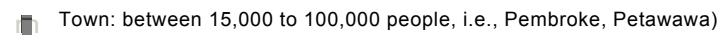
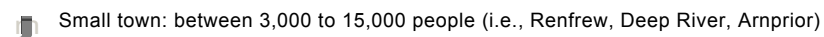
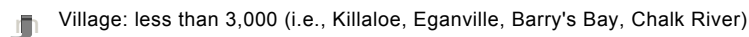
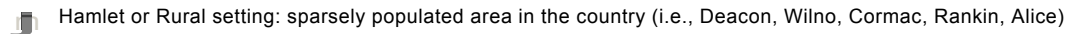
2. What grade are you currently in?



3. What is your gender?

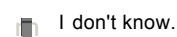
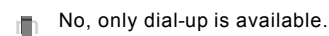
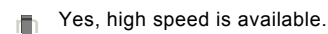


4. What type of area do you live in?



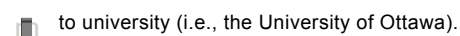
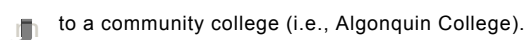
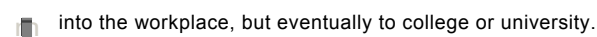
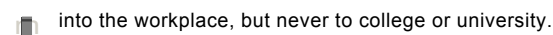
5. Is high speed internet available in the area where you live?

(Note: While dial-up internet ties up your phone line, high speed does not.)



6. What is your postal code (if known)?

7. After high school, I hope to go....



8. Which academic stream are you in for your math courses? (If you are in Grade 7 or 8, choose the stream you think you will take in high school.)

- ☐ Locally Developed (workplace)
- ☐ Applied (college)
- ☐ Academic (university)

9. My marks in math are generally...

- ☐ In need of improvement (Level 1 or less: 59% or less)
- ☐ Satisfactory (Level 2: 60-69%)
- ☐ Good (Level 3: 70-79%)
- ☐ Excellent (Level 4: 80-100%)

10. What is the highest level of education obtained by your mom/guardian #1?

- ☐ I don't know.
- ☐ None
- ☐ elementary school
- ☐ high school
- ☐ college
- ☐ university

11. What is the highest level of education obtained by your dad/guardian #2?

- ☐ I don't know.
- ☐ None
- ☐ elementary school
- ☐ high school
- ☐ college
- ☐ university

12. How many people share the computer you use to do homework?

- ☐ I don't have access to a computer.
- ☐ 4 or more people
- ☐ 3 people
- ☐ 2 people
- ☐ 1 (I have my own computer)

13. How many people share the internet connection you use to do homework?

-  I don't have internet at home.
-  4 or more people
-  3 people
-  2 people
-  1 (I have my own internet connection)

14. How frequently do you use the following technologies?

	Never	Rarely	Monthly	Weekly	Daily
Web sites					
Internet search engines (i.e., Google)					
cell phone					
social networks (i.e., Facebook, MySpace, Ning, etc.)					
e-mail (i.e., Hotmail, etc.)					
media production software (i.e., Photoshop, Garage Band, iMovie, etc.)					
blogs/wikis					
Downloading music/videos/pictures (i.e., YouTube, Flickr, etc.)					
Uploading music/videos/pictures					

2. Preferences

1. Opinions about school work

Choose the answer that most applies.

	strongly disagree	disagree	agree	strongly agree
I think doing homework is important.				
One or both of my parents think doing homework is important.				
One or both of my parents make sure I'm doing my homework.				
I think math is important.				
One or both of my parents think math is important.				

2. Opinions about computers

	Strongly disagree	Disagree	Agree	Strongly agree
Working with computers is important.				
Working with computers is fun.				
Working with computers is easy.				
One or both of my parents think computers are important.				

3. Opinions about using Homework Help

	Strongly disagree	Disagree	Agree	Strongly agree
Using Homework Help would improve my mark in mathematics.				
Using Homework Help would allow me to do my homework more easily.				
Using Homework Help would allow me to complete my homework faster.				
Using Homework Help would give me a better understanding of mathematics.				

4. Others' opinions about Homework Help

	Strongly disagree	Disagree	Agree	Strongly agree
My math teacher encourages me to use Homework Help.				
One or both of my parents encourage me to use Homework Help.				
My friends talk about the benefits of Homework Help.				

5. Opinions about the promotion of Homework Help

	Strongly disagree	Disagree	Agree	Strongly agree
Homework Help was well promoted at my school (posters, announcements, etc.)				
My math teacher often reminds me to use Homework Help.				
One or both of my parents remind me to use Homework Help.				
The lesson I received on using Homework Help was useful.				

*** 6. How often do you use the online math tutorial Homework Help?**

-  Never
-  Rarely
-  Monthly
-  Weekly
-  Daily

3. Questions for those who never or rarely use Homework Help

1. Why have you never or rarely used Homework Help? (Choose all that apply.)

- ☐ I've never heard of Homework Help before.
- ☐ I forgot about Homework Help.
- ☐ I don't care about math homework.
- ☐ I don't have homework in math.
- ☐ I don't have time because of extracurricular activities.
- ☐ I have to work during the hours that Homework Help is offered (5:30 - 9:30 p.m.)
- ☐ I don't have trouble in math.
- ☐ My parent, teacher, or friend helps me when I have trouble.
- ☐ I don't or rarely have access to a computer when I do homework.
- ☐ I don't or rarely have access to high speed internet when I do homework.
- ☐ Other (please specify)

2. What, if anything, could be done to make Homework Help more appealing to use?

3. Is there something other than Homework Help that would be useful in helping you with mathematics?

4. Opinions about the usability of Homework Help

1. Opinions about the usability of Homework Help
(ONLY THOSE WHO HAVE USED HOMEWORK HELP SHOULD DO THE FOLLOWING QUESTIONS)

	Strongly disagree	Disagree	Agree	Strongly agree
The lineup to chat with a tutor goes quickly.				
It's easy to use the interactive white board (where you can draw formulas, shapes, etc.).				
It's easy to communicate with a tutor using texting.				
I find the instructions from tutors easy to understand.				
I find that tutors explain things well.				
I find using Homework Help easier than asking my teacher for help.				
I find it more convenient to get tutoring online than in person.				
It is important to me and my family that Homework Help is offered free of charge.				
I would find it easier to use a microphone to chat with the tutor than to text.				
It is important to me that the tutor does not know my name.				

2. The best thing about Homework Help is...

3. If I could change something about Homework Help, it would be...

4. I think using Homework Help has helped improve my mark in math.

- Strongly disagree
- Disagree
- Agree
- Strongly agree

5. Improvement in mathematics mark

1. I think Homework Help has improved my mark in math by...

- ☐ a few percentage points
- ☐ about 5 percentage points
- ☐ 10 to 20 percentage points
- ☐ 20 percentage points or more

1. Do you have any further comments or suggestions about the online tutorial

Homework Help?

Appendix B:**Interview Protocol****Study:**

From Digital Divide to Digital Opportunity: The Adoption of e-Tutoring in a Rural School Board

Time of Interview:**Date:****Place:****Interviewer:****Interviewee:****Position of the Interviewee:**

Description of Project: This study seeks to understand the why students choose to use, or not to use, the online tutorial Homework Help. It also aims to compare how students in urban areas might use or perceive Homework Help differently than those in rural areas.

Questions:

1. What is your role in the implementation Homework Help?
2. Do you think this school board is a good candidate for the Homework Help pilot project? Why or why not?
3. What benefits can you see from the adoption of online tutorials such as Homework Help?
4. What barriers can you see in implementing Homework Help in this school board?
5. Do you think the rural nature of the school board will play a role in the tutorial's implementation?

Appendix C:
Focus Group Protocol

Study:

From Digital Divide to Digital Opportunity: The Adoption of e-Tutoring in a Rural School Board

Time of Interview:**Date:****Place:****Interviewer:****Participants and their Grade Levels:**

Description of Project: This study seeks to understand why students choose to use, or not to use, the online tutorial HH. It also aims to compare how students in urban areas might use or perceive HH differently than those in rural areas.

Questions:

1. Why did you decide to use/not to use HH?
2. What most influenced your decision to use/not to use HH?
3. What are the features of HH that you most like and/or dislike (if you had the opportunity to try it during the in-class presentation)?
4. What could be done to make HH better? Or, are there better alternatives to HH that could help students wanting help with homework?