USE OF TECHNOLOGY IN IMPROVING LITERACY

By

FRANK R. YEKOVICH * AGNES CAVE ** CAROL WALKER YEKOVICH ***

*-*** Department of Education, The Catholic University of America, Washington, D.C.

ABSTRACT

The Technology-Rich Authentic Learning Environments (TRALE) program was designed to develop for young, urban learners a responsive and effective instructional program in which technology played a vital part in the completion of meaningful, problem-based tasks. TRALE was implemented in early childhood classrooms (i.e., K-3rd grade) as a technology-rich learning community where participating classrooms used technology to achieve a role they assumed in a community (e.g., general store, newsroom), and students in these classrooms learned knowledge and acquired skills prescribed by particular content standards and the curriculum of the school district.

This paper focuses on how technology-based tools were used for enhancing students' literacy acquisition. Student achievement data indicate that when implemented as designed, TRALE significantly improved the standardized reading test scores of 2nd and 3rd graders.

Keywords: Urban Learners, Technology, Authentic Learning, Language Arts, Early Childhood Education

INTRODUCTION

Purpose of the Study

Literacy and its instruction continue to be the center of attention in the United States in the 21st century. Higher literacy skills are related to academic (Cunningham & Stanovich, 1998), economic (Oxenham, Diallo, Katahoire, Petkova-Mwangi, & Sall, 2002), political (Stotsky, 1996), and employment (Banovetz, 2000; Brunner, 1993) success. Literacy provides access to public goods and services and makes possible employment opportunities and the economic well being of citizens. Power, influence, and authority are held by those who have higher literacy proficiency and thus most effectively obtain, use, and evaluate information for solving important problems and most successfully communicate the results of these processes (Freire, 1970; Leu, 2000). In other words, literacy is intrinsically related to issues of equity and social justice. Thus access to equitable, quality literacy education is of utmost importance, especially for disadvantaged youth. Because of its importance, classroom teachers, parents, researchers, policy makers, and other stakeholders have been interested in increasing students' literacy skills, and many have searched for the best instructional methods to ensure that students not only learn how to decode and understand text but also use their reading skills to produce more knowledge and apply what they read in their daily lives.

Advancements in technology may be used in the attainment and enhancement of literacy skills (McGee & Richgels, 2006). The capacity of technology to support literacy development has been widely researched, and many consider the impact of electronic technology on education profound (Reinking, McKenna, Labbo, & Keiffer, 1998). There seems to be a consensus that children's literacy development is supported by their engagement with technology as it may serve as a scaffold for literary acts (Reinking, et al., 1998) and allow students to explore concepts, principles, theories, problems, and other phenomena. Many instructional applications of technology have been designed as researchers examined the crucial relationship between literacy and technology. Researchers have studied the effect of the internet on students' learning (Kuiper, Volman, & Terwel, 2008; Schuh & Farrell, 2006) and various software programs on literacy experiences for both normally developing children (Brown, 2003; Cuddeback & Ceprano, 2002; Labbo, 2005; Torgesen &

Mathes, 2002) as well as for children with special needs (Blythe, 2006; Duris, 2005; Gardner, 2008; Peterson-Karlan, Hourcade, & Parette, 2008). These programs seemed to be effective in increasing gains in literacy, and this article focuses on another program that has the capacity to contribute to students' increased achievement in reading.

Among many attempts to increase the effectiveness of literacy instruction is the Technology-Rich Authentic Learning Environments (TRALE) program that infuses technology in authentic learning contexts. The purpose of this paper is to examine how this unique early childhood education program had the capacity to engage students in literacy activities through the use of technology and lead to increased scores on standardized reading assessments. The nature of the authentic learning component of the program is explored in another paper (Cave & Yekovich , 2009).

This paper describes how technology was infused in this learning environment and how it enhanced young students' literacy development. The first part of this paper describes TRALE and its implementation, and the second part of the paper contains student achievement data as evidence for TRALE's effectiveness.

The Description of TRALE

TRALE was designed to be a technology-rich program in which young children completed problem-based learning activities, and technology was utilized as a tool to complete those tasks. For example, when young children learned to alphabetize, they created inventory lists for their 'classroom store,' and the completed lists were turned into computerized spreadsheets to be used for real inventory and accounting purposes as the children were learning how to read, write, and do math.

TRALE was implemented in K-3 classrooms in one urban elementary school (we will call *Target*) in a city in the Mid-Atlantic Region. At Target Elementary, TRALE was operationalized as a community comprised of businesses and service organizations. Each classroom assumed a unique role (e.g., a store, newspaper, theater group, museum, art gallery, video store, post office, candy store, card shop, and poetry club), and together the classrooms, using technology, engaged in the exchange of goods and services as learning opportunities in language arts. For instance, a performance by the theater group was viewed by one or more reporters from the newspaper, and the actors and actresses read their performance reviews in the newspaper. These journalists and actors then went shopping in the general store or rented a video in the video store. The TRALE community functioned through successful interactions within each classroom and among the members of the community. In sum, TRALE was not a substitute or stand-alone language arts curriculum. Rather it was intended to incorporate the curriculum standards mandated by the school district and to enhance teachers' instructional practices across the content areas by providing them with a coherent unifying theme (situated context) for their classroom. At the same time, this theme provided a meaningful anchor for children's learning as they were using technology to complete their tasks (Walker &Yekovich, 1999).

TRALE has two delivery components, a technology component and another dealing with authentic learning activities. This paper focuses on the use of technology and its impact on young students' literacy development. The use of technology is a central component of TRALE because

- multimedia technology is an efficient delivery system for multisensory input, so it encourages the development of literacy skills of a diverse student population;
- technology engages young children for long periods of time providing the practice they need to develop their skills;
- technology encourages children to work together to solve problems, promoting collaboration;
- technology provides structure and scaffolding (e.g., pull-down menus) that provide assistance for children in their zone of proximal development (Vygotsky, 1978) as they solve problems;
- well designed and pedagogically sound multimedia

software programs allow young children to concentrate on higher level skills (e.g., constructing a meaningful message) while the computer takes over some parts of a resource consuming task (e.g., the computer puts the letters on the screen while the children concentrate on what they want to write), and technology can provide opportunities for children to practice small, prescribed sets of cognitive activities in motivating contexts.

Further, with the increasing importance of computer literacy in today's world, young children should have as much access as possible to the tools they will be expected to use in the future.

TRALE's Implementation

TRALE's Technology Infrastructure.

Each classroom was equipped with 2-6 Apple computers. Besides these computers, each TRALE classroom had a printer, a digital camera, and multiple sets of headphones. Additionally, three color scanners were shared among the classrooms. The computers had internet access, built-in CD ROM drives, and color monitors. The computers and printers were networked both within and across classrooms in a way that allowed multiple computers in a classroom to access network services simultaneously even though the classroom had only one direct network connection.

A variety of software, which was either installed or accessible via CD-ROM, focused on specific skills. Some of the software included games and activities related to language arts, and other areas, such as math, integrated word processing, spreadsheet and database, word processing and letter-sound matching activities on various levels, desktop publishing for children, multimedia authoring, keyboarding skills, interactive multimedia books and games, interactive story writing and reading, word recognition games, reading comprehension, phonics, and spelling, drawing and simple animation, digital image downloading and editing, scanning, painting, coloring, costumes, block art, stickers, and games like checkers.

Technology use was integrated into the classroom activities in two distinct ways. First, teachers set up the computers as a "center" and consequently used them for individual and small group activities such as reading, writing, art, and other subjects. The other distinct use of technology revolved around each classroom's unique role within the community. Because each classroom simulated some service or organization within the community, technology was employed as part of the ongoing functioning of the agency. For instance, the employees of the school newspaper used word processing to write up and revise their articles.

Within each classroom, part of the language arts component of the curriculum was designed around sets of problem-based activities that created its role within the community. For example, the theater was organized as a performing arts company, which performed plays and poetry recitals publicly in the community. To accomplish their goal, the members of the theater used technology in a number of problem-based activities that fostered literacy development. For instance, some of the activities included creating scripts on the computer, designing sets, creating props using various software, publishing programs and announcements, learning lines, playing a role, and communicating a story to a watching audience. Each activity in turn was tied to explicit language arts standards specified by the state, and a number of the activities naturally relied on technology use (e.g., preparation of programs, creation of art for the sets).

Each classroom was conceptualized in the same manner as the theater. Each organization had a particular goal or function, each had a number of problem-based activities that had been designed to foster literacy development (using appropriate state standards as the objectives), and each class used technology in order to accomplish their tasks (e.g., word processor and clipart for publishing articles, spreadsheets for inventory control, or graphics for the creation of African art in the museum). A very detailed description of how technology was infused in the learning activities is provided by Cave and Yekovich (2008).

One of the most important questions regarding an

innovative program is whether it is effective. In other words, was TRALE accomplishing its primary goal of improving student achievement? This issue is discussed in the next section of the paper.

Analysis of Student Achievement

Student Achievement in the Pilot Year

For the 2nd and 3rd grades, student growth was measured (i.e., from Year 1 to Year 2) by collecting data "within each student." "Within student" reporting eliminates spurious differences attributable to nuisance variables (such as overall differences in ability across classes) and provides a more stable indicator of change for each child over time. These analyses include grade equivalent scores (GES)"within students" because GES can demonstrate growth within each child in terms of a student's grade level year and month of achievement, and also because the school district reported student achievement using GES for each child. In second grade a high implementing TRALE teacher (whose level of implementation was measured by TRALE's Degree of Implementation Instrument) was compared to a non-project teacher in terms of growth from 1st grade to 2nd grade on the school district's standardized achievement test.

Second Grade

Table 1 displays children's average growth results in GES in each sub-test in the 2nd grade project classroom (general store) and a 2nd grade non-project classroom to indicate the number of years the children progressed.

A number of important results are immediately visible. First, the columns labeled "Growth" show a substantial positive effect for the project classroom. In reading, the gains in the TRALE classroom were enormous compared to the non-project classroom. In the vocabulary sub-test and language expression the gains were tenfold and in reading comprehension total the gain was threefold.

It is also remarkable that the TRALE classroom's 1st grade (pre-test) scores were lower than their non-project counterparts on the standardized achievement test, yet consistently higher on their 2nd grade post test. Thus, the TRALE implementation in the project classroom not only produced substantial growth, it also appeared to be particularly effective for the students with the lower 1st grade test scores.

Third Grade

Table 2 presents the standardized achievement test data at the end of the first year in GES for the 3rd grade TRALE (NewsRoom) and the 3rd grade non-project classroom.

Due to reliability problems with the pre-test data from Year 1 for this group of children, it was not possible to compute average growth for 3rd graders as it was done for 2nd graders. Nevertheless, the data in Table 2 showed overall superior performance for the students in the project classroom when compared to the non-project class. Particularly noteworthy was the TRALE students' performance in Language Mechanics, which showed a year increase. Thus, data showed consistent effects of improved performance and selectively large effects for the area naturally emphasized by the technology activities in the NewsRoom (e.g., using computers for editing and publishing stories).

In short, the evaluation of TRALE's pilot implementation was positive as the 2nd and 3rd grades showed positive

Standardized Achievement Subtests	General Store (n=15)			Non-Project (n=15)		
	1st	2nd	Growth	1st	2nd	Growth
Reading						
Vocabulary	1.25	1.98	.74	1.64	1.71	.07
Comprehension	1.37	2.37	1.01	1.46	1.82	.36
Total	1.33	2.16	.83	1.54	1.78	.24
Language						
Expression	1.16	1.86	.7	1.59	1.66	.07

*Growth is defined in number of years progressed (i.e., Grade Equivalent Score).

Table 1. Comparison between a TRALE Project Classroom and a Non-Project Classroom in Terms of Growth* from 1st to 2nd Grade on the School District's Standardized Achievement Test.

Standardized Achievement Subtests	NewsRoom (n=16)	Non- Project (n=20)
Reading		
Vocabulary	2.4	2.5
Comprehension	2.6	2.3
Total	2.5	2.4
Spelling	3.2	3.0
Language		
Mechanics	3.5	2.5
Expression	2.6	2.9
Total	2.9	2.7

*Growth is defined in number of years progressed (i.e., Grade Equivalent Score).

Table 2. Comparison of End-of-Year 1 Standardized Achievement Test GES for the 3rd Grade TRALE Project Classroom (NewsRoom) - with a 3rd Grade Non-Project Classroom.

benefits in language arts.

Student Achievement in the Second Year

The second year of the project was a transitional period in the district's schools. The adoption and introduction of the new *Houghton-Mifflin* reading series together with a new set of curriculum standards occurred simultaneously with the introduction of a new standardized test.

The new standardized achievement test was administered to children in grades 1 through 6. Most of the children at Target Elementary were tested in October and May. For the purposes of data analysis, the test-retest format was selected. Since repeated measurements were available on most children, growth or change "within each student" could be computed. This eliminated the need to worry about whether TRALE and non-project classrooms had students of equal ability. The state changed the format of reporting student achievement data from GES to Normal Curve Equivalent (NCE) scores that are percentile-like rankings. This format also permitted meaningful analyses because the percentages allowed for comparisons to the national norms. Using NCE scores, it was possible to compare growth from fall to spring; i.e., the degree to which a particular class's relative standing changed (i.e., did the class remain at its standing, or did it move up or down.)

Using the new standardized test, the state measured student achievement both at the beginning and the end of the school year. This test-retest format provided built-in measures of individual growth during a roughly 6-month period. Since the 2nd and 3rd grade classrooms (i.e., the general store and the newsroom) were in their second year of participation in TRALE, these two classrooms were believed to provide the best measure of TRALE's effectiveness in the absence of extraneous influences.

Second Grade. Tables 3 provides the average growth of students who worked in the general store, compared with a randomly selected class on the same grade level that did not participate in the TRALE project. In Table 3, the results from the 2nd grade general store compared with one non-project 2nd grade classroom are very encouraging.

Students in the store generally showed more growth than their control counterparts. This improvement was evident in Total Reading, Word Study Skills, and Reading Comprehension. The only measure that showed a reversal was Word Reading and that reversal was quite small.

Third Grade. The data for the Newsroom comparison, displayed in Table 4, are mixed. While students in the TRALE class showed an additional month of growth in Reading Comprehension (.81 versus .71 year), they showed substantially less growth in Word Reading (.63 versus 1.92) than the comparison group. The magnitude of the Word Reading difference carried over to also affect overall growth in reading (see the row labeled Total Reading). The superiority in Reading Comprehension by TRALE students is important and consistent with the idea- that the increased reading and editing associated with publishing the newspaper was responsible for this edge. Still, it was disappointing not to be able to more closely replicate the results of the pilot implementation.

Given the encouraging results of the pilot, the project staff had obviously hoped for more convincing results in the second year of TRALE's implementation. What happened

Standardized Achievement Test/Subtest	General Store (n=23)			Non-Project (n=21)		
	Fall	Spring	Growth	Fall	Spring	Growth
Total Reading	1.29	1.93	.64	1.21	1.76	.55
Word Study Skills	.89	1.70	.81	.85	1.43	.58
Word Reading	1.32	1.76	.44	1.19	1.67	.48
Reading Comprehension	1.46	2.19	.73	1.42	2.08	.66

*Growth is defined in number of years progressed (i.e., Grade Equivalent Scores).

Table 3. Comparison between the TRALE Project Classroom and a Non-Project Classroom in Terms of Growth* from the Beginning to the End of 2nd Grade on the State's Standardized Achievement Test, during the Second Year.

Standardized Achievement Test /Subtest	Newsroom (n=14, 19)			Non-Project (n=10, 17)		
	Fall	Spring	Growth	Fall	Spring	Growth
Total Reading	1.88	2.79	.91	1.59	2.84	1.25
Word Study Skills	1.48			1.17		
Word Reading	1.90	2.53	.63	1.49	3.41	1.92
Reading Comprehension	2.18	2.99	.81	1.96	2.67	.71

*Growth is defined in number of years progressed (i.e., Grade Equivalent Scores).

Table 4. Comparison between the TRALE Project Classroom and a Non-Project Classroom in Terms of Growth* from the Beginning to the End of 3rd Grade on the State's Standardized Achievement Test, during the Second Year.

to produce the modest effects? Two factors were assumed to be primarily responsible, namely a school system in extreme flux and the degree to which TRALE was actually implemented in the project classrooms. In the following paragraphs these factors are featured.

The change in state leadership, along with increased Federal intervention at all levels of the school district's functioning, produced a school system in extreme flux. The amount of uncertainty and misinformation abounded and this situation was only exacerbated by a constantly changing organizational infrastructure. This upheaval became noticeable early during the second year of TRALE's implementation and continued to worsen as the school year progressed. Throughout the year teachers were burdened with conflicting requirements regarding the use of the *Houghton-Mifflin* materials, the importance of the *Work Sampling/Continuous Progress* system, their ability to participate freely in the TRALE project and independently of the incoming *Houghton-Mifflin* curriculum, the importance of improving students' scores, and the criteria used to complete their annual performance evaluations. In short, the stresses within the school system largely spilled over into the daily functioning of the teachers within the classroom. Through the weekly meetings with the teachers and their weekly logs it was possible to document these difficulties. Unfortunately, it is not possible to partial out these effects and adjust the implementation and evaluation of TRALE accordingly. Instead these effects are used indirectly to explain TRALE's modest success.

As a result of the uncertainty under which the teachers operated, substantial variability in TRALE's implementation was observable across the five classrooms. In modest estimation, the success of the 2nd grade class and the mixed results of the 3rd grade class correspond to the degree to which TRALE was implemented in those classrooms. The 2nd grade teacher was the highest implementer and the 3rd grade teacher was lower. This difference in the degree of implementation was measured by an instrument called the TRALE DOI (The Degree of Implementation of the Technology-Rich Authentic Learning Environment).

In closing, the initial formative evaluation was encouraging and at the same time sobering. TRALE in the early childhood grades appeared to be an effective integration of technology and especially useful in getting young, urban children involved in learning.

Student Achievement in the Third Year

In the 3rd year of the project, data reports and analyses continued to utilize NCE scores to assess student achievement. 'Performance standards' (using four categories: 1/ below basic, 2/ basic, 3/ proficient, and 4/ advanced) were also added to describe children's academic performance. Reports focused on how many children moved out of the below basic category to higher levels; i.e., basic, proficient, and advanced. The

	TRALE			Non-Project 1			Non-Project 2		
Standardized Test Score Scale	Fall	Spring	Change	Fall	Spring	Change	Fall	Spring	Change
Total Reading in NCE	21.2	37.5	**+16.3**	29.1	37.4	*+8.3*	21.2	33.6	*+12.4*
Performance Standards in % of students in each category	bb b p 59 24 18	bb b p 44 31 25	bb b p **-15 +7 +7**	bb b p 38 38 25	bb b p 18 44 44	bb b p **-20 +6 +19**	bb b p 60 27 13	bb b p 53 41 6	bb b p **-7 13 -7**

*Note: Instruction is considered successful if (1) the Change number is *negative* in the below basic category from the fall to the spring semester, which means that the % of students decreased in the below basic category from the fall to the spring semester and (2) simultaneously if the Change number is *positive* in the basic and proficient categories from the fall to the spring semester, which means that the % of students increased in those categories.

Table 5. Comparison among the TRALE Project Classroom and the Non-Project Classrooms in Terms of (1) Average Amount of Change from the Beginning to the End of Second Grade on the State's Standardized Achievement Test Using Normal Curve Equivalents and (2) % of Students in Various Categories Using Performance Indicators, during the Third Year.

following paragraphs discuss the results for the specific grade levels.

Second Grade. The standardized achievement test results for the second grade classrooms are given in Table 5.

Again, the non-overlapping data from the fall to the spring semester are due to the different versions of the standardized test during the two test administrations. At the beginning of the year the project class appeared to perform on the same level (21st% tile in NCEs) as the Non-project 2 class. The Non-project 1 class started the year off at a higher rank (29th %tile in NCEs). In the spring, the TRALE class performed on the same level as the Non-project 1 class. This means that the TRALE class caught up with the Non-project 1 class, which began the school year with the highest rank on this grade level. Examining growth indicated in the Change box, the reader may see that the TRALE class outperformed both of the non-project classes. (TRALE=16.3, Non-project 1=8.3, and Non-project 2= 12.4).

At the bottom of Table 5 the performance standards indicate that the TRALE classroom was the second most successful to move the children from the below basic to the basic category. The Non-project 1 class did even a better job of moving children up. The Non-project 2 class did more poorly compared to the other two 2nd grades.

In sum, the second grade TRALE class showed increased performance in terms of moving up in the national sample in terms of NCE. This result is very encouraging for the TRALE project.

Third Grade. Table 6 presents the descriptive results for all three third grade classrooms. The reader should note again that all third grade classes were ranked very low in the national sample (TRALE 1=26.8 %tile, TRALE 2= 20.8 %tile, and the non-project class=10.1 %tile in terms of NCE) in the fall semester.

The data for the non-project class deserve discussion before proceeding with the third grade evaluation. Note that in the fall semester every child in this class was in the below basic category. In the spring, 95% of the children moved out of the below basic category, of which 23% moved to the basic, 59% to the proficient, and 14% to the advanced levels. Clearly these results are exceptional and warrant further investigation. If the practices in this classroom were as effective as these results imply, we need to document and export them to other classes within the school as soon as possible.

Prior to comparing the non-project class with the two TRALE classrooms, it is important to assume that the gains made by the children were real and lasting. Consequently, an analysis of the progress made by the students from this class on subsequent administrations of standardized tests was undertaken. Logically, one might expect that once students were proficient and advanced in their reading level, at a minimum they would continue to grow at an average rate, assuming they received reasonable reading instruction. Additional analyses involved looking at performance standards for the children who graduated from this classroom in the second year and those who graduated in the third. The May and October results of the standardized test given in

	TRALE 1			TRALE 2			Non-Project		
Standardized Test Score Scale	Fall	Spring	Change	Fall	Spring	Change	Fall	Spring	Change
Total Reading in NCE	26.8	30.0	3.2	20.8	27.8	7.0	10.1	60.4	50.3
Performance Standards in % of students in each category	bb b p 63 25 13	bb b p 58 25 17	bb b p **-5 0 4**	bb b p 83 17 0	bb b p 84 12 4	bb b p **1 -5 4**	bb bp 100 0 0	bb b p a 5 23 59 14	bb b p a **-95 23 59 14**

*Note: Instruction is considered successful if (1) the Change number is *negative* in the below basic category from the fall to the spring semester, which means that the % of students decreased in the below basic category from the fall to the spring semester and (2) simultaneously if the Change number is *positive* in the basic, proficient, and advanced categories from the fall to the spring semester, which means that the % of students increased in those categories.

Table 6. Comparison among the TRALE Project Classrooms and the Non-Project Classroom in Terms of (1) Average Amount of Change from the Beginning to the End of Third Grade on the State's Standardized Achievement Test Using Normal Curve Equivalents and (2) % of Students in Various Categories Using Performance Indicators, during the Third Year.

the same calendar year were compared (e.g., May of second year to October of third year) for each of the students. This comparison did not show that the students maintained their May standing in October. Thus comparisons of TRALE and non-project children was not warranted as a significant number of students regressed or declined. Consequently, it was impossible to complete a fair evaluation for the third grade TRALE classrooms. On further investigation, it came to be known that the classroom teacher in the non-project classroom became extremely concerned about her students' standing in terms of standardized tests as well as her position as a classroom teacher and resorted to unethical handling of the children's test data.

Since the third grade control group could not be used in the data analysis, only the two TRALE classes can be compared. If the project had been implemented throughout the whole year, it would have been possible to compare student achievement in a high implementer's and a low implementer's classes. However, this data analysis is not considered desirable as the project was implemented only during the last part of the school year.

In sum, student achievement data produced modest support for TRALE's effectiveness. In second grade, TRALE was effective in increasing student achievement. In third grade it was impossible to conduct a quantitative analysis due to the potential unreliability of the test results in the non-project class, so there are no hard data for TRALE's effectiveness or its ability to significantly increase children's achievement as measured by the state's standardized achievement test.

Other Factors Affecting TRALE

At the beginning of the third year TRALE's implementation showed more definite results. What are the factors that moderated the potentially powerful effects observed in the pilot? In the previous years at Target, the timely start of the implementation of TRALE always suffered due to unfavorable circumstances on the school or district levels. Due to the lack of or low level of program implementation, the potentially powerful effects of the program could not be observed. Though planned, TRALE teachers were not able to start the implementation of TRALE at the beginning of the school year due to four factors delineated below. These obstacles adversely affected the implementation of the program and thus its effectiveness.

In the second year it became very clear that TRALE was not sustainable as an independent, experimental curriculum module that was simply used voluntarily. The fact that TRALE was not recognized by the state or school-level administrators as a program requiring any type of support or autonomy to achieve its goals was the first major obstacle in the implementation of TRALE. Instead, TRALE was "tolerated" and "allowed" as long as it did not impinge on district-level or school-level mandates. Several examples attested to that, for instance,

- mandating the *Houghton-Mifflin* series and not enforcing its integration with the TRALE activities,
- the lack of any type of support for TRALE teachers, for example, providing planning periods during the day,
- providing no supplies for TRALE's implementation, such as textbooks, computer supplies, or community-related artifacts, and
- the introduction of a testing period in the middle of the literacy block that constantly interrupted the TRALE activities.

In the third year Target was mandated to adopt a school-wide reform program to provide the infrastructure in which TRALE was to be embedded. The school voted to adopt the *Community for Learning (CFL)* model, of which the Adaptive Learning Environments Model (ALEM) was a component (cf. Wang, 1992). ALEM is an integrated approach to classroom management and organization of the learning environment, and it emphasizes a classroom in which cognitive apprenticeships can flourish. TRALE came to be known as the instructional component of ALEM, and together these two components formed an integrated instructional practice to be implemented at Target. Because ALEM provided the classroom infrastructure for TRALE, the focus at Target turned to the successful implementation of the ALEM program first. Other schools interested in adopting TRALE

in the future may save considerable time and effort if they import TRALE only after ALEM is highly implemented.

The introduction of ALEM and the teacher training that took most of the year at Target in the third year was the second factor that postponed the implementation of TRALE. The teachers needed many months to create and put in place most of the components of ALEM. Thus the implementation of TRALE had to be put on hold. By the time ALEM was in place in the second half of the spring semester of the third year, there were only six weeks left to implement TRALE. This is a very short time for any program to show its effects.

The third major external factor that affected TRALE's effectiveness was the conditions of the state and the impact that those conditions had on Target directly and TRALE indirectly. The new leadership in the school district along with increased Federal intervention at all levels of the state's work produced a lot of instability. The amount of uncertainty, confusion, and frustration increased. The teachers faced conflicting demands described earlier regarding the Houghton-Mifflin materials and their participation in TRALE, the importance of increasing standardized test scores, and the criteria for their performance evaluation. In sum, the tensions within the school system impacted the daily functioning of the teachers, which they documented in their weekly journals and at meetings. Unfortunately, these confounding effects cannot be partialed out to adjust for the implementation of TRALE accordingly. Rather, TRALE's modest success is indirectly attributed to these factors.

As a result of (i) the uncertainty under which the teachers operated and (ii) the level of commitment required, substantial variability existed in TRALE's implementation across the classrooms. This variability in implementation is the fourth factor that impacted TRALE's success. In order to document this variability, TRALE's Degree of Implementation (TRALE DOI), which was created to assess program implementation in each class and across the classes, showed that the gain in student achievement largely corresponded to the teachers' degree of implementation of TRALE.

Conclusion

In sum, data on student achievement are encouraging. When TRALE was highly implemented, it appeared to be effective in increasing reading proficiency as it was shown in the second grade store. However, high implementation had to last throughout the school year in order for the program to show its effectiveness in every class. TRALE's moderate effects stem from the limited time TRALE was implemented at Target. The authors are hopeful that the implementation of TRALE in subsequent school years will not be hindered so that children can gain from the full instructional benefit of the program. Future studies will examine student achievement as a result of program participation in TRALE in Years 4 and 5.

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ABOUT THE AUTHORS

Dr. Yekovich is an Ordinary Professor of cognitive psychology at The Catholic University of America. He is interested in studying how technology can be infused in an authentic learning environment to increase young urban learners' learning.

Dr. Cave is an Assistant Professor of cognitive psychology and the Director of Teacher Education at The Catholic University of America. She is interested in how children's writing development can be fostered in a technology-rich authentic learning environment.

Dr. Walker Yekovich is a retired Associate Professor of cognitive psychology at The Catholic University of America. She is interested in authentic uses of technology in urban settings.