DOES THE USE OF TECHNOLOGY IN THE CLASSROOM INCREASE STUDENTS’ OVERALL ACADEMIC PERFORMANCE?

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Abstract

Technological advances and a decrease in the cost of technology have resulted in nearly 93 percent of public schools classrooms in the United States having access to the Internet, and a considerable increase in educational programs that incorporate technology into the curriculum (North Central Regional Educational Laboratory, 2005). Due to the prevalence of technology in the classroom, the effectiveness of such programs has become a prevailing research topic amongst social scientists. This thesis reviews past research and provides an analysis of relevant studies conducted within the last ten years. Using Daft and Lengel’s media richness theory as a basis, this meta-analysis provides a comprehensive overview of the effect of technology enhanced learning (TEL) programs on K-12 students’ overall academic performance and factors that can increase the effectiveness of such programs.
We the undersigned, certify that we read this thesis and approve it as adequate in scope and quality for the degree Master of Arts.

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CHAPTER I: INTRODUCTION

The Problem

Technology has increasingly become an integrated part of our lives—so much so that it seems preposterous to even think of doing the most simple, routine tasks without the use of a cellular phone, laptop computer, or personal global positioning system, more commonly known as GPS. While people of all ages increasingly use technology for routine tasks, children are among the most frequent users of technology (Kaiser Family Foundation, 2010). Just as technology has changed aspects of our daily lives, it is undoubtedly changing education.

Technological advances provide easier facilitation of and access to information, but technology does not change the message received by students, or the students’ ability to grasp and retain information (Thurlow, Lengel, & Tomic, 2004, p. 42).

Technology that is incorporated into the classroom for the purpose of enhancing the learning process is referred to as technology enhanced learning (TEL) (Dror, 2008). Despite high expectations of the ability of school administrators and teachers to enhance student learning through the incorporation of technology in the classroom, TEL programs have produced lackluster results (Sinclair, 2009, p. 46). “The history of technology in the classroom is one of cycles of exaggerated promises, highly publicized installations with committed teachers, and masterful and inventive excuses for why the promises went unfulfilled” (Venezky, 2004, p. 3). Problems implementing TEL programs have risen due to lack of understanding of the most effective approaches of selecting which technologies to use, the most effective ways to integrate technology, and a lack of understanding of what factors may impact the effectiveness of TEL programs (Bordbar, 2010; Communication Without Barriers, 2007; Sinclair, 2009; Venezky, 2004). Additionally, during the technology integration process, a common problem is that
teachers often rely on the technology to teach students, rather than using the technology as an educational tool, or the technology is used in situations that do not warrant its use (Dror, 2008; Honan, 2010). When implementing technology into curriculum, it is critical to assess what tasks can be completed without the use of various technologies, and to “remind ourselves of what may be lost when we do use them” (Beniger, 1989, p. 120).

*Importance of the Study*

As technology is increasingly incorporated into curriculum in K-12 classrooms around the globe, understanding the implications of using TEL to achieve educational objectives becomes increasingly important.

The last two decades have witnessed a worldwide proliferation of information and communication technologies (ICT) into the field of education. The global adoption of ICT into education has often been premised on the potential of the new technological tools to revolutionize an outmoded educational system, better prepare students for the information saga, and accelerate national development efforts. (Bordar, 2010, pp. 179-180)

The cost of technology and educational platforms has also become increasingly inexpensive, which has made technology more universally accessible (Klein, 2010). The increased accessibility of technology means that schools around the world, with students from various socio-economic backgrounds, are increasingly exposed to TEL. Therefore, understanding the impact of TEL programs, and the best ways to integrate technology into the classroom, is critical. Previous research indicates that when used properly, technology can enhance the learning experience and increase academic performance. Whether technology in the classroom is beneficial is dependent upon the way in which the technology is used by teachers implementing
the technology, teacher competency levels with the given technology, the degree to which the technology is utilized in the classroom, and the type of technology used (Sinclair, 2009). A meta-analysis of more research on the topic can provide insight into the integration of TEL to ensure that learning is enhanced, and external factors that could impact TEL programs.

**Definition of Terms**

**Academic performance**: communication and collaboration skills, student motivation, and independent learning.

**Contingency theory**: Suggests that no particular way to make decisions for, or organize an organization, is best for all because every organization is unique (Daft & Lengel, 1986).

**Information and communication technology (ICT)**: Technology used as a tool to enhance learning (Bordbar, 2010).

**Information processing theory**: A cognitive development theory that humans process, rather than simply respond to stimuli, which effects memory and application of information (Fischer, 2010).

**K-12**: Students enrolled in school in Kindergarten through twelfth grades.

**Media multitasking**: Using more than one medium at once (Kaiser Family Foundation, 2010).

**Media richness theory (MRT)**: A theory that suggests certain technologies may be more desirable when they feature characteristics that aid in the usability of the technology and dissemination of information (Daft & Lengel, 1986).

**Meta-Analysis**: A research method that draws conclusions about the strength or consistency of communication effects across studies (Rubin, Rubin, Haridakis, & Piele, 2010).

**Multi-user virtual environment (MUVE) games**: Gaming systems that enable multiple users to simultaneously participate in shared virtual environments (Mallan, Foth, Greenaway, & Young, 2010).

**Technology enhanced learning (TEL)**: Educational programs that incorporate various technologies with an objective of increasing learning (Dror, 2008).

**Organization of Remaining Chapters**

In order to provide a comprehensive view of the effects of technology in the classroom, past research and present analysis was organized into the four remaining chapters: 2) review of
previous literature; 3) research scope and methodology; 4) the study; and 5) summaries and conclusions.

The first chapter of this study summarizes the importance of the research on TEL programs. Previous research on the effectiveness of TEL programs, philosophical assumptions, and theoretical framework on which the study is based are reviewed in the second chapter. Chapter three discusses the scope of the study and the methodology used. Analysis, including review of research trends and discussion of research findings, is provided in chapter four. Chapter five includes limitations of the study, recommendations for further research, and final conclusions and thoughts.
CHAPTER II: REVIEW OF LITERATURE

Introduction

The fact that there has been a surge in the presence of technology in classrooms throughout the United States and the world is common knowledge. However, the effectiveness of TEL programs has become a subject of debate. The level of effectiveness of TEL programs largely depends on the way in which the technology is integrated into the curriculum and how it is viewed by students, teachers, and school administrators.

... technology is only a tool; it allows us to develop dialogue and interaction, but is a means, not an end in and of itself. Tech-based global education has the capacity to improve critical thinking and cultural pluralism but requires far more than just fancy technology; it requires careful, thoughtful curriculum development, and the support of organizations whose goal is to build authentic global communities online. (Klein, 2010, p. 86)

While the majority of researchers agree that TEL programs can successfully increase students’ overall academic performance, findings concerning the most efficient way to incorporate the technology, reasons why the technology should be integrated into existing curriculum, and factors that may help or hinder the integration of TEL programs vary.

Philosophical Assumptions and Theoretical Framework

Although the way in which information is distributed does not necessarily change the message (Thurlow, Lengel, & Tomic, 2004, p. 42), the method of delivery and incorporation of technology can change the way the information is absorbed and how much of the information is retained (Gitlin, 2002, p. 31). The combination of technological tools, progressive pedagogy and
creativity allows teachers to humanize the world and its inhabitants for students (Klein, 2010, p. 86). However, too much emphasis on the technology, rather than on the actual information, can be detrimental to a child’s development.

The schools teach their children to operate computerized systems instead of teaching things that are more valuable to children. In a word, almost nothing that they need happens to the losers. Which is why they are losers… Eventually, the losers succumb, in part because they believe, as Thamus prophesied, that the specialized knowledge of the masters of a new technology is a form of wisdom… The result is that certain questions do not arise. For example, to whom will the technology give greater power and freedom? And whose power and freedom will be reduced by it? (Postman, 1992, pp. 10-11)

The incorporation of technology in the classroom can be quite useful, as “the use of virtual environments for collaboration and learning can result in unprecedented flow of ideas, leading to higher levels of productivity” (Chandra, Theng, Lwin, & Foo, 2009, p. 2). However, there is an appropriate time and place for the use of various technologies. According to Draft and Lengel’s media richness theory (MRT), which is largely based on the contingency and information processing theories, certain technologies may be more desirable than others due to the fact that a particular technology has a greater ability to reproduce the information that the user intended and “change understanding within a time interval” (Daft & Lengel, 1986). Institutions must be aware of what students and teachers may be losing during the information-exchange process when new technology is introduced—balance is essential, as some classroom situations do not warrant the use of technology (Gitlin, 2002, p. 31).
MRT was originally designed by Daft and Lengel as a guide to achieve effective managerial communication (Sheer, 2010, p. 224). In this concept, various communication channels or media, have different levels of “richness,” which is based on the following characteristics:

- The availability of instant feedback, which allows questions to be asked and corrections to be made
- The use of multiple cues, such as physical presence, voice inflection, body gestures, words, numbers, and graphic symbols
- The use of natural language, which can be used to convey an understanding of a broad set of concepts and ideas
- The personal focus of the medium (Sheer, 2010, p. 224)

The more characteristics and to what extent a medium possesses each characteristic determines its richness. Although TEL has changed drastically since Daft and Lengel’s development of MRT in the mid 1980s, the theory remains relevant, because new technology can provide similar characteristics on comparable levels in different ways (Daft and Lengel, 1986). In addition to changes in the situations that MRT is applicable, the understanding of the ways in which MRT can be applied has also changed since the theory was developed.

In early studies, it was viewed exclusively as a characteristic of a medium, unchanging across users and situations. The ambiguity or equivocality of a situation determined the requirements for which a medium would be selected. This research, focused largely in the organizational context and primarily on managers, was essentially normative to the population. Later approaches proposed
that media richness was more of a perception of characteristics and capacities as opposed to a stable feature. (Feaster, Dimmick, & Ramirez, 2007, p. 2)

Therefore, MRT can be used not only to explain which TEL programs may be more desirable in specific situations or environments, but also to reveal the most desirable TEL programs for individual users—students and teachers. The concept of media richness has been used by researchers in various disciplines, including communication, sociology, and psychology, to explain behavior—the decision to use one medium over another. Timmerman used MRT as a basis for understanding the difference between mindless and mindful use of technology within organizations (Timmerman, 2002). It was found that “the relationships between variables from [media richness theory] and media use were significantly greater when participants were in the mindful condition,” as opposed to mindless use (Timmerman, 2002, p. 111). These findings can be applied to the recommended use of TEL programs in the classroom, meaning that TEL is more likely to be effective when users are mindful of the technology’s intended use throughout the duration of the program. Nowak and Rauh’s study of technology use to enhance communication also offers invaluable insight into understanding TEL. They found that while media features or characteristics must be considered when selecting technology, “social norms and rules influence how media are, and should be used” (Nowak & Rauh, 2004, p. 3).

Sheer used the media richness theory to explain why adolescents in Hong Kong preferred using MSN instant messenger over ICQ instant messenger to develop friendships online (Sheer, 2010).

Respondents using both MSN and ICQ perceived MSN as a richer IM that offered greater control than ICQ. MSN’s greater richness and control relative to ICQ’s resulted in teenage users’ spending more time and discussing various topics more
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frequently on MSN than on ICQ. Relative factors such as richness and control have led to better friendship quality on MSN than ICQ, but have not introduced differences in the number of friendships. (Sheer, 2010, p. 223)

It is important to note that media richness does not necessarily mean that quantities will increase. In Sheer’s study, students did not form more friendships online with the richer technology, but the overall experience was enhanced (Sheer, 2010). The same applies for TEL programs. When TEL programs are selected based on qualities that may enhance learning processes or make them easier to integrate into existing curriculum, the result will not necessarily be an entire student body with above-average grades, but rather a richer, more enhanced learning experience—which is to say, overall academic performance.

The Literature

The following describes literature relevant to the research topic of the effect of technology on the academic performance of K-12 students. The review addresses the findings of researchers in related academic disciplines—communication and sociology—in an effort to find conclusive evidence of whether technology can enhance student learning. It will discuss the prevalence of technology in classrooms, the relationship between technology in the classroom and increased overall academic performance, and factors that increase the likelihood of successful implementation of technology in the classroom and improved academic performance.

The Prevalence of Technology in the Classroom

Children have become so used to incorporating technology into daily activities that they have become skilled at “media multitasking” (using more than one medium at once), and
actually use a total of 10 hours and 45 minutes worth of media entertainment within a
compressed period of 7 hours and 38 minutes a day (Kaiser Family Foundation, 2010). Although
most children lead technology-centered lives, this does not necessarily mean that technology has
a place in the classroom; however, “nearly 100 percent of public schools in the United States
have Internet access, with 97 percent reporting having a broadband connection” (Tripp & Herr-

Various technologies that are typically incorporated into education include mobile
learning platforms, interactive videos, complex gaming, electronic blackboards, immersive
technologies, and electronic presentation tools. These tools are commonly referred to as
technology enhanced learning (TEL) tools (Dror, 2008) or information and communication
technologies (ICT) (Venezky, 2004; Bulfin & North, 2007; Hayes, 2006). In 1994, 3 percent of
public school instructional rooms had Internet access, compared with 93 percent in 2003 (North
Central Regional Educational Laboratory, 2005). While digital media and networked technology
are increasingly prevalent in the lives of some young people, many still struggle to gain
meaningful access to technology (Tripp & Herr-Stephenson, 2009, p. 1203).

TEL and Increased Academic Performance

Dr. Harold Wenglinsky, who studied the link between teacher classroom practices and
student academic performance, conducted a study observing the “One Computer Per Child”
program in South Africa, which concluded that TEL systems can increase overall academic
performance for students regardless of socio-economic status, age, or race (Sinclair, 2009).
When properly utilized, technology can increase student achievement levels, increase family
involvement in the learning process, and improve teachers’ competency and effective utilization
of technology (Sinclair, 2009). Program participants noted that the technology enhanced
students’ communication and collaboration; improved quality of instructional activities, especially in science; improved students’ organizational skills; enhanced students’ motivation; and promoted students’ autonomous learning (Sinclair, 2009).

During a year-long digital imaging project at a multicultural school in an urban area of the United Kingdom, researchers Abbott and Shaikh found that “employing creative ways of learning across the curriculum using digital technology facilitated greater pupil motivation and achievement in all participating schools, [and] using [technology] actively involved pupils in the decision-making process and pupils took greater responsibility for aspects of their own learning” (2005, p. 457). In the study, students were taught prior to the integration of the technology that they were not to rely solely on the technology, but rather use it as a tool (p. 459); just as when a pencil is used as a writing tool, the student is still responsible for the words written on the paper and the meaning conveyed through those words.

Two studies examined the affect of multi-user virtual environment (MUVE) games used as TEL systems. The MUVE games utilized in the studies conducted by Mallan, Forth, Greenaway, and Young (2010), and Yong and Ping (2010) were Second Life and Quest Atlantis, respectively. Both MUVE games share the following common features:

- Persistence of the in-world environment
- A shared space allowing multiple users to participate simultaneously
- Virtual embodiment in the form of an avatar
- Interactions that occur between users and objects in a 3D environment
- An immediacy of action such that interactions occur in real time
- Similarities to the real world such as topography, movement and physics that provide the illusion of being there (Mallan, Forth, Greenaway, & Young, 2010, p. 204)
Quest Atlantis not only “attracted and engaged” students, but also “the recognition and reward system…motivated the students to attempt and submit their quests” (Yong & Ping, 2010, p. 25). “In [Second Life], there is no predetermined purpose (such as winning a quest) unless the user wishes to create or build one (Mallan, et al., 2010, p. 204). Although both gaming systems are similar, students who used Quest Atlantis exemplified more academic achievement in the areas of motivation and independent learning, which researchers attributed to the game’s reward system. Additionally, although students who used Quest Atlantis showed significant improvement in their overall academic performance for the particular subject matter, urban planning, there are still barriers in the implementation and integration of such technology into schools (Yong & Ping, 2010, pp. 20-21).

The 3D environment was play, fun, and possibly variety to the students. However, the teachers were very disturbed by the students’ attraction to the 3D environment. Teachers had to constantly remind the students and at times, very determined to get them to re-focus on their quests, which were more helpful to their daily work. Being a source of attraction to the students, the 3D environment was a constant strain and frustration to the teachers. It was more of a distraction, than a motivation tool. However, from the teachers’ point of view, the more time and effort the students put into exploring these interactive digital elements would mean that there was lesser time for the students to be engaged in the completion of quests which was a more academically related activity. In this instance, there seemed to be a tension between the culture of school and the culture of games. (Yong & Ping, 2010, pp. 25-26)
Therefore, school administrators and teachers must integrate the technology in a way so that it goes with the culture of the institution, rather than against it. Yong and Ping note that the disturbances were due mainly to the differences between the expectations of the teachers and students (p. 26). Thoroughly going over the purpose of the technology and how and when it is to be used prior to implementation will ensure that teachers, as well as students, parents, and administrators have similar expectations for TEL systems.

*What Factors Make TEL Conducive to Increased Learning?*

While the incorporation of technology in the classroom does affect learning, and in fact, can help children absorb more information through the learning process, there are several factors that must be present to foster the successful incorporation of TEL systems in primary learning environments. It can be easy for school administrators and teachers to become reliant on technology, rather than use it as a tool to help with the learning process. A detrimental mistake that many educational institutions make when incorporating TEL systems in the curriculum is depending on the technology to increase learning, rather than to support the learning process. Without proper utilization of the technology, TEL educational programs experience limited success (Dror, 2008).

The first factor that must be present in order for technology to have a beneficial effect on learning is clear and measurable objectives. Prior to the implementation of any technology in curriculum, teachers and students should be aware of why the technology is being used and how it will help meet educational goals and objectives (Sinclair, 2009). This will ensure that the technology is used to maximize results, rather than to have other accidental, purposeful, or improper uses (Thurlow, et al., 2004). Technology should not be used just because it is available,
but rather, because it will enable teachers and students to reach learning goals that were not obtainable or as easily obtainable without the technology (Dror, 2008). One of the most telling factors of whether a technology will be successfully incorporated in curriculum is the knowledge and competency level of the teachers who will use and teach others to use the technology (Sinclair, 2009). The teacher’s role is critical in structuring activity in ways that challenge and build upon pupils’ implicit conceptualizations, while integrating new scientific ideas (Hennessy, Deaney, Ruthven, Winterbottom, 2007, pp. 283-284). Along with technology, it is essential to employ effective communication methods when using the technology to maximize results (Communication Without Barriers, 2007). This effective communication must take place on both ends—from teachers and administrators—so administrators can explain why and how the technology is used, and teachers can voice any concerns to increase the level of comfort with the technology.

“…there is growing concern that teachers are not engaging with these new technologies” (Honan, 2010, p. 179). The key is in proper training so the focus is not on the technology, but rather on what is to be taught by teachers learned by students. This will also increase the likelihood that the teachers will incorporate the technology into their curriculum (Honan, 2010). Teachers should be able to use the technology at near expert level, but many cannot. Instead of formal professional development for teachers, teachers often must resort to using practical knowledge and previous experience when incorporating TEL system into the classroom (Bordbar, 2010, p. 181). School administrators should consider the cost of extensive teacher training when evaluating technology costs. Otherwise, the technology will be a waste, as it will most likely be misused or not used to maximize student potential (Sinclair, 2009). “As teachers develop technical competence, general pedagogical abilities and ability to integrate ICT into the
curriculum become more important” (Venezky, 2004, p. 15). As teachers become more competent in the use of technology, they begin to adapt the technology to their own teaching style and curriculum, rather than simply focusing on the technology, which is beneficial for both the teachers and their students (Venezky, 2004, p. 15).

Additionally, learners must have some control over the learning process. Control provides students with a sense of ownership of the learning process, which significantly improves learning. This sense of ownership increases motivation and enables students to take a more active role in their own learning (Dror, 2008). “Students cannot use [cognitive] tools without thinking deeply about the content that they are learning, and second, if they choose to use these tools to help them learn, the tools will facilitate the learning process” (Jonassen, 1994, para. 7).

Technology presents the opportunity to employ powerful cognitive tools that can be used by students to solve complex and authentic problems. In order for this to occur, however, technology needs to be used in theoretically sound ways, and it needs to be used by students rather than teachers. (Herrington & Kervin, 2007, p. 220)

The level of control that should be allotted to students can vary greatly depending on age and subject matter, and can be as simple as enabling students to decide the order in which they will complete a series of online workshops (Dror, 2008). To the contrary, as technology is incorporated into curriculum, teachers become the sole user of the technology, “or alternatively, the focus sometimes rests solely on the technology itself” (Herrington & Kervin, 2007, p. 220). In order to ensure that the TEL system is incorporated in the classroom in a way in which student academic achievement is maximized, Hennessy, et al. (2007) suggest using Kenneth Rogoff’s
framework of guided participation, in which “a skilled partner subdivides tasks into manageable goals and gradually increases the child’s participation and responsibility for activities, extending familiar knowledge and skills” should be utilized (p. 284). Additionally, during the integration process, and after the TEL system is fully integrated, teachers must continue to guide students’ use of the technology with provisions for proper use (Selwyn, 2006, p. 14).

Herrington and Kervin (2007) suggest a number of other factors that must be present for the successful incorporation of TEL systems in the curriculum:

- Authentic contexts that reflect the way the knowledge will be used in real life
- Access to expert performances and the modeling of processes
- Multiple roles and perspectives
- Collaborative construction of knowledge
- Reflection to enable abstractions to be formed
- Articulation to enable tacit knowledge to be made explicit
- Coaching by the teacher at critical times
- Assessment of learning within the tasks
- Ongoing professional learning and development for teachers

When various technology programs are considered for incorporation in curriculum, the programs should be evaluated based on the aforementioned criteria to ensure that the best learning environment is created, which is conducive to proper utilization of the technology and maximum realization of potential learning (Herrington & Kervin, 2007). The most effective way to determine whether a technology has been properly integrated into the classroom is to observe the behavior and academic progress of the students who have used the technology (Hayes, 2006).

In addition to the aforementioned factors, institutional culture must be considered when
deciding whether to incorporate technology into the classroom, as well as what type of technology would be most appropriate to achieve desired results. “Technology use in classrooms is often employed for all the wrong reasons—such as convenience, pressure from school administrators, the belief that students need to be entertained, and so on” (Herrington & Kervin, 2007, p. 219). One of the most common, yet detrimental, mistakes schools make is denying that the institution has goals beyond the cognitive advancement of their students. Depending on the type of technology used, the entire learning environment and school culture could be transformed, which may or may not be aligned with the institution’s goals (Venezky, 2004, p. 4).

In addition to the school’s culture, school administrators must consider the various cultures within the student body when deciding whether to incorporate technology in the classroom, and which technology to use. “It has often been argued that the generally ‘low-tech’ and formulaic use of information technology in schools leaves teachers and administrators facing ‘a legitimacy crisis with kids’—further alienating ‘tribes’ of media-centered young people from their less ‘switched-on’ elders” (Selwyn, 2006, pp. 5-6). Although a new technology may be seemingly advanced for some teachers and administrators, many children have exposure to similar technology outside of the classroom.

Rather than approach home and school as very different spaces and the practices of young people in these different spaces as having little relevance to each other, Bakhtin’s theory of the dialogical nature of language highlights the dynamic and constitutive relationship between home and school literacy practices as a site of continual negotiation and exchange. In the wider context of young people’s everyday lives, tightly bounded distinctions separating literacy and technology practices make little sense. Young people’s language practices and their
engagement with various forms of digital culture do not belong to separate domains. (Bulfin & North, 2007, p. 248)

Therefore, it is only natural to not only incorporate technology in the classroom, but also to select a technology that is at a level suitable for the students who will use it. Of course, the students belonging to the same school district could be of various socio-economic statuses, which would in turn affect the level of exposure to technology outside of the classroom, and the students’ competency level with use of the technology. However, as previously mentioned, according to Dr. Wenglinsky’s findings, socio-economic factors do not affect the effectiveness of TEL systems in the classroom (Sinclair, 2009), but that is something that school administrators may want consider prior to selecting which type of technology to use, especially if there is limited time to teach students how to use a particular technology. “The important implication for education systems is that since this type of knowledge is organized segmentally; it does not embody any explicit principles by which it can be transferred across sites” (Hayes, 2006, p. 576).

Therefore, what works in one school may not be effective in another school due to differences in culture, teaching staff, students, and administrators.

Research Questions

Due to the recent surge of use of TEL systems in the classroom, research including long-term observations and results of incorporating technology in the classroom are not available. Current research is limited to the almost immediate impact of the incorporation of technology in the classroom. The following research questions were designed to expand existing research concerning the subject matter of technology use in the classroom to increase learning:

1. How can technology be successfully integrated into the classroom?
2. What should schools avoid during the integration process to realize the potential effectiveness of the technology?

3. How does the way in which information is presented affect students’ ability to grasp and retain information?

4. What factors increase the likelihood of successful implementation of technology in the classroom and improved academic performance?
CHAPTER III: SCOPE AND METHODOLOGY

Scope of the Study

There is a plethora of research available concerning the effect of technology in the classroom. As technological advances became more accessible to the common public in the second half of the 20th century, the availability of research on the topic has seemingly also increased exponentially. Although there is a wide array of material available, it appears as though the majority of studies analyze the immediate, rather than long-term, affect of technology in the classroom. What began as the analysis of the incorporation of simple technologies, such as digital cameras (Abbott & Shaikh, 2005) and low-tech computers (Sinclair, 2009), has developed into the analysis of the effect of more advanced learning systems, such as 3D multi-user virtual environment games (Mallan, et al., 2010; Yong & Ping, 2010).

Daft and Lengel’s media richness theory suggests that specific types of technology may be better suited to convey certain messages based on the intended message and audience (1986). This theory is supported by Gitlin’s assertion that the method of delivery of information does, indeed, alter the way in which it is absorbed and how much of the information the student will remember later (2002, p. 31). Given that there are so many different technologies available for school administrators and teachers to choose from, this thesis will focus on the most effective way to incorporate technology into the classroom in a way in which it improves the students’ overall academic performance rather than simply for the sake of having the technology. This study reviews recent research from 2001 to 2010 pertaining to the effect of the incorporation of technology in the classroom for children grades K-12.

Methodology of the Study
A qualitative meta-analysis of research was conducted to assess the validity and strength of the finding of previous studies on the effects of technology in the classroom. For the purpose of this thesis, academic studies refers to studies conducted by researchers at the university level and published in peer-reviewed journals, books, and at conferences. Data was also collected from academic books, journal articles, a non-profit organization, and a scholarly article. Communication & Mass Media Complete and Google Scholar were the primary online databases utilized to locate relevant journal articles in the communication, technology, education, and sociology fields.

The meta-analysis will provide the support for a larger synthesis of conclusions regarding the effect of technology on students’ overall academic performance. The meta-analysis method, which consists of data collection from previous research and analysis, is an appropriate research method for the purpose of this thesis, as it enables the comparison of data from multiple studies to come up with a general conclusion (Rubin, Rubin, Haridakis, & Piele, 2010). In this way, this thesis provides a comprehensive overview of the subject, as well as detailed findings from previous studies and to identify possible areas of further research that may be needed, and to see more clearly what research is revealing.
CHAPTER IV: THE STUDY

The Literature

Current research on the effects of TEL on the academic performance of K-12 students is quite extensive and is comprised of studies spanning several decades. Due to the recent surge of the use of TEL in the classroom, research including long-term observations and results of incorporating technology in the classroom are not available. Although available research examines different types of TEL, the recommendations for the proper integration and utilization of TEL programs were generally consistent. The general consensus of the findings were that TEL does in fact increase overall academic performance for K-12 children, if properly integrated. Therefore, much of current research discusses the proper way to integrate TEL programs in the classroom and internal and external factors that may help or hinder the process. Analysis of current data, which offers additional insight into the effect of TEL on academic performance is arranged in the following categories: (1) teacher and administrator roles in TEL programs; 2) learning with TEL programs; and 3) TEL and cultural considerations.

Teacher and Administrator Roles in TEL Programs

Nearly 100 percent of public schools have Internet access in the United States, and incorporate other types of TEL into the curriculum (Tripp & Herr-Stephenson, 2009, p. 1190). Research has generally supported the notion of student learning being enhanced by the use of computer technology in their classroom activities. In fact, education has for decades, discussed this issue, and has concluded that greater learning would be taking place, if the classrooms had more computer technologies for both students and teachers. (Sinclair, 2006, p. 46)
However, the prevalence of TEL programs and the fact that it is believed that TEL can increase academic performance does not guarantee that these programs will be effective. While digital media and networked technology are increasingly prevalent in the lives of some young people, many still struggle to gain meaningful access to technology (Tripp & Herr-Stephenson, 2009, p. 1203). Due to improper, or lack of meaningful use, of technology in the classroom, “computers are not making the anticipated inroads into assisting students learning, as we previously believed” (Sinclair, 2009, p. 46). A resounding theme in the analyzed research was the pivotal role of teachers in the successful integration of technology into the classroom. A general consensus is that “the teacher’s role is critical in structuring activity in ways that challenge and build upon pupils’ implicit conceptualizations, while integrating new scientific ideas” (Hennessy, et al., pp. 283-284). A lack of understanding on the part of teachers of how to use technology in the classroom and the purpose of the TEL program has resulted in TEL programs with lackluster results with minimal impact on overall academic performance.

Sinclair’s (2009) summary of Dr. Harold Wenglinsky’s observation of the “One Computer Per Child” program in South Africa studied the link between teacher classroom practices and students’ academic performance when TEL was incorporated into the curriculum, finding that the willingness of teachers and administrators to integrate technology into the classroom and learn how to use it competently has a profound impact on the successful integration of TEL programs (p. 47). Despite these findings, Sinclair found that “those teachers who use computers as instructional tools do so infrequently and unimaginatively” (p. 46).

Current research, conducted between 2004 and 2010, reveals that the reason behind the infrequent and unimaginative use of technology in the classroom is not simply because teachers are resistant to change or unwilling to incorporate the technology into the classroom. To the
contrary, many teachers do not actually feel competent using the technology themselves or do not completely understand why the technology is being used and the best way to incorporate it into the existing curriculum (Sinclair, 2009; Bordbar, 2010; Venezky, 2004; Hennessy, Deaney, Ruthven, & Winterbottom, 2007). “…technology is used meaningfully when teachers have a good understanding of computer technology and believe that it has the power to influence learning” (Sinclair, 2009, p. 46). Therefore, a great deal of responsibility lies with school administrators to ensure that teachers receive the necessary training to understand how the technology works and how it will aid in students’ learning process. However, “instead of formal professional development for teachers, teachers often use practically knowledge and previous experience with incorporating TEL into the classroom” (Bordbar, 2010, p. 181). For the successful integration of TEL, school administrators must first provide teachers who will be using the technology with clear educational objectives, as “poorly stated educational objectives, teachers’ experiences and knowledge” increase the likelihood that the technology will not be utilized, or will be used improperly (Sinclair, 2009, p. 47).

Another key misconception that the analyzed research reveals is the belief that teacher competency means that teachers must be able to use the technology at an expert level to successfully integrate it into existing curriculum (Sinclair, 2009, p. 48). This misconception has actually hindered the success of TEL programs and made administrators and teachers weary for two reasons: (1) fear that teachers will not be able to learn how to use the technology at an expert level; or (2) the training that would be needed to help teachers learn how to use the technology at an expert level would be too expensive and time consuming (Sinclair, 2009; Venezky, 2004).

To the contrary Venezky’s (2004) research, which examines the use of the Internet in K-12 classrooms, reveals that teachers must simply be proficient with the technology in order to
utilize it properly and to incorporate it into the curriculum (p. 15). Venezky’s work expands a model that was derived from the Apple Classrooms of Tomorrow (ACOT) program, which incorporates four stages of the integration process for teachers: survival, mastery, impact and innovation (p. 15). While the “mastery” stage could be translated as “expert,” the ACOT program views the mastery stage as a point in which teachers understand how to use the technology and can also teach students how to use the technology to increase academic performance. Venezky’s research supports Sinclair’s findings that teachers do not have to be expert technology users, but adequate training and support for teachers is critical, because it enables teachers to use the technology as a tool rather than becoming dependent on the technology, or not using it at all (2004).

As teachers develop in technical competence, general pedagogical abilities and ability to integrate ICT into the curriculum become more important. In the innovation stage, the teacher restructures the curriculum and learning activities, moving beyond the proposed procedures and content. Where a core set of ICT applications are institutionalized within a school, teachers feel free to adapt ICT to their own style of teaching. (Venezky, 2004, p. 15)

While proper training of the use of any technology that is incorporated into curriculum is essential, too much focus on the technology can also be detrimental to the TEL program (Abbott & Shaikh, 2005, p. 459). Abbott and Shaikh (2005) examined the effect of a TEL program that incorporated the use of digital imaging technology into the classroom. Digital imaging technology refers to the use of a digital camera and the manipulation of the image with image-editing software (p. 455). In the year-long study, elementary students in a multicultural, urban
area of the UK were taught how to use the technology, and the use of the technology was incorporated into various academic activities. Abott and Shaikh’s (2005) findings are as follows:

Employing creative ways of learning across the curriculum using digital technology facilitated greater pupil motivation and achievement in all participating schools, [and] using digital cameras actively involved pupils in the decision-making process and pupils took greater responsibility for aspects of their own learning. (p. 457)

Venezky’s research supports Abbott and Shaikh’s findings. “ICT rarely acts as a catalyst by itself for schooling change yet can be a powerful lever for realizing planned educational innovations (Venezky, 2004, pp. 9-10). According to Venezky’s findings, “ICT can be used as a communication tool, an access path to resources, a facilitator of cooperative activities for teachers or students, or as a variety of other aids,” but should essentially be viewed only as a learning tool (2004, p. 10). Therefore, utilizing the best available technologies will not necessarily result in increase academic performance for students. Teachers and administrators must find innovative ways to use technology to develop the most effective TEL programs (Abbott & Shaikh, 2005). School administrators must incorporate “careful planning, involvement of teachers in planning and implementation, [and] appropriate support for staff development” in order to increase the effectiveness of TEL programs (2004, p. 10).

Learning with TEL Programs

TEL can be effectively utilized in two ways in the classroom: “students learning ‘from’ computers, and students learning ‘with’ computers (Sinclair, 2009, p. 47). When students learn “from” TEL programs, they are learning about various technologies, “such as word processing programs, programming languages, or just exploring the Web” (2009, p. 47). When students
learn “with” TEL programs, the “technologies become cognitive tools” (2009, p. 48). Further explanation of learning with TEL programs is as follows:

When used as cognitive tools, computer technologies serve, and build students’ social skills, cognitive perspective, tolerance, creativity and high order thinking skills. It is within this context that teachers should be able to use computers as agents of support-structures for students learning. It provides and supports fun, curiosity, academic independence and interdependence. (Sinclair, 2009, p. 47)

The most successful TEL programs incorporate both aspects—learning from and with technology. However, in order for the program to reach its full potential and increase students’ overall academic performance, students must be aware of which activities constitute learning from the technology that is used, and which activities constitute learning with the technology that is used (2009, pp. 47-48). Yong and Ping’s (2010) research, which is based on Yrjö Engeström’s Activity Theory, supports Sinclair’s findings. Basic principles of the Activity Theory are as follows:

- Object-orientedness
- The hierarchical structure of activity
- Internalization-externalization with mental processes versus external behavior and inter-psychological versus intra-psychological
- Mediation
- Development (p. 25)

Yong and Ping used the Activity Theory to construct their study, which utilized the 3D MUVE game, Quest Atlantis, to help motivate academically at risk students (2010). While the TEL program did successfully motivate students to use the technology, there were some
disturbances noted by teachers who participated in the program, which were attributed to the
difference between the expectations of the teachers and that of the students (p. 26). Students
successfully learned “from” the technology, by “learning of technology skills and learning of
content knowledge,” but began to use the technology for non-academic purposes that school
administrators, teachers, and parents had not intended (pp. 29-30). Although students were
aware of the purpose of the technology, they were naturally tempted to utilize it for other
purposes. To rectify the situation of students’ and teachers’ conflict of interest, students were
given more control to help them want to learn “with” the technology. After students become
proficient in the use of the technology, the students were given more control of their individual
learning. The “student-directed, game-based learning pedagogy” provided a sense of control
over the learning process, which resulted in increased motivation to not only use the technology,
but use it for its intended academic purpose (pp. 29-30). This student-directed learning approach
also ensures that students view the technology as a tool rather than an object, which will help
students focus on learning from and with the technology (p. 33).

Hennessy et al.’s (2007) research, which expounds upon Kenneth Rogoff’s framework of
guided participation, supports these findings (p. 283-284). During guided participation, teachers
provide students with lessons that include goals that students must reach to move on to the next
level or lesson. Student participation is gradually increased as lessons are completed and
technology competency increases until the student is largely responsible for his or her learning
through increased participation (p. 284). The study examines the way in which teachers were
able to effectively integrate the use of interactive whiteboards into the curriculum. Using the
guided participation approach, students were given control over their individual learning, which
resulted in increased motivation and independent learning (pp. 295-297). Herrington and Kervin
(2007) also suggest that who utilizes the technology is more important than the actual technology.

Technology presents the opportunity to employ powerful cognitive tools that can be used by students to solve complex and authentic problems. In order for this to occur, however, technology needs to be used in theoretically sound ways, and it needs to be used by students rather than teachers. (Herrington & Kervin, 2007, p. 220)

Therefore, students’ roles in TEL learning programs is to actively participate in the program and take a proactive role in their own individual learning. However, this is only possible if teachers receive the necessary training from school administrators to teach students how to use the technology in a way that will increase overall academic performance through innovative methods, such as guided participation.

**TEL and Cultural Considerations**

Although there were geographical differences in the aforementioned research, location seemed to have no bearing on the impact of TEL programs, as researchers found similar results in an array of geographical locations—the United States, United Kingdom, South Africa, Australia, and Hong Kong. Research was also conducted in urban, rural, affluent, and poverty-stricken communities, which also did not have a bearing on the effectiveness of TEL programs. However, a commonality between the studies was the focus on culture—not only the culture of individual students, but the culture of the schools integrating the technology as well. Cultural differences do not necessarily change the effectiveness of TEL, but can change certain aspects of the TEL programs, such as the technology used, training, and implementation time. Therefore, a
TEL program that was successful in one school may have completely different results in seemingly similar academic environments (Hayes, 2006).

Researchers emphasize that students’ cultural differences can impact the approach school administrators and teachers should take when implementing TEL, as well as what kind of TEL should be used. “Social norms and rules influence how media are, and should be used,” (Nowak & Rauh, 2004, p. 5). Understanding social norms and rules, key aspects of culture, can help school administrators select technology that is more likely to increase student academic performance. Selwyn’s (2006) study of in-school Internet use of children in the UK found that there was often a “digital disconnection between emerging generations of technology-rich students accustomed to high levels of Internet use and their technology-poor schools” (p. 5).

Many K-12 children lead technology-centered lives. This increased exposure has resulted in the need for the use of more advanced technology in the classroom (Selwyn, 2006). To the contrary, Selwyn found that school administrators and teachers often select TEL tools based on the current competency levels of teachers and administrators, rather than selecting the most effective technology for teaching students and then learning how to use the technology themselves. The end result is a disconnection between students and teachers, which can inhibit the learning process (Selwyn, 2006).

Similarly, Bulfin and North (2007) conducted an ethnographic case study of Australian adolescents’ technology use in contrasting schools. The researchers found that “young people’s language practices and their engagement with various forms of digital culture do not belong to separate domains,” (2007, p. 248). Students were more engaged in the learning process when technological skills that are developed at home and other avenues outside of school were also exercised in the classroom (2007). Creating a distinction between the technology practices of
students non-academic lives and the way technology is used in academic settings is not conducive to increased learning or academic performance (2007, p. 248). Therefore, TEL programs should incorporate technology at a level that is suitable for the majority of students, rather than at levels reflecting teacher competency.

Many schools are comprised of students from different socio-economic statuses, which could also affect the level of technology exposure students have outside of the classroom. Therefore, it cannot be assumed that all students require the use of advanced technology in the classroom. However, as previously mentioned, according to Dr. Wenglinsky’s study of the “One Computer Per Child” program, socio-economic factors do not affect to the effectiveness of TEL systems in the classroom (Sinclair, 2009). When children have varying degrees of technology exposure outside of the classroom, it is the responsibility of teachers and school administrators to effectively teach students how to use the technology in a manner that all students understand its use and can use it proficiently. If time constraints prevent proper teacher or student training prior to the implementation of technology, administrators should consider the use of alternative TEL tools (Herrington & Kervin, 2007). In order to make these decisions, an understanding of student culture is critical.

In addition to cultural influences of individual students, institutional culture should also be considered when deciding whether to integrate TEL programs into curriculum, as well as what type of technology is appropriate (Herrington & Kervin, 2007, p. 219). School administrators should evaluate the school’s existing culture as well as its ideal culture prior to the incorporation of any technology into curriculum, because the integration of TEL programs is likely to change the culture, regardless of intent. “Technology creates its own imperatives and, at
the same time, creates a wide-ranging social system to reinforce its imperative,” (Beniger, 1989, p. 105).

Venezky’s (2004) research of 94 case studies of K-12 schools that successfully implemented TEL programs in 23 countries supports the concept of the influence of technology on school culture. Technology has the power to alter the learning environment, which could temporarily or permanently transform school culture (2004).

A technology that allows every student to advance at his or her own pace in a selected subject may have many applications for lifelong learning and for selected skills at other levels. However, its potential for transforming K-12 education is near zero. (Venezky, 2004, p. 4)

It may be advantageous for schools with a culture of being on the cutting edge of technology to select advanced TEL programs, while schools with an undefined technology culture may want to select tools that can be easily integrated into existing curriculum. However, this does not mean that the same TEL tools are appropriate for schools with similar cultures as each institution has unique characteristics that may make certain technologies more desirable than others (Hayes, 2006). Therefore, school administrators and teachers must take a systematic approach when selecting TEL tools to ensure the technology is aligned with the institution’s goals (Venezky, 2004).

Discussion

Daft and Lengel’s MRT has guided research concerning the effectiveness of TEL programs. Initially, researchers focused largely on the characteristics of various media to determine whether the media would be desirable for organizations. These desirable characteristics were viewed as being representative of the entire population, regardless of
varying situations, organizations, or individuals (Feaster, et al., 2007). As MRT further developed and was applied to various types of organizations and situations, the unique needs of organizations and individuals was taken into consideration, as a determinant of desirable media (Feaster, et al., 2007, p. 2). Since an all-encompassing statement cannot be made about which technologies are best for TEL programs due to vast differences in existing curriculum, school and student culture, desired implementation timeframes, and training capabilities, past research has solely focused on the effectiveness of TEL programs in general. However, suggestions of what makes certain environments more conducive to increased student academic performance as opposed to others would be useful. Instead, past research suggests methods to integrate TEL programs into curriculum, but does not provide a basis to help determine which technologies are better for certain situations.

Based on the findings of past research, the integration of TEL programs into curriculum will undoubtedly have an impact on student academic achievement, school culture, and children’s culture outside of the school (Venezky, 2004). What determines whether the impact of the TEL programs will be positive or negative largely depends on the reasons the technology was incorporated into the curriculum, training prior to the integration of the technology, continued training after the TEL program has been implemented, and clearly-stated objectives to students and teachers (Abbott and Shaikh, 2005; Mallan, et al., 2010; Sinclair, 2009; Yong and Ping, 2010).
CHAPTER V: SUMMARIES AND CONCLUSIONS

The incorporation of technology into curriculum can increase students’ academic performance (Chandra, Theng, Lwin, & Foo, 2009, p. 2); however, there are factors that can either increase or decrease the effectiveness of TEL programs that must be taken into consideration. Factors that could alter the effectiveness of TEL in the classroom include the academic performance level of students prior to the commencement of the program, teacher training programs, teacher competency levels with the technology, and social class. However, previously conducted research has taken these factors into account when assessing the effectiveness of TEL programs. It has been found, that despite these factors, TEL programs are effective and can increase students’ overall academic performance (Abbott and Shaikh, 2005; Mallan, et al., 2010; Sinclair, 2009; Yong and Ping, 2010). However, given that this meta-analysis is dependent upon the findings of previously conducted research, complete exploration of the topic is both revealing and limited.

Limitations of the Study

Previously conducted research analyzed the effectiveness of one type of TEL to gauge whether the TEL program was effective. However, once it is determined that a type of TEL program can be successfully integrated to enhance academic performance, research seems to dissipate without further examination of why the TEL was effective, which could either be due to the type of technology used, or the type of technology used with a particular subject. Since technology is only a tool, certain tools may be used more efficiently to complete certain tasks (Honan, 2010). Additionally, students may be able to learn a specific type of information easier with one type of tool versus another type of tool (Gitlin, 2002, p. 31).
The effect of frequency of use for TEL was not sufficiently addressed in the analyzed research as well. In the studies, researchers developed an integration plan in which the TEL would be incorporated into the classroom, and then changes in academic performance were observed. Minimal effects of the incorporation of TEL programs were not attributed to inaccurate frequency of use, but rather to lack of teacher training, improper use of the technology, poorly communicated reasons for the incorporation of the technology, or a mismatch between the school’s cultural and that of the students’. However, since the frequency of use of the TEL was never adjusted, nor did researchers reveal why the frequency of use was selected, this factor could not be analyzed.

Another limitation of available research is the examination of the total effect of TEL on students’ overall academic performance. Although research findings show that TEL programs can increase overall academic performance in the subject matter that the TEL is incorporated, whether TEL programs can impact a child’s academic performance in other subject areas was not discussed. TEL programs can transform culture (Venezky, 2004). Effective TEL programs should create a culture conducive to the development of effective communication and collaboration skills, independent learning, and student motivation regardless of subject matter. Therefore, children who have participated in successful TEL programs could possibly experience similar changes in overall academic performance in all subject matters. However, there is currently no available research to support this inference. More research is needed to determine what types of TEL programs work best to relay what type of information and in what setting, the frequency of use needed for TEL, and whether TEL programs impact student learning across subject areas, even when the technology is not used in all subjects.

Recommendations for Further Study
As technology continues to be an integral part of children’s lives, both inside and outside of the classroom, and TEL programs are increasingly integrated into curriculum, research questions must evolve. Previously conducted research has sufficiently answered the question of whether TEL programs can increase academic performance and the necessary measures for successful integration of TEL into existing curriculum. However, these research findings do not address TEL in its entirety.

Past and present research on the topic incorporates both exploratory studies and content analyses, which was mostly focused on the effectiveness of individual types of TEL, rather than TEL as a whole. Therefore, studies concluded that TEL can effectively increase students’ overall academic performance based on one type of TEL tool. Comprehensive research evaluating the effectiveness of various types of TEL versus other types of TEL could be beneficial. Additionally, exploration into the impact of frequency of use of TEL and the effect of TEL on students’ academic performance in subject matters in which the technology was not implemented could help increase understanding of the subject. Comparing various types of TEL, using similar subjects, such as students in a particular grade from similar schools, could provide additional insight to help school administrators and teachers understand which types of TEL are most effective in certain situations or for teaching which subjects.

Conclusions

Technology in the classroom is already a reality in most schools. The extent to which technology is integrated into curriculum is likely to increase exponentially as technological advances continue and the cost of technology decreases (Bordar, 2010; Klein, 2010). This meta-analysis sought to understand if technology could enhance students’ learning experience and
overall academic performance, as well as to provide additional understanding of the role of TEL programs in curriculum.

Klein (2010) concludes that technology is a tool that can enhance learning, but cannot solely be relied upon to increase student academic performance. Supporting these findings, Dror (2009) and Honan (2010) assert that teachers often rely upon technology, rather than using it for its intended use due to lack of training and poorly communicated objectives. As the use of technology in the classroom continues and expands, an understanding of what technology to use, when to use the technology, and why the technology should be used is imperative. Beniger (1989) and Postman (1995) warn against the overuse or misuse of technology.

We proceed under the assumption that information is our friend, believing that cultures may suffer grievously from a lack of information, which, of course, they do. It is only now beginning to be understood that cultures may also suffer grievously from information glut, information without meaning, information without control mechanisms. (Beniger, 1989, p. 70)

To avoid the common mistake of employing unnecessary technology, or technology that is not most desirable to achieve academic goals, Hayes (2006) suggests school administrators should carefully evaluate the school’s culture and the culture of the student body. Additionally, teachers must be provided with adequate training prior to technology integration and continued training throughout the TEL program to ensure that all concerns are addressed and objectives are met (Bordbar, 2010; Communication Without Barriers, 2007; Hennessy, et al., 2007; Honan, 2010; Venezky, 2004).

Although Daft and Lengel’s (1986) media richness theory was originally developed as a guide for effective managerial communication across various media channels, the theory is
applicable in the understanding of TEL programs. Just as different media were theorized to be more desirable to organizations and organizational members based on characteristics of the media, TEL programs can be selected based on whether their characteristics or features will make the technology more desirable to students, teachers, and the school’s culture (Nowak & Rauh, 2004; Feaster, et al., 2007). While some characteristics, such as ease of implementation, may be desirable for nearly all schools, it is likely that seemingly similar schools will prefer to use different TEL programs based on the school’s culture, culture of the student body, implementation time, and existing technology used (Hayes, 2006).

Since there are a number of factors that must be present for the successful integration of TEL into curriculum, it cannot be determined whether TEL programs actually cause increased student academic performance. However, there is a strong correlation between increased student academic performance and TEL programs that incorporate proper teacher training, clearly defined goals and objectives, and consider student and institutional culture.


Klein, J. D. (2010). When you can't bring your classroom to the world, bring the world into your classroom. *Youth Media Reporter*, 486-88.


