Computers & Education 59 (2012) 925–936

Contents lists available at SciVerse ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

The implementation of e-tutoring in secondary schools: A diffusion study

Julie A. Corrigan*

Faculty of Education, University of Ottawa, Lamoureux Hall (LMX), 145 Jean-Jacques-Lussier Private, Ottawa, Ontario, K1N 6N5 Canada

ARTICLE INFO

Article history:
Received 10 December 2011
Received in revised form
8 March 2012
Accepted 14 March 2012

Keywords:
e-tutoring
Diffusion research
Mixed methods
e-learning
Secondary schools

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; results indicate that this model is significantly correlated with the adoption of e-tutoring. Implications for the integration of educational technologies in secondary education, especially in relation to e-tutoring, are discussed.

1. Introduction

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. 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). 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-tutorials[1] in library settings, fewer than 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, Fuchs et al., 2008; Fuchs, Seethaler et al., 2008; Means, Toyama, Murphy, Bakia, & Jones, 2009; Merriman & Codding, 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 new phenomenon that exploded onto the scene with improvements in network bandwidth and the advent of Web 2.0 technologies. 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).

* Tel.: +1 613 294 9529; fax: +1 613 562 5963.
E-mail addresses: Julie.Corrigan@uOttawa.ca, julieanncorrigan@gmail.com.

[1] 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 chat rooms, usually using a Learning Management System platform.

0360-1315/$ – see front matter
doi:10.1016/j.compedu.2012.03.013

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 out-performed 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 (Ontario Ministry of Education, 2011). It works by providing free, synchronous e-tutoring by Ontario certified mathematics teachers to students in Grades 7–10. 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 in general, and particularly by rural students (Corrigan, 2011) and applied stream (vocational) 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-risk[2] than academic students (Ferguson, Tilleczek, 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.

2. 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 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

[2] 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).

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.

2.1. *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 Fig. 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.

2.2. *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

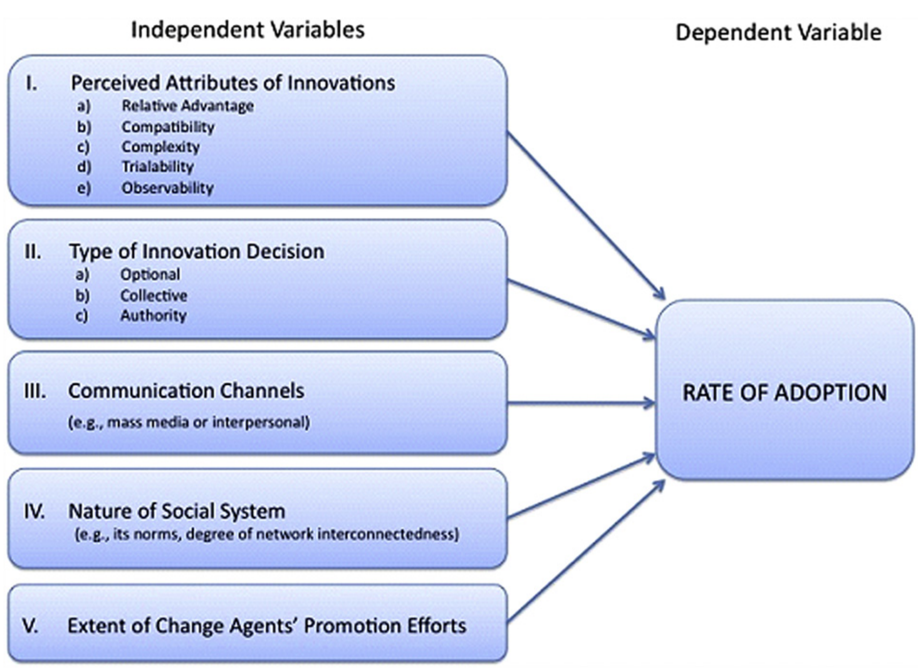

Fig. 1. Rogers' (2003) diffusion of innovations model.

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.

2.3. 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 (Rafaeli, 1986), information gathering (Maddox, 1998), Web surveillance and voter guidance (Johnson & Kaye, 1998), and social activism (Pavlik & Everette, 1996). While many diffusion theories perceive the adopter as passive (i.e., the hypodermic needle model, of late[3]), 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 et al. (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.

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.

3. 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.

4. Method

4.1. 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

[3] 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.

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 1.

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, 2011; for further discussion on rural versus urban adoption of e-tutoring).

4.2. 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. In total, 14 people were interviewed, which is considered an appropriate sample size for qualitative research in general, and case studies specifically (Creswell, 2007; Guest, Bunce, & Johnson, 2006; Williams, 2000). The adult interview participants included the following: the eLC (e-Learning Contact), 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 an elementary school in the district. Purposive sampling was used to select the adult participants using the criteria of expert knowledge of, and significant involvement with, Homework Help. For the student sample, all students in Grades 7 to 10 in the school district received a recruitment letter, which resulted in a total of 11 students volunteering to participate. As a result, there were two student 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.

4.3. Procedure

The quantitative phase of the study involved designing a survey modelled after those used in dozens of similar DoI studies (e.g., Dwivedi, Choudrie, & Brinkman, 2006; Oh, Ahn, & Kim, 2003; Rogers, 2003; Sonnenwald, Maglaughlin, & Whitton, 2001). Since there was no pre-existing instrument specific to e-tutoring, previous DoI surveys were modified. The development and validation of the instrument involved conducting a literature review to identify appropriate survey items, both content and construct validity, and a pilot test. During the pilot test, colleagues reviewed the survey for clarity and content validity. Revisions were made to the wording of some questions to ensure greater clarity. Construct validity was established via factor analysis. Finally, to ensure reliability, Cronbach's values were estimated. See the Results section for these analyses.

Within the DoI model, Rogers (2003) 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 percent 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,

Table 1
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

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 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 min. 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.

5. 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.

5.1. 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.

5.1.1. 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 transformation, skewness was reduced from 2.197 to -1.595 and kurtosis from 4.291 to .738.

5.1.2. Independent-groups t test

An independent-groups t test 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 (1988) guidelines, $d = .49$ represents a medium effect size.

5.1.3. Cronbach's consistency of measure

Table 2 illustrates the internal consistency of the five constructs. Coefficient alpha for relative advantage was .92, indicating a high degree of internal consistency among items. The coefficient alphas for the remaining innovation attributes were as follows: observability .83 (good),

Table 2
Summary of statistics obtained from reliability testing ($N = 303$).

Construct	Number of items	Cronbach's α
Relative advantage	4	.92
Observability	7	.83
Complexity	5	.77
Compatibility	7	.67
Trialability	2	.79

trialability .79 (fair), complexity .77 (fair), and compatibility .67 (marginal). The relatively high Cronbach's values for all constructs (except compatibility) imply that they are internally consistent, and thus the survey instrument can be said to be reliable. These results are consistent with those of the Principal Components Analysis.

5.1.4. Factor analyses

Three principal factors extractions with Varimax rotation were conducted on 1) data from the overall sample, as well as 2) data from the academic and 3) 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 2 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. Factor analysis was also was used to verify the construct validity (convergent and discriminant validity). 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.

5.1.5. 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 3, 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 β regression coefficients: relative advantage ($\beta = -.26$, $t(178)$, $p < .05$), observability ($\beta = -.28$, $t(178)$, $p < .05$), and trialability ($\beta = -.16$, $t(178)$, $p < .05$). 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 4 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 β coefficients: relative advantage ($\beta = -.21$, $t(113)$, $p < .05$) and observability ($\beta = -.19$, $t(113)$, $p < .05$).

Table 3
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

The bold values indicates the highest factor loadings.

Table 4
Standard multiple regression of factor scores on HH rate of adoption within the academic subgroup.

Variables	Pearson r HH rate of adoption	B	β
1. Relative advantage	−.26	−.06	−.261[a]
1. Observability	−.28	−.07	−.283[a]
3. Complexity	.01	.00	.01
4. Compatibility	.00	9.854-ES	.00
5. Trialability	−.16	−.040	−.16[a]
R			.42
R^2			.18[a]
Adjusted R^2			.15
Std. error of the estimate			.23

[a] Indicates significance at $p < .05$.

5.2. 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). Tables 5and 6 summarizes the themes and sub-themes that emerged from this process, as well as literature that supports these themes, where applicable.

5.2.1. 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 queue 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 min 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).

Table 5
Standard multiple regression of factor scores on HH rate of adoption within the applied subgroup.

Variables	Pearson r HH rate of adoption	B	β
1. Relative advantage	−.22	−.04	−.21[a]
1. Observability	−.20	−.03	−.19[a]
3. Complexity	−.10	−.01	−.09
4. Compatibility	−.13	−.02	−.11
5. Trialability	.02	.00	.02
R			.33
R^2			.11[a]
Adjusted R^2			.07
Std. error of the estimate			.16

[a] Indicates significance at $p < .05$.

Table 6
Themes and sub-themes from qualitative analysis.

Theme	Sub-theme	Support in literature
Relative advantage	Academic instruction	Biesinger and Crippen (2008); Fuchs, Fuchs, et al. (2008); Merriman and Codding (2008)
	Immediacy of tuition	Prensky (2003)
	Anonymity	Myers, Bishop, Rajaman, and Kelly (2004); Rabinovich (2009); Song (2005)
	Convenience	Johnson et al. (2010)
Observability	Promotion efforts	Rogers (2003)
	Parental supervision	
Complexity	Ease of use	Davis (1989); Rogers (2003)
Compatibility	Motivation	Fredericks and Eccles (2002); Gottfried, Fleming, and Gottfried (2001); Gottfried, Marcoulides, Gottfried, Oliver, & Guerin (2007)
	Academic stream	N/A
	Learning style	N/A
	Hours of availability	N/A
Trialability	Internet accessibility	OECD (2001); Looker and Thiessen (2003)
	Internet/computer affordability	Foy (2005); Looker and Thiessen (2003)
Suggestions for improving homework help	Range of subjects	N/A
	Range of grades	Middleton and Spanias (1999)
	Appeal	N/A
	Mobile application	N/A
	Artificial intelligence	N/A

5.2.2. 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.

5.2.3. 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."

5.2.4. 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).

5.2.5. 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.

5.2.6. 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 queue, 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.

6. 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? Regression 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 and teacher involvement may play a dominant role thus making the effect of observation higher than in the general population. Thus, the important role of parental and teacher influence in Homework Help's adoption cannot be understated. While certain efforts have been made to promote Homework Help via parents (articles in the local newspaper, demonstrations at School Council meetings, etc.), more emphasis needs to be focussed on the role of adult stakeholders in diffusing Homework Help. Possible ideas include refrigerator magnets listing the Homework Help web site (as were used in some French school districts) and e-mails sent directly to parents (as paper newsletters may, inadvertently, end up at the bottom of students' lockers and never reach their target audience). Additionally, the teachers need to play a more active role in promoting Homework Help. Data from the interviews show that some students—the ones whose teachers neglected to promote Homework Help—had completely forgotten about the service. Teachers should consistently remind students of the service, especially before tests or after a difficult lesson. Mathematics teachers should continue to distribute bookmarks listing with the Homework Help web site, as some are already doing. During the focus group, one student (S9) noted that she did not think that she would need the service, but then was happy to discover the bookmark in her mathematics textbook before a difficult test. Further, during communication with parents (i.e., phone calls home, during parent-teacher interviews, etc.), teachers should take the opportunity to remind parents of the value of the service.

Other than observability, relative advantage was significant in its own right. 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 queue. 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, 2008), 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. Policy interventions from all levels of government, and from the private sector, can do much to mitigate these barriers.

While students in general are disinclined to use e-tutoring services in this school district, vocational students are of special concern. This study shows that there is a significant difference between the mean rates of Homework Help adoption between the academic and applied stream student subgroups. Data gathered by the Education Quality and Accountability Office (EQAO, 2010) suggest two reasons for this: applied students have less access to a home computer than their academic counterparts, and they are typically assigned less homework. 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 schoolwork. Further, 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. These data were corroborated by the interviews with students. Further, students 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, academic support would likely be most successful during class time. The study suggests that, for this sub-group at least, Homework is not the answer; the answer lies in a pedagogical shift within the classroom itself.

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 any time soon.

6.1. 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.

6.2. 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)

Acknowledgements

Special thanks to the study participants and to the reviewers who helped improve this article. Also, I am indebted to Drs David Trumpower, Chris Suurtamm, and Christian Blanchettefor their tremendous patience and unending support.

This research was supported by the Social Sciences and Humanities Research Council, award no. 767-2011-1226.

Appendix. Supplementary material

Supplementary material associated with this article can be found in the online version, at doi:10.1016/j.compedu.2012.03.013.

References

Agarwal, R., Sambamurthy, V., & Stair, R. (2000). Research report: the evolving relationship between general and specific computer self-efficacy—an empirical assessment. *Information Systems Research, 11*, 418–430.

Barnes, R. (2005). Moving towards technology education: factors that facilitated teachers' implementation of a technology curriculum. *Journal of Technology Education, 17*, 6–18.

Biesinger, K., & Crippen, K. (2008). The impact of an online remediation site on performance related to high school mathematics proficiency. Retrieved from Wilson Web. *Journal of Computers in Mathematics and Science Teaching, 27*(1), 5–17.

Cavanaugh, C., Gillan, K. J., Kromrey, J., Hess, M., & Blomeyer, R. (2004). *The effects of distance education on K–12 student outcomes: A meta-analysis*. Naperville, Ill.: Learning Point Associates. http://www.ncrel.org/tech/distance/index.html.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Corrigan, J. A. (2011). The e-tutoring e-divide: facilitating online academic support services in rural school districts. In C. Prachalias (Ed.), *Proceedings of the 7th international conference on education, Vol. 1* (pp. 506–512). Samos, Greece: Research and Training Institute of East Aegean, ISBN 978-960-466-079-7.

Creswell, J. W. (2007). *Qualitative inquiry & research design*. Thousand Oaks, CA: Sage.

Creswell, J. W. (2009). *Research design: qualitative, quantitative, and mixed method approaches*. Los Angeles: Sage.

Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. September. *MIS Quarterly*, 319–340.

Dwivedi, Y. K., Choudrie, J., & Brinkman, W. P. (2006). Development of a survey instrument to examine consumer adoption of broadband. *Industrial Management & Data Systems, 106*(5), 700–718. doi:10.1108/02635570610666458.

Education Quality and Accountability Office. (2010). *School board report. Grade 9 assessment of mathematics*. Renfrew County Catholic DSB (67199). Report retrieved from. https://eqaoweb.eqao.com/pbs/Listing.aspx.

Ferguson, B., Tilleczek, K., Boydell, K., & Rummens, J. A. (2005). *Early school leavers: understanding the lived reality of student disengagement from secondary school, final report*. Report prepared by Community Health Systems Resource group of the Hospital for Sick children for the Ontario Ministry of Education and Training, Special Education Branch. Retrieved from. http://www.edu.gov.on.ca/eng/parents/schoolleavers.pdf.

Flowers, A. T. (2007). NCLB spurs growth in online tutoring options. January 1 *School reform news*. Chicago, IL: The Heartland Institute, Retrieved July 3, 2007, from. http://www.heartland.org/Article.cfm?artId=20426.

Foy, V. J. (2005). *A study of computer ownership and school and home use of computer technology of the students of alliance high school* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses Database. (UMI No. 3180800).

Fredericks, J. A., & Eccles, J. S. (2002). Children's competence and value beliefs from childhood through adolescence: growth trajectories in two male-sex typed domains. *Developmental Psychology, 38*, 519–533.

Fuchs, L. S., Fuchs, D., Craddock, C., Hollenbeck, K. N., Hamlett, C. L., & Schatschneider, C. (2008). Effects of small-group tutoring with and without validated classroom instruction on at-risk students' math problem solving: are two tiers of prevention better than one? *Journal of Educational Psychology, 100*(3), 491–509. doi:10.1037/0022-0663.100.3.491.

Fuchs, L. S., Seethaler, P. M., Powell, S. R., Fuchs, D., Hamlett, C. L., & Fletcher, J. M. (2008). Effects of preventative tutoring on the mathematical problem solving of third-grade students with math and reading difficulties. *Council for Exceptional Children, 74*(2), 155–175.

George, B., & Dykman, C. (2009). Virtual tutoring: the case of TutorVista. *Journal of Cases in Information, 3*(3), 45–61, Retrieved from. http: //www.igi-globaLcom.

Gewektz, C. (2005). Tutoring efforts move forward down under. *Education Week, 24*(41), 14.

Gottfried, A. E., Fleming, J. S., & Gottfried, A. W. (2001). Continuity of academic intrinsic motivation from childhood through late adolescence: a longitudinal study. *Journal of Educational Psychology, 93*, 3–13.

Gottfried, A. E., Marcoulides, G. A., Gottfried, A. W., Oliver, P. H., & Guerin, D. W. (2007). Multivariate latent change modeling of developmental decline in academic intrinsic math motivation and achievement: childhood through adolescence. *International Journal of Behavioral Development, 31*, 317–327. doi:10.1177/0165025407077752, Retrieved from. http://jbd.sagepub.com/cgi/content/abstract/31/4/317.

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough?: an experiment with data saturation and variability. *Field Methods, 18*(1), 59–82. doi:10.1177/1525822X05279903.

Johnson, G. M., & Bratt, S. E. (2009). Technology education students: e-tutors for school children. *British Journal of Educational Technology, 40*(1), 32–41. doi:10.1111/j.1467-8535.2007.00805.x.

Johnson, T. J., & Kaye, B. K. (1998). The Internet: vehicle for engagement or a haven for the disaffected? In T. J. Johnson, C. E. Hays, & S. P. Hays (Eds.), *Engaging the public: How government and the media can reinvigorate American democracy* Lanham, MD: Rowman & Littlefield.

Johnson, L., Levine, A., Smith, R., & Stone, S. (2010). *The 2010 horizon report*. Austin, Texas: The New Media Consortium.

Katz, E., Blumler, J. G., & Gurevitch, M. (1974). *The uses of mass communication*. Beverly Hills, CA: Sage.

Lissaman, R., De Pomerai, S., & Tripconey, S. (2009). Using live, online tutoring to inspire post 16 students to engage with higher level mathematics. *Teaching Mathematics and Its Applications, 28*, 216–221. doi:10.1093/teamat/hrp028.

Looker, D., & Thiessen, V. (2003). *The digital divide in Canadian schools: Factors affecting student access to and use of information technology* (Catalogue No. 81-597-XIE). Ottawa: Statistics Canada.

Mackey, T. P., & Ho, J. (2008). Exploring the relationships between web usability and students' perceived learning in web-based multimedia (WBMM) tutorials. *Computers & Education, 50*(1), 386–420.

Maddox, K. (1998, October 26). E-commerce becomes reality. *Advertising Age, pS1*(1).

McQuail, D. (1994). *Mass communication: An introduction* (3rd ed.). London, Thousand Oaks, New Delhi: Sage Publications.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. Washington, D.C.: U.S. Department of Education, Office of Planning, Evaluation, and Policy Development. Retrieved form. www.ed.gov/about/offices/list/opepd/ppss/reports.html.

Merriman, D. E., & Codding, R. S. (2008). The effects of coaching on mathematics homework completion and accuracy of high school students with attention-deficit/hyperactivity disorder. *Journal of Behavioural Education, 17*, 339–355. doi:10.1007/s10864-008-9072-3.

Middleton, J. A., & Spanias, P. A. (1999). Motivation for achievement in mathematics: findings, generalizations, and criticisms of the research. *Journal for Research in Mathematics Education, 30*, 65–88.

Myers, S. C., Bishop, D., Rajaman, S. S., & Kelly, J. (2004, March). Virtual office hours: tutoring distance students in statistics and economics. In: *Paper presented at the Ohio commons for digital education*, Columbus, OH.

O'Connor, B. C. (2003). *A successful pathway for all students: Final report of the at-risk working group*. Retrieved from. http://www.edu.gov.on.ca/eng/document/reports/atrisk/preface.

OECD. (2001). *Understanding the digital divide*. Paris: OECD. Retrieved from. http://www.oecd.org.

Oh, S., Ahn, J., & Kim, B. (2003). Adoption of broadband Internet in Korea: the role of experience in building attitude. *Journal of Information Technology, 18*, 267–280.

Ontario Ministry of Education. (2011). *Homework help* (website). Retrieved from. http://www.edu.gov.on.ca/elearning/homework.html.

Owston, R. (2007). Contextual factors that sustain innovative pedagogical practice using technology: an international study. *Journal of Educational Change, 8*(1), 61–77.

Pavlik, J. V., & Everette, E. D. (1996). *New media technology and the information superhighway*. Boston: Allyn & Bacon.

Prensky, M. (2003). e-Nough! *On The Horizon, 11*(1), 1–14, MCB University Press. Retrieved from. www.marcprensky.com/writing/default.asp.

Rabinovich, M. (2009). iPASS project: an online tutoring system. *Innovate, 5*(4), 1–6, Retrieved from. http://www.innovateonline.info/index.php?view=article&id=639.

Rafaeli, S. (1986). The electronic bulletin board: a computer-driven mass medium. *Computers and the Social Sciences, 2*(3), 123–136.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Rogers, E. M., Dearing, J. W., Rao, N., Campo, M. L., Meyer, G., Betts, G. J., et al. (1995). Communication and community in a city under siege: the AIDS epidemic in San Francisco. *Communication Research, 22*(6), 664–678.

Ruggiero, T. (2000). Uses and gratifications theory in the 21st century. *Mass Communication & Society, 3*(1), 3–37.

Song, W. (2005). *A study of student use of an online message board in an introductory physics class* (Master's thesis). Available from ProQuest Dissertations and Theses Database. (UMI No. 1459475).

Sonnenwald, D. H., Maglaughlin, K. L., & Whitton, M. C. (2001). Using innovation diffusion theory to guide collaboration technology evaluation: work in progress. In: *Proceedings of the tenth IEEE international workshops on enabling technologies: Infrastructure for collaborative enterprises* (pp. 114–119). Cambridge, MA, USA: IEEE. doi:10.1109/ENABL.2001.953399.

Straub, E. T. (2009). Understanding technology adoption: theory and future directions for informal learning. *Review of Educational Research, 79*(2), 625–649. doi:10.3102/0034654308325896.

Sulcic, V., & Sulcic, A. (2007). Can online tutors improve the quality of e-learning? *Issues in Informing Science and Information Technology, 4*, Retrieved from. http://proceedings.informingscience.org/InSITE2007/IISITv4p201-210Sulc388.pdf.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston: Pearson/Allyn and Bacon.

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption implementation: a meta-analysis of findings. *IEE Transactions on Engineering Management, 29*(1), 28–43.

Wikibooks. (2011). *Communication theory/uses and gratifications*. Retrieved from. http://en.wikibooks.org/wiki/Communication_Theory/Uses_and_Gratifications.

Wildemuth, B. M. (1992). An empirically grounded model of the adoption of intellectual technologies. *Journal of the American Society for Information Science, 43*(3), 210–224.

Williams, M. (2000). Interpretivism and generalisation. *Sociology, 34*(2), 209–224.

Wolcott, H. T. (1994). *Transforming qualitative data: Description, analysis, and interpretation*. Thousand Oaks, CA: Sage.

Wollons, R. (Ed.), (2000). *Kindergartens and cultures: The global diffusion of an idea*. New Haven, Conn.: Yale University Press.