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A formative experiment investigating the use of multimedia book reviews to increase elementary students' independent reading

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Diverse methods have been employed to study the effects of computer-based literacy activities in classrooms. However, since the early 1980s, when computers first became available in classrooms, research has predominantly entailed conventional experiments comparing the effectiveness of instructional interventions with and without computers (Means et al., 1993). Nonetheless, literacy researchers have consistently argued that experimental studies alone cannot provide useful information about how computer-based activities might enhance literacy in schools (e.g., Bruce & Rubin, 1993; Dickinson, 1986; Mehan, 1989; Michaels & Bruce, 1989; Reinking & Bridwell-Bowles, 1991; Reinking & Pickle, 1993; Rubin & Bruce, 1990; Venezky, 1983). That view reflects a broader concern among many educational researchers who believe that new approaches to research are needed to address the complex factors affecting instruction and learning in classrooms (e.g., Eisenhart & Borko, 1993; Jackson, 1990; Smagorinsky, 1995).

A limitation of conventional experiments is that they do not typically focus on the many interacting variables that influence the effectiveness of computer-based interventions in schools, nor do they shed much light on how a particular computer-based activity might produce unique effects depending on how it is integrated into a particular educational environment. Instead, in conventional experiments researchers try to control the influence of most situational factors; they try to ensure that an intervention is implemented uniformly despite different circumstances; and they focus on postintervention outcomes instead of what happens while the intervention is implemented. In addition to limiting the variables and outcomes considered, these characteristics of conventional experiments may perpetuate a point of view that restricts the influence of technology in schools. As Emihovich and Wager (1992) stated,

> [computers] are perceived as add-ons to the educational process...this perception will not change until educators begin to realize that media or technology use in schools should be examined from a holistic cultural perspective. That is, the introduction of any new technology should be considered in relation to its effect on the school culture as a whole. (pp. 435–436)

The limitations of conventional experiments have been offset by qualitative and ethnographic studies examining how computer-based activities might affect literacy in classrooms (e.g., Dickinson, 1986; Friedman, 1990; Labbo, 1996; McGee, 1987; Mehan, 1989; Turner & Depinto, 1992; von Tetzchner, Rogne, & Lilleeng, 1997). Such studies typically document carefully what happens in classrooms when a computer-based application is introduced. However, typically they do not directly address two related questions that are particularly relevant to instruction: What factors add to or detract from an interven-

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Using the methodology of a formative experiment (Jacob, 1990), this study investigated how a computer-based instructional intervention (creating multimedia reviews of books) might be implemented to achieve a valued pedagogical goal in literacy instruction (increasing the amount and diversity of elementary students' independent reading). Consistent with formative experiments, the following questions were addressed: (a) What factors in the educational environment enhance or inhibit the intervention's effectiveness in achieving the pedagogical goal? (b) How can the intervention and its implementation be modified during the experiment to achieve more effectively the pedagogical goal? (c) What unanticipated positive or negative effects does the intervention produce? (d) Has the educational environment changed as a result of the intervention? Diverse quantitative and qualitative data were gathered during 2 academic years in 4 fourth-grade and 5 fifth-grade classrooms in 3 schools. Major findings include that the success of the intervention was related to the mediating effects of using technology, changes in the interactions among students and teachers, the administrative climate of a school, teachers' perceptions of their technological expertise, and students' engagement in relation to their reading ability. Also discussed are what unanticipated effects were observed and the extent to which the respective classroom environments were changed by the intervention

Un experimento formativo en el que se investiga el uso de revisiones multimedia de libros para promover la lectura independiente en estudiantes primarios

Mediante el uso de un experimento formativo (Jacob, 1990), este estudio investigó la forma en que una intervención pedagógica basada en la computadora (creando revisiones multimedia de libros) podría implementarse para alcanzar un objetivo pedagógico valioso en la enseñanza de la lectoescritura (aumentando la cantidad y diversidad de las lecturas independientes de estudiantes primarios). En coincidencia con los experimentos formativos, se formularon las siguientes preguntas: (a) ¿Qué factores del contexto educativo promueven o inhiben la efectividad de la intervención para lograr el objetivo pedagógico? (b) ¿Cómo pueden modificarse la intervención y su implementación durante el experimento para lograr más eficazmente el objetivo pedagógico? (c) ¿Qué efectos no anticipados positivos o negativos produce la intervención? (d) ¿Se ha modificado el contexto educativo como resultado de la intervención? Se recogieron diversos datos cuantitativos y cualitativos durante 2 años académicos en aulas de 4º y 5º grado en 3 escuelas. Los principales hallazgos fueron el éxito de la intervención y su relación con los efectos mediadores del uso de la tecnología, los cambios en las interacciones entre estudiantes y docentes, el clima administrativo de la escuela, las percepciones de los docentes acerca de su conocimiento tecnológico y el compromiso de los estudiantes en relación con su habilidad de lectura. También se discuten los efectos no anticipados que se observaron y el alcance de las modificaciones en los contextos escolares respectivos debidos a la intervención.

Ein formatives Experiment untersucht die Verwendung von Multimedia-Buchrezensionen zur Verbesserung des eigenständigen Lesens der Grundschüler

Durch Nutzung der Unterrichtsmethodik als ein formatives Experiment (Jacob, 1990) untersuchte diese Studie wie die durch Computer vermittelte Erteilung von Anweisungen (mittels Schaffung von Multimedia-Buchrezensionen) eingesetzt werden könnte, um ein bewertbares pädagogisches Ziel bei den Lese- und Schreibanweisungen (durch Steigerung von Menge und Mannigfaltigkeit des eigenständigen Lesens bei Grundschülern) zu erreichen. In Einklang mit formativen Experimenten wurden die folgenden Fragen angeschnitten: (a) Welche Faktoren im Unterrichtsbereich steigern oder hemmen die Effektivität der Intervention zur Erreichung des pädagogischen Zieles? (b) Wie kann die Intervention und ihre Durchsetzung im Verlauf des Experimentes verändert werden, um das pädagogische Ziel noch effektiver zu gestalten? (c) Welche nicht vorhergesehenen positiven oder negativen Effekte entstehen aus der Intervention? (d) Hat sich das Unterrichtsumfeld als Folge dieses Eingriffes verändert? Diverse quantitative und qualitative Daten wurden über 2 Unterrichtsjahre in Klassenräumen der 4ten und 5ten Klasse in 3 Schulen zusammengestellt. Als wesentliche Ergebnisse gelten, dass der Erfolg der Intervention in direkter Relation zu den effektiv vermittelnden Einflüssen der Technologieanwendung stand, sowie der Wechselwirkung in der gegenseitigen Beeinflussung unter Schülern und Lehrern, dem administrativen Klima der Schule, der seitens der Lehrer empfundenen Auffassung und Eigenbeurteilung ihrer technologischen Sachkenntnis, und das Schülerengagement in Relation zu ihren Leseleistungen. Ebenfalls werden die nicht vorhergesehenen oder erwarteten Effekte angesprochen und der Umfang, in welchem sich die jeweilige Klassentaumuawelten durch die Intervention wandelten.

オンライン書評を利用した小学生の自主読書の増加を調査する形成実験

これは、小学生の自主的な読書量を増やし、多様化を促すという読み書きの授業における重要な教育目的を達成するために、コンピューター（オンライン書評）を利用する授業が実践された様を調査した形成実験(Jacob,1999)である。形成実験の方法論に忠実に、以下の問題が扱われる。(a)上記の教育的目標を達成する際に、教育環境上のどのような要因によって、実験の効果は高められ、抑えられたか、(b)上記の教育的目標をより効果的に達成するべく、実験のなかで授業がどのように修正されていったか、(c)実験によって発見されたポジティヴな或いはネガティヴな効果とはどのようなものか、(d)実験の結果として、教育環境は変化したか。様々な量と質のデータが、3つの学校の、4年生の4クラスと5年生の5クラスで、2年間にわたって集められた。教育の成功が、コンピューター・テクノロジーを用いる教育効果、生徒と教師の相互関係の変化、学校の管理環境、コンピューター・テクノロジーの専門知識に対する教師の理解力、及び読解力の有無による生徒の授業への積極性と関わっていることなどが示される。また、実験によって、どのような予期せぬ効果が発見されたか、各クラスの環境がどの程度変化したかが論じられる。

Une expérience didactique sur l'utilisation des revues de livres multimédia afin d'améliorer la lecture autonome d'élèves d'école élémentaire

En utilisant une méthode d'expérimentation didactique (Jacob, 1990), cette recherche a examiné comment une intervention éducative basée sur ordinateur (créer des revues de livres multimédia) peut être mise en place pour atteindre un objectif pédagogiquement valorisé dans l'enseignement de la littératie (augmenter la quantité et la variété des lectures autonomes d'élèves d'école élémentaire). On a posé les questions suivantes, correspondant à une expérimentation didactique : a) Quels facteurs de l'environnement éducatif améliorent ou inhibent l'efficacité de l'intervention au regard de l'objectif pédagogique ? b) Comment l'intervention et sa mise en œuvre peuvent être modifiées en cours d'expérience pour atteindre plus efficacement l'objectif pédagogique ? c) Quels effets inattendus, positifs ou négatifs, produit l'intervention ? d) L'environnement éducatif est-il transformé à la suite de l'intervention ? Diverses données quantitatives et qualitatives ont été rassemblées pendant deux années scolaires dans 4 classes de quatrième année et 5 classes de cinquième année de trois écoles. Les principaux résultats indiquent que le succès de l'intervention est lié aux mécanismes de l'utilisation de la technologie, des changements dans les relations maître-élèves, au climat administratif de l'école, à la perception qu'ont les maîtres de leur compétence technologique, et à l'engagement des élèves en rapport avec leur niveau en lecture. On discute également des effets inattendus qui ont été observés et du degré de changement respectif des environnements éducatifs consécutivement à l'intervention.

tion's success in accomplishing a valued pedagogical goal? More important, how might the intervention be adapted in response to those factors to better accomplish that goal?

In the present investigation we addressed these relevant questions and the limitations of the methodologies of previous research by adopting an approach to classroom research that has been referred to as a formative experiment (Jacob, 1992; Newman, 1990). Formative experiments, as we will describe more fully in a subsequent section, investigate how instructional interventions can be adapted in response to factors that enhance or inhibit their effectiveness in achieving a pedagogical goal. Furthermore, formative experiments aim to reveal a wide range of interacting factors and events that influence an intervention's effectiveness and its unanticipated consequences.

The instructional intervention reported here involved fourth- and fifth-grade students and their teachers in creating multimedia book reviews related to their independent reading. We employed a formative experiment to investigate how we might engage elementary school students and their teachers in creating multimedia book reviews with the goal of increasing the amount and diversity of students' independent reading. Our study encompassed nine classrooms in three schools during 2 academic years.

Formative experiments may be especially applicable to conducting classroom research aimed at investigating computer-based interventions because the expected advantages of such interventions have been difficult to achieve (Newman, 1990). On the one hand, it is clear that much of the interest in educational uses of computers has been related to the belief that they have strong potential to transform positively the standard modes of teaching and learning in schools (e.g., Cuban, 1986; International Society for Technology in Education, 1998; Lemke, 1998; Leu, 2000; Newman, 1990; Papert, 1993; Sheingold, 1991). On the other hand, it is also clear that simply introducing innovative, powerful, computer-based activities into a classroom is often not enough to realize this potential (Means, 1994; Reinking, Labbo, & McKenna, in press). Furthermore, there has been a tendency to focus inordinately on acquiring technology without a concomitant attention to establishing clear pedagogical goals that its acquisition will promote (Labbo & Reinking, 1999; Reeves, 1992) and a tendency to use technology in perfunctory ways that are not meaningfully integrated into instruction (U.S. Congress, 1995).

Indeed, Papert (1993) has argued that schools often intentionally or unintentionally subvert any possibility that new technologies will transform existing instructional practice. Even under the best of circumstances, integrating technology into instruction requires that teachers and administrators deal with a variety of technological, logistical, curricular, financial, and other obstacles not typically associated with other interventions (Gustafson, 1993; Hadley & Sheingold, 1993). Even when computer-based activities are specifically designed to transform teaching and learning, they may be implemented in a way that maintains the status quo. A well-documented example is the work of Bruce and his colleagues (Bruce & Peyton, 1990; Bruce & Rubin, 1993; Michaels & Bruce, 1989; cf. Miller & Olson, 1994) who have conducted extensive investigations of a computer-based intervention called QUILL, which was designed and implemented with the goal of increasing authentic reading and writing activities in middle-grade classrooms. However, they found that the new technology-based activity did not transform instruction. Instead, it was integrated into established patterns of instruction and social organization.

On the other hand, some studies indicate that new technologies can be integrated into instruction in ways that positively transform instruction and that promote the goals of literacy instruction (e.g., Fawcett & Snyder, 1998; Garner & Gillingham, 1996; Myers, Hammett, & McKillop, 1998). However, these studies provide few clues about what factors may be associated with successful or unsuccessful implementation of new technologies to enhance literacy instruction or how interventions might be implemented under what conditions to achieve particular goals. Pursuing such knowledge is increasingly important given the growing availability and use of technology in schools and the movement of digital technologies into the mainstream of daily literate activity (Flood & Lapp, 1995; Leu, 2000; Reinking, 1995, 1998).

Determining what factors enhance or inhibit a classroom intervention's effectiveness in achieving a particular pedagogical goal and determining how the intervention or its implementation might be modified to better achieve that goal are central to formative experiments. Thus, we believe that formative experiments not only fill a methodological gap in the research, but also are especially well matched to studying how new technologies can be integrated into literacy instruction. However, formative experiments have not been widely used in educational research; they have not been fully explicated as a research methodology; and they have been conceptualized somewhat differently by different researchers (cf., Jiménez, 1997; Moll & Diaz, 1987; Neuman, 1999; Reinking & Watkins, 1998). Thus, we provide here a brief introduction to formative experiments and how we have conceptualized them in relation to the current study.

According to Jacob (1992), formative experiments originated among neo-Vygotskian scholars who saw experimental and naturalistic designs as limited because

those designs investigated the *current* forms and content of schooling, not what *could* be. Formative experiments are related to but not yet clearly distinguishable from approaches to research such as situated evaluation (Bruce & Rubin, 1993), design experiments (Brown, 1992), formative evaluation (Flagg, 1990), rapid prototyping (Tripp & Bichelmeyer, 1990), and perhaps even to the use of pilot studies in conventional experiments. However, some distinctions can be made. For example, formative experiments differ from formative evaluation in that they are more closely connected to testing existing theory because they focus on the goals of the actors (i.e., students and teachers) than upon outcomes alone. Likewise, they differ from pilot studies in that they focus on achieving a predetermined goal rather than studying possible outcomes.

Our own conception of formative experiments has been influenced primarily by Newman's (1990) work, partly because he explicated formative experiments in relation to how technology might transform an instructional environment. He described a formative experiment as follows: "In a formative experiment, the researcher sets a pedagogical goal and finds out what it takes in terms of materials, organization, or changes in [a technology-based intervention] to reach the goal" (p. 10). Nonetheless, we have found it necessary and useful to create a more specific methodological framework for designing and conducting a formative experiment. The following six questions, which we believe are consistent with the roots of formative experiments in general and Newman's work in particular, compose our framework (see Baumann, Dillon, Shockley, Alvermann, & Reinking, 1996, for an explanation of an earlier version of this framework):

1. What is the pedagogical goal of the experiment, and what pedagogical theory establishes its value?

2. What is an instructional intervention that has potential to achieve the identified pedagogical goal?

3. As the intervention is implemented, what factors enhance or inhibit its effectiveness in achieving the pedagogical goal?

4. How can the intervention and its implementation be modified to achieve more effectively the pedagogical goal?

5. Has the instructional environment changed as a result of the intervention?

6. What unanticipated positive or negative effects does the intervention produce?

The subsequent two sections address questions 1 and 2; that is, first we identify our pedagogical goal and justify its value, and then we identify the instructional intervention explaining why it has potential to achieve the pedagogical goal. Following a section describing our method and methodology, we present data pertaining to implementing the intervention effectively (questions 3 and 4). Finally, we discuss questions 5 and 6 in separate sections, which are followed by a general discussion.

Our pedagogical goal and its value

Our pedagogical goal was to increase the amount and diversity of students' independent reading. In addition to voluntary reading being a long-standing, widely accepted, and intuitively valued instructional goal in literacy instruction, theory and research have reinforced its centrality as a powerful means to increase students' reading competency and to engage them in the joys of reading (Morrow, 1991). For example, Stanovich (1986) has argued that differences in reading achievement are due in large measure to differences in the amount of children's reading. Data from the National Assessment of Educational Progress (NAEP) have long documented strong positive correlations between reading out of school and reading achievement (see Foertsch, 1992). Similarly, there is long-standing evidence that valued correlates of reading achievement such as vocabulary knowledge are also related to how much children read (see Freebody & Anderson, 1983). Independent reading has also been a defining attribute of engaged reading (Alvermann & Guthrie, 1993). Increasing children's interest in reading independently is also identified consistently as deserving high priority for research among teachers and school administrators (e.g., O'Flahavan et al., 1992).

Despite the well-established view that frequent independent reading is an important component of literacy achievement, data have consistently shown that many children do not frequently read independently. For example, Anderson, Wilson, and Fielding (1988) found that reading ranked well behind other outside-school activities such as watching television and talking on the telephone. NAEP data have consistently documented decreases in the amount of students' independent reading (Foertsch, 1992). Specifically, those data document decreases in library use and in reading for fun, which have been accompanied by an increase in the percentage of students reporting that they read only fiction or only nonfiction and that they tend to read a single author. There is also strong evidence from a national investigation that attitudes toward recreational reading steadily decrease as children move from first to sixth grade (McKenna, Kear, & Ellsworth, 1995). Thus, increasing independent reading

can readily be justified as a valued and important pedagogical goal by virtue of its well-documented role in influencing reading achievement and the clear evidence that many students do relatively little of it.

Instructional intervention

An instructional intervention investigated in a formative experiment may be well established in the literature, or it may be designed specifically by the investigator to address a particular pedagogical goal (Baumann et al., 1996). The instructional intervention in the present investigation falls within the latter category. In either case, but especially in the latter, an explicit rationale is needed for believing that the intervention may indeed promote the pedagogical goal. In this section we provide a rationale and description of the intervention.

Rationale for the intervention

Our rationale for using multimedia book reviews to increase the amount and diversity of independent reading was based on our speculation that it might be a useful alternative to the ubiquitous, yet widely criticized, conventional book report and its many variations in classrooms (see Soter, 1994). We believed that creating multimedia book reviews would reframe many aspects of the conventional book report, thus addressing its potential limitations and encouraging more personal engagement in independent reading (Alvermann & Guthrie, 1993).

There is long-standing evidence that students dislike writing book reports (Carlsen & Sherrill, 1988; Krieger, 1991/1992), and that this dislike undermines some of its intended purposes, for example by encouraging students to read less (i.e., shorter books) and more narrowly (by avoiding genres and topics that may prove unappealing; see Spiegel, 1981). The dislike of the typical required book report, both by students and by many authorities on literacy instruction, is grounded in the long-standing awareness that it represents writing and responding to literature in ways that require low personal involvement, thus discouraging engagement and risk taking (e.g., Glassner, 1996; Kirby & Kirby, 1985).

Creating multimedia book reviews, on the other hand, may positively reframe several aspects of the required book report. For example, unlike book reports that are often written only for the teacher, multimedia book reviews as digital documents naturally lend themselves to being shared by a larger audience that might include other students, parents, or even the World Wide Web. In fact, there is much research to suggest that one of the clear advantages of digital reading and writing is that it engages students positively in meaningful communicative experiences (Beach & Lundell, 1998; Bruce & Rubin, 1993; Garner & Gillingham, 1996, 1998; Myers et al., 1998; Turner & Depinto, 1992).

Another important aspect of our rationale for investigating multimedia book reviews is that they are conceptually related to book reports. That is, multimedia book reviews might be conceived as a type of book report. That conceptual relation may be important given previous findings that computer-based activities may not substantially transform instruction if they do not readily mesh with existing instructional activities and goals (Bruce & Peyton, 1990; Bruce & Rubin, 1993; Michaels & Bruce, 1989; cf. Miller & Olson, 1994). It has been argued that transformation is more likely if computer-based instructional interventions are first assimilated into existing structures and goals (Newman, 1990; Reinking, Labbo, & McKenna, in press). Nonetheless, we believe that the instructional potential of multimedia book reviews is much richer and ultimately more conducive to transformation. That belief and the often negative connotations of the term *book report* led us to adopt the alternative term *book review.*

Overview of the intervention and computer materials

Consistent with formative experiments, the intervention and its implementation changed during this investigation. However, in this section we focus on describing the final version of the computer-based intervention, although we highlight a few modifications that were made in response to practical and pedagogical circumstances during this experiment.

Like a conventional book report, multimedia book reviews are completed by students after they read a book they have selected to read independently. Unlike a conventional book report, multimedia book reviews are created with the aid of a computer, which allows graphics and sound to accompany textual information. Also unlike book reports, multimedia book reviews can be compiled into a searchable database available to students, teachers, parents, and others. We planned that the database would be available in an easily accessible location such as a school's media center. Doing so, we reasoned, would create a meaningful purpose and a concrete audience for students' work and would provide an appealing mechanism for students to become aware of one another's reading and to find books they too might like to read, which might in turn stimulate more reading.

To create multimedia book reviews we taught teachers and students to use HyperCard (Version 2.1), which at the time of this study was a popular and relatively powerful yet easy-to-use authoring system for creating nonlinear programs and presentations on the Macintosh computer. The depth to which we acquainted

teachers and students with HyperCard varied systematically depending on the circumstances of the school and classroom. However, all participants learned to use the rudimentary tools of HyperCard programs referred to as *stacks* that are made up of *cards* (screens) linked by clicking on *buttons*. All participants could enter text, graphics, and audio into the HyperCard-based multimedia book reviews.

One dilemma we faced in designing and implementing the intervention was how to balance the need to standardize a book review format, which would allow the reviews to be searched in the database, and our desire to allow students freedom to exercise creativity and individuality in response to their reading, which we believed would enhance students' engagement and, thus, the potential for increasing independent reading. Discovering that dilemma and its implications, and exploring ways of contending with it during an ongoing investigation, illustrate a methodological advantage of formative experiments. That is, for formative experiments, such dilemmas create opportunities for understanding and for adaptation.

Briefly, our solution was first to invite teachers and students to participate in the design of a standard book review interface, which is consistent with an approach used and advocated by Leu et al. (1998). The final design based on their input is made up of the two screens, or cards, we refer to collectively as the *review template* (see Figure 1a–b). The card shown in Figure 1a is a main menu showing the books a student has read. Additional menu cards can be added if a student wishes to add more books. Clicking on one of the book icons provides access to a student's review (Figure 1b), which includes several searchable text fields where students enter information about a book they have read. The text fields scroll so that students can enter an unlimited amount of text within each field.

Figure 1a An example of the main menu card

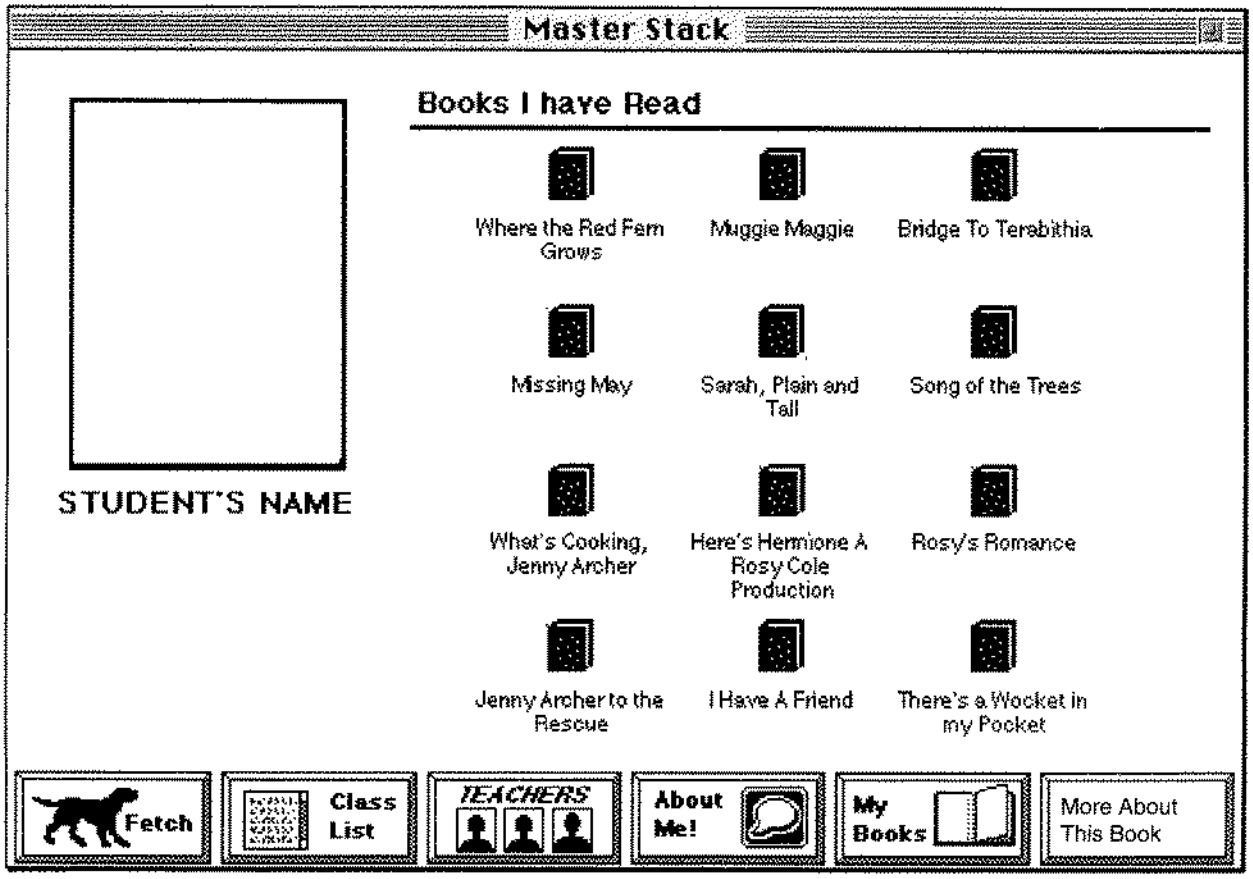
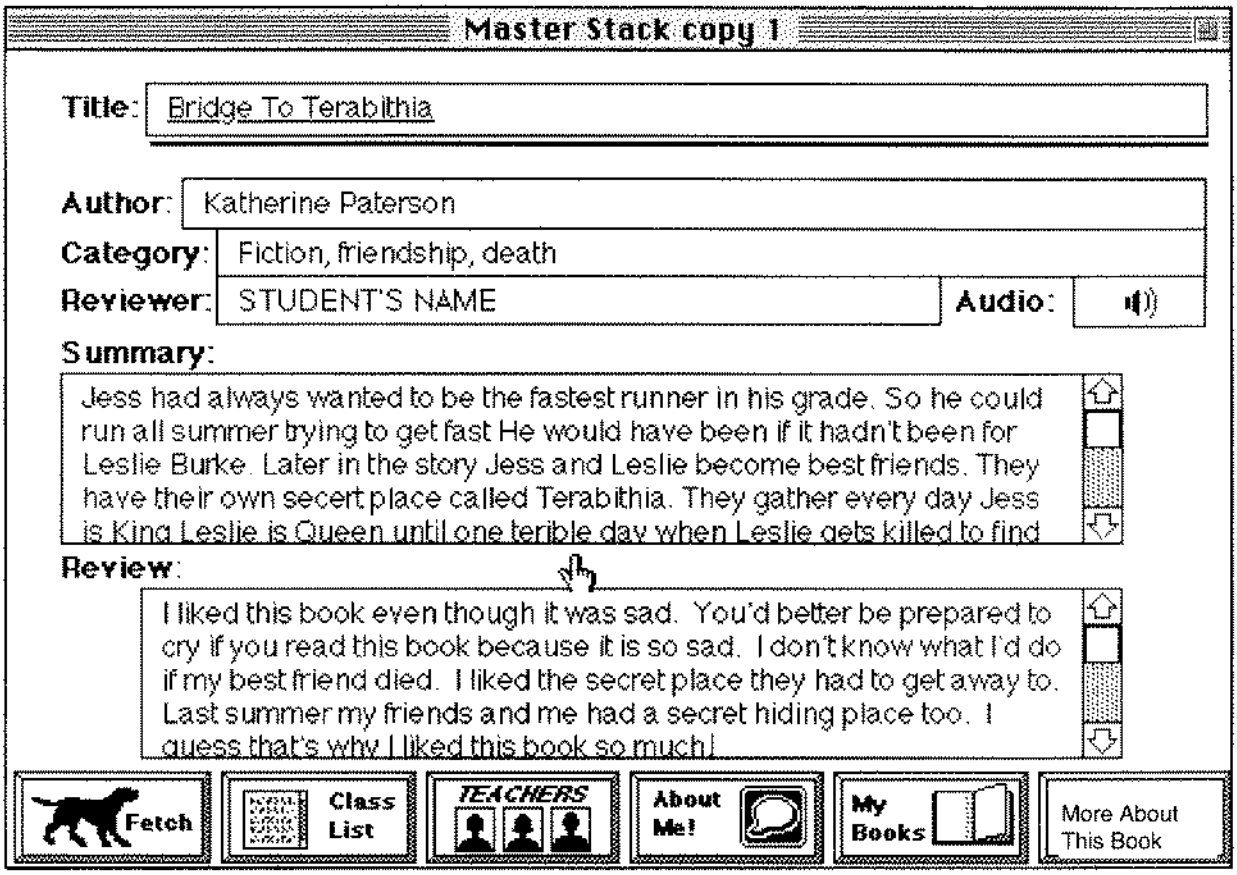


Figure 1b An example of a review card



However, to encourage creativity and ownership, we also created nonsearchable sections of the template where students could individualize their reviews. These sections included an *Audio* button that played a student's recorded sound effects or comments about a book, an *About Me!* button linked to a card that enabled students to enter autobiographical information, and a *More About This Book* button linked to blank cards where students could expand upon the review template (see Figure 1b). For example, on these additional cards many students chose to include pictures from clip art files, often modified or supplemented by their own artwork created with online drawing tools, additional information about authors or characters, and so forth. The remaining buttons at the bottom of the card in Figure 1b enable a user to return to the menu screen (*My Books* button), to access a list of teachers and the members of their respective classes (*Teachers* and *Class List* buttons), and to search the entire database (*Fetch* button).

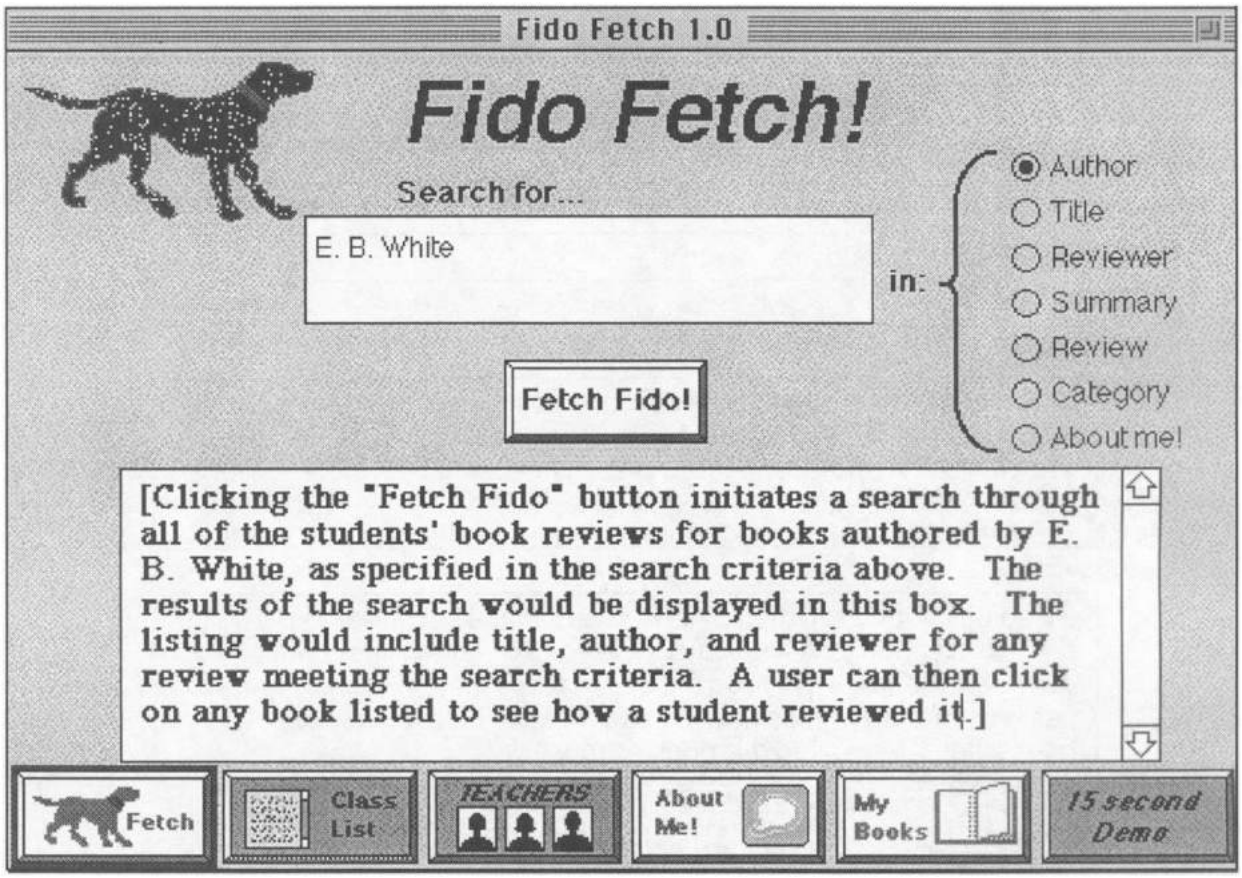
Users of the multimedia book review HyperCard stack could explore its contents in two ways. First, they could choose to access a particular teacher's class by clicking on a picture of that teacher (a menu screen not shown), which would take them to a class list. Clicking on the name of a particular student would take them to that student's menu screen showing the books that have been read and reviewed. A second option would be to use *Fido Fetch!*, our name for the search engine created to search for books by various criteria such as title and author (see Figure 2).

Method and methodology

Research sites and participants

This study was conducted in two elementary schools during one school year and in a third elementary school during the subsequent school year. The schools

Figure 2 Screen from which database of multimedia book reviews could be searched



were selected from among six schools contacted that had expressed an interest in the project and that had or were willing to purchase the minimal hardware needed to implement the intervention. The final selection of schools was based on proximity, equipment and facilities, initial enthusiasm for and commitment to the project, and student populations. A summary of the research sites and participants is provided in Table 1.

Of the two schools that participated during the first school year, Collins School (all names of schools, teachers, and students are pseudonyms) was located in a small town within commuting distance of a large metropolitan area. The school was relatively large with three or four classrooms of approximately 30 students at each grade level, K–5. Students and teachers reflected the community's homogenous population consisting of predominantly European American, middle and upper middle class families, many of whom commuted to work in the nearby large metropolitan area. At Collins School we implemented the intervention in two fourth-grade classes taught by Ms. Andrews and Ms. Broward. Ms. Andrews was beginning her third year of teaching while Ms. Broward had many years experience and was nearing retirement. They taught in adjacent classrooms and had collaborated on various activities prior to this project.

Formative experiments do not require comparisons among alternative interventions or control classrooms as in a conventional experiment. However, to enrich our data and understanding, we chose to gather some data in 2 comparison classrooms (one fourth- and one fifth-grade classroom) at Collins School. Teachers in those classes had been using and continued to use a commercial computer program designed to increase the amount and diversity of students' independent reading. From observing in these classrooms early in the school year, we determined that they were similar to Ms. Broward's and Ms. Andrew's classrooms. However, instead of creating multimedia book reviews, students' factual knowledge of books they had read was tested through multiple-choice questions administered at a classroom computer. Students

Table 1 Summary of research sites and participants

Schools (year)	Teachers (grade/role)	Students/community	Configuration of computers
Collins (1)	Ms. Andrews (fourth) Ms. Broward (fourth) Comparison teacher (fourth) Comparison teacher (fifth)	Predominantly European American small town near large metropolitan area	1 Macintosh computer in each classroom, shared scanner
Hartwig (1)	Ms. Burton (fifth) Ms. Palmer (fifth) Ms. Pearson (fifth) Ms. Page (Chapter 1)	European American and African American (15%), rural/agricultural, mix of blue-collar and professional families	Computer lab with 12 Macintosh computers
Borders (2)	Ms. Morris (fourth) Ms. Sievers (fifth) Ms. Ellers (Chapter 1)	European American and African American (15%), rural/agricultural, mix of blue-collar and professional families	Resource room for Chapter 1 students with 10 Macintosh computers

were awarded points based on their score, and they earned various rewards based on the total number of points they received during a grading period.

Hartwig School, the second school in which we worked during the first year, was located in a rural area, although students came from blue-collar and professional homes in a nearby small town as well as from agricultural areas. Approximately 15% of the students at Hartwig were African American, and the remainder were predominantly European American. The school had two or three classrooms of 25–30 students at each grade level, K–5. We worked with 3 fifth-grade classes taught respectively by Ms. Burton, Ms. Palmer, and Ms. Pearson. Ms. Page, a Chapter 1 teacher who routinely assisted in all three classes, also often assisted in implementing the intervention. All three teachers and Ms. Page had been teaching more than 10 years (at least 4 at Hartwig), and they frequently worked closely as a team.

During the second year of the project, we worked at Borders School. It was also a rural school in the same district as Hartwig School, and it had a similar student population. At Borders School we worked with one fifth-grade class (Ms. Sievers), one fourth-grade class (Ms. Morris), and a Chapter 1 teacher (Ms. Ellers) who also managed the computer lab and who had the primary responsibility for implementing the intervention with both classes. All of the teachers had more than 5 years teaching experience. Ms. Morris and Ms. Ellers had been at Borders School for at least 5 years, and Ms. Sievers arrived a month after the beginning of the school year to replace a teacher who resigned suddenly.

Hartwig and Borders schools each had a small computer lab with 12 and 10 Macintosh computers, respectively. Both schools had several printers and access to a color scanner for digitizing pictures. Collins School had a computer lab with outdated computers, but two Macintosh computers and a scanner were purchased to be shared by the two classes involved in the project. During the first year of the project, we were interested in discovering the logistical and pedagogical implications of implementing the intervention in a computer lab setting where students worked for approximately 1–2 hours a week when compared to classrooms in which a single computer was available all day. These two alternatives represent typical patterns of availability in elementary schools (Becker, 1990, 1992). Likewise, the varying numbers and availability of computers necessitated that we also vary the way the project was implemented. For example, at Collins School students were more dependent on teachers, parent volunteers, and members of the research team to assist them with HyperCard, because with only a single computer it was not feasible to provide activities that would allow them to become proficient in using HyperCard independently.

All classrooms were self-contained for most of the day except for subjects such as art, physical education, and band. A relatively small percentage of the students in each classroom left periodically for special instruction in the Chapter 1 or gifted programs. A commercial basal reading series figured prominently in reading instruction. Although Ms. Andrews and Ms. Broward at Collins School described themselves as having a whole language orientation, we did not observe their practices to deviate greatly from the other teachers who used basal readers extensively. Prior to their involvement in this experiment, all of the teachers implemented activities aimed at encouraging independent reading. Such activities included requiring students to write conventional book reports, reading

aloud sections of books that they thought students might want to read, and putting up bulletin boards showing the number of books read by each student in the class. For the most part the teachers made books available for independent reading through a classroom library rather than through regular trips to the school library.

The composition of the university research team varied during the course of the project but included the principal investigator, three consultants (a university-based instructional technologist, an expert on qualitative research methods, and an elementary school teacher not involved in implementing the intervention), and several graduate students who assisted with various aspects of the project at different stages. We considered the classroom teachers with whom we worked to be integral members of our research team. Consistent with other formative experiments we continually sought their interpretations of what was occurring in their classrooms relative to the experiment, and we solicited their suggestions for modifying the intervention. Members of the university research team met regularly with the teachers to discuss mutual observations of what was occurring and to plan future strategies and modifications. Teachers also kept written logs of their observations, which were discussed periodically with a university researcher.

Nonetheless, we do not consider this formative experiment to be an example of collaborative research (Allen, Buchanan, Edelsky, & Norton, 1992; Anders, 1996; Jervis, Carr, Lockhart, & Rogers, 1996). We did not involve the teachers formally in analyzing data. Neither did we involve them directly in preparing this report, with the exception that an earlier draft was sent to each teacher-participant and school principal requesting suggestions and concerns that might be addressed through revision or through the inclusion of a rejoinder to a final report.

As determined through a semistructured interview, all of the teachers had some background with computers in their teaching, although the amount and type of that experience varied. By observing their classrooms and daily routines before the multimedia book review activity was introduced, we found that all of the teachers were actively using the computer in conjunction with their teaching activities but they did so in ways that were largely perfunctory and not fully integrated into their instructional program. For example, the following comment was typical: "I use it [the computer] mostly for when they finish their work and for enrichment type [activities]." The teachers were all enthusiastic about discovering more ways to use the computer in their instruction, which was a criterion for choosing to work with them in this project, but they all acknowledged some degree of trepidation about technology, which they felt was typical of their peers. Beyond these general similarities, there were many important differences among teachers, students, and classrooms that are relevant and that will be discussed in subsequent sections.

Procedure

This formative experiment proceeded through several phases with minor variations at each school. During the months prior to the introduction of the intervention in the fall, representatives of the university research team met with teachers, the school principal, and district office personnel to discuss the project, roles and expectations for participants, needed hardware, and other relevant issues. Also during this time, teachers, parent volunteers, and teacher aides met with the university research team to receive training in HyperCard, to hear our explanation of formative experiments, and to discuss multimedia book reviews and how they might be implemented in their respective classrooms and schools beginning in the fall.

During approximately the first 6 weeks of the school year, we gathered qualitative data to gain a thorough understanding of the students, teachers, classrooms, and schools. Through observational field notes and interviews with students and teachers we were able to determine that most students in all of the classrooms engaged in some independent reading at least occasionally during school hours, although in all classrooms there were at least a few students who were never observed to read independently without a teacher's explicit encouragement or insistence. Focus group discussions revealed evidence of out-of-school reading as well. For example, most students knew details about the local public library, and they reported reading at least occasionally at home.

Also during that period, we gathered quantitative data to establish a baseline for comparing the amount and diversity of students' independent reading before and after the intervention was introduced. Teachers administered the Elementary Reading Attitude Survey (ERAS; McKenna & Kear, 1990), a standardized instrument designed to measure students' attitudes toward reading in and out of school, which we presumed to be related to independent reading. Teachers also administered a student questionnaire designed by the university research team to determine primarily the diversity of students' reading (Choosing Things to Read questionnaire; see Appendix A). Teachers also sent home a questionnaire designed by the university researchers to determine parents' perceptions of students' independent reading (see Appendix B).

The quantitative data were consistent with the qualitative data in suggesting that overall the amount and diversity of students' independent reading was average or

somewhat above average, although there was some variation across classrooms. For example, the mean raw scores on the ERAS indicated that students had relatively positive attitudes about in-school and out-of-school reading (see Table 2). In all but two of the classes (Ms. Andrews at Collins School and Ms. Sievers at Borders School) the mean raw scores were above the 50th percentile. Likewise, data from the parents' questionnaire indicated moderate levels of independent reading outside of school (see Table 3, range of reading) with mean values for each class ranging from 2.73 to 3.15 on a 5-point Likert scale.

After baseline data were collected, students were introduced to the concept of multimedia book reviews in a presentation by the university research team (in year 1) or by their teacher (in year 2). At Hartwig and Borders schools students were then taught the following HyperCard skills: using the drawing tools, copying and pasting graphics, creating buttons and text fields, and linking cards. At Collins School, where only a single computer was available in each classroom, students' knowledge of HyperCard was necessarily more limited, which allowed us to compare the intervention's effects under typical variations in the availability of computers in schools. Another difference was that at Hartwig School during year 1, a graduate student led approximately 10 weekly lessons designed to familiarize students with HyperCard. Consistent with formative experiments, analysis of these lessons led to the development of lessons that were made available to teachers at Borders School in year 2, where the teachers taught the lessons to students (see Reinking & Bonham, 1997). Doing so allowed us to determine if teachers with relatively little background in using computers and with no knowledge of HyperCard could, with minimal instruction and support, familiarize their students with HyperCard.

In approximately January of both school years students began to create their multimedia book reviews using the review template. Students at Collins School, because they had not been taught all of the skills necessary to use HyperCard, were limited to entering information into the common review template. Students at Hartwig and Borders, on the other hand, had the skills necessary to go beyond the template (the *More About This Book* button; see Figure 1b).

The next phase of the project involved compiling students' book reviews into a database to be made available for use in each school's media center. Several factors

Table 2 Means and standard deviations for pre- and postexperimental raw scores on subscales of the Elementary Reading Attitude Survey (ERAS)

	Recreational reading			Academic reading			Total		
School/teacher	Pre	Gain/loss[a]	Post	Pre	Gain/loss[a]	Post	Pre	Gain/loss[a]	Post
Collins School									
Andrews (n = 25)	29.	.96	30.32	23.08	.00	23.08	52.44	.96	53.40
	(5.37)		(4.72)	(6.27)		(5.33)	(10.28)		(8.49)
Broward (n = 21)	29.74	(.50)	29.24	29.19	(5.00)**	24.19	58.93	(5.50)**	53.43
	(5.40)		(4.63)	(6.19)		(4.17)	(10.74)		(7.43)
Hartwig School									
Burton (n = 16)	29.00	.25	29.25	26.88	1.13	28.00	55.88	1.37	57.25
	(6.61)		(4.95)	(8.40)		(4.98)	(14.15)		(8.67)
Palmer (n = 21)	29.76	(.14)	29.62	25.24	3.62*	28.86	55.00	3.48*	58.48
	(5.50)		(6.40)	(4.58)		(6.47)	(8.92)		(10.87)
Pearson (n = 20)	31.55	(2.05)*	33.60	28.05	(2.95)	31.00	59.60	5.00*	64.60
	(3.35)		(5.19)	(5.19)		(3.85)	(6.58)		(7.69)
Borders School									
Morris (n = 26)	27.33	(1.91)	25.43	25.50	(2.52)	23.25	52.83	(4.15)	48.68
	(7.97)		(10.07)	(7.29)		(8.23)	(14.44)		(17.33)
Sievers (n = 20)	27.00	1.15	28.15	24.96	.32	25.28	51.96	1.47	54.43
	(5.06)		(6.96)	(5.59)		(6.69)	(8.96)		(12.83)
Comparison classes									
Teacher 1 (n = 18)	30.50	(2.06)	28.44	29.06	(8.34)**	20.72	59.56	10.40	49.16
	(4.78)		(4.62)	(5.89)		(5.04)	(9.03)		(9.17)
Teacher 2 (n = 22)	31.09	(3.73)**	27.36	27.86	(5.04)*	22.82	58.95	(8.77)**	50.18
	(6.38)		(6.92)	(7.37)		(5.80)	(12.68)		(11.35)

[a]Δ=gain(loss)
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 3 Means and standard deviations for variables on pre- and postexperimental parent questionnaire

	Library card possession			Trips to library			Books checked out			Change in interest	Change in amount	Reading for enjoyment		
School/teacher	Pre	Gain/loss[b]	Post	Pre	Gain/loss[b]	Post	Pre	Gain/loss[b]	Post	Post	Post	Pre	Gain/loss[b]	Post
Collins School														
Andrews (n = 11)	1.73 (.47)	.27*	2.00 (.05)	1.80 (2.10)	.00	1.80 (.92)	1.09 (.30)	.18	1.27 (.47)	2.46 (1.04)	2.55 (1.13)	1.82 (1.08)	.00	1.82 (1.08)
Broward (n = 14)	1.36 (.47)	.43**	1.79 (.51)	1.29 (.42)	.89*	2.18 (.33)	1.21 (.73)	.08	1.29 (.80)	3.14 (.80)	3.07 (1.07)	1.69 (.75)	.08	1.77 .93
Hartwig School														
Burton (n = 16)	1.56 (.51)	.07	1.63 (.50)	1.13 (.92)	.20	1.33 (1.45)	1.13 (.34)	.19	.94 (.57)	2.44 (1.09)	2.38 (1.09)	1.53 (1.06)	.84*	2.37 (1.06)
Palmer (n = 19)	1.74 (.81)	.00	1.74 (.60)	2.00 (.56)	.06	1.94 (1.11)	1.11 (.81)	.00	1.11 (.79)	2.68 (.86)	2.38 (1.59)	1.94 (.69)	.56*	3.35 (.52)
Pearson (n = 21)	1.68 (.48)	.14	1.82 (.40)	1.67 (1.80)	.09	1.76 (1.58)	1.14 (.70)	.09	1.05 (.61)	2.77 (.87)	2.86 (.71)	2.10 (1.12)	.05	2.15 (.93)
Borders School														
Morris (n = 13)	1.71 (.47)	.00	1.71 (.47)	1.77 (1.88)	.62	2.39 (1.56)	1.29 (.47)	.08	1.21 (.43)	NA (.63)	2.50 (.65)	1.64 (1.08)	.15	1.79 (1.05)
Sievers (n = 14)	1.85 (.38)	.07	1.92 (.28)	2.50 (1.00)	.00	2.50 (1.93)	1.08 (.28)	.07	1.15 (.56)	2.79 (1.31)	2.71 (1.27)	1.77 (1.17)	.23	2.00 (1.16)
Comparison teachers														
Teacher 1 (n = 22)	1.73 (.46)	.18	1.91 (.29)	1.57 (1.67)	.38	1.95 (1.60)	1.65 (1.88)	.35	1.30	2.35 (.81)	2.35 (.86)	1.96 (1.29)	.18	2.14 (1.13)
Teacher 2 (n =1 7)	1.71 (1.25)	.00	1.71 (.49)	2.14 (2.41)	.00	2.14 (1.77)	(.47) 1.29 (.49)	.15	1.14 (.38)	2.00 (.58)	2.14 (.69)	1.14 .69	.43	1.57 .79

[a]See Appendix A for complete questionnaire and explanation of variables.
[b]Δ=gain(loss)
*$p < .05$ **$p < .01$.

Table 3 Means and standard deviations for variables on pre- and postexperimental parent questionnaire (continued)

	Free time Reading			Reading/TV			Reading ability estimate			Children's books at home			Range of reading materials		
School/Teacher	Pre	Gain/loss[a]	Post	Pre	Gain/loss[a]	Post	Pre	Gain/loss[b]	Post	Pre	Gain/loss[b]	Post	Pre	Gain/loss[b]	Post
Collins School															
Andrews (n = 11)	.18 (.40)	.28	.46 (.52)	.49 (.36)	.05	.44 (.39)	2.55 (.93)	.19	2.36 (.67)	3.83 (.98)	.09	3.91 (.83)	2.85 (.44)	.24	3.09 (.37)
Broward (n = 14)	.29 (.47)	.14	.43 (.51)	.31 (.42)	.11	.42 (.33)	1.77 (.73)	.38**	2.15 (.80)	3.21 (.80)	.14	3.07 (1.07)	2.82 (.45)	.11	2.93 (.47)
Hartwig School															
Burton (n = 16)	.25 (.45)	.31	.56 (.81)	.31 (.36)	.13	.44 (.50)	2.43 (.76)	.07	2.50 (.76)	2.75 (1.24)	.06	2.69 (1.20)	2.99 (.79)	(.16)	2.83 (.63)
Palmer (n = 19)	.90		.53*	.52 (.56)	.43*	.95 (1.11)	2.63 (.81)	.06	2.69 (.79)	3.16 (1.34)	.10	3.26 (1.33)	3.10 (.69)	.25*	3.35 (.52)
Pearson (n = 21)	(.81)	.37	(.60)	.43 (.51)	.17	.60 (.57)	2.47 (.70)	.05	2.42 (.61)	3.14 (1.49)	.24	2.91 (1.26)	3.15 (.64)	.04	3.19 (.51)
	.41 (.67)	.18	.59 (.59)												
Borders School															
Morris (n = 13)	.20 (.41)	.13	.33 (.62)	.43 (.82)	1.51*	1.94 (2.55)	2.53 (.91)	.06	2.47 (.83)	1.13 (.99)	.34	3.47 (.52)	2.73 (.69)	.05	2.78 (.65)
Sievers (n = 14)	.54 (.78)	.08	.46 (.52)	.51 (.54)	.96*	1.47 (1.37)	2.31 (1.18)	.23	2.54 (1.22)	3.23 (1.17)	.51*	3.74 (1.13)	3.09 (.72)	.14	3.23 (.79)
Comparison teachers															
Teacher 1 (n = 22)	.46 (.80)	.09	.55 (.86)	.60 (.70)	.00	.60 (.53)	2.71 (.96)	.10	2.62 (.97)	3.41 (1.05)	.09	3.32 (1.13)	2.95 (.79)	.03	2.97 (.81)
Teacher 2 (n = 17)	.29 (.49)	.26	.51 (.79)	.18 (.12)	.14	.32 (.31)	2.43 (.54)	.14	.32 (.79)	3.00 (1.29)	.46	2.54 (1.13)	2.97 (.51)	.21	2.76 (.70)

[a]See Appendix A for complete questionnaire and explanation of variables.
[b]Δ=gain(loss)
*$p < .05$ **$p < .01$.

prevented us from reaching this phase during the first year in Collins and Hartwig schools; for the same reasons we did not reach this phase until April in Borders School during year 2. Mainly, we underestimated the interacting logistical, pedagogical, and technological problems associated with teaching teachers and students HyperCard, creating workable programs, and consolidating the book reviews into the database so that they could easily be searched. Thus, an original component of the planned intervention was implemented only marginally during the second year of the project. The final phase of the project occurred during the last weeks of the academic year. Students and parents again completed the written surveys used to establish a baseline at the beginning of the school year.

Methodology

The methodology of formative experiments has not been fully explicated in the research literature. In this section we present our emerging understanding of formative experiments as a research methodology. Specifically, we discuss the issue of quality in terms of internal and external validity, and we identify our epistemological stance. Then, we describe the qualitative data we collected and how it was analyzed.

We believe that formative experiments exist simultaneously within two domains of research that Salomon (1991) has described as systemic (i.e., the study of complex learning environments undergoing change) and analytic (i.e., the study of causal relations among selected variables), a distinction, he argued, that transcends quantitative and qualitative paradigms. Thus, we believe that gathering both quantitative and qualitative data, as we have done in the present study, is consistent with formative experiments. Because both qualitative and quantitative data may be useful in conducting formative experiments, they align with what Tashakkori and Teddlie (1998) defined as mixed methodologies.

As with other research methodologies, the quality of studies employing mixed methodologies is fundamentally an issue of internal and external validity. However, internal validity may be viewed differently within different methodologies. For example, in formative experiments, statistical analyses of quantitative data are not necessarily conducted to establish unequivocal causal relationships (Tashakkori & Teddlie, 1998). Instead, they are conducted to support or refute inferences about linkages among certain factors or events. Thus, the statistical analyses we report in a subsequent section were conducted to enhance the type of internal validity that Krathwohl (1993) referred to as "explanatory credibility" (p. 271). In terms of explanatory credibility, we also believe that quality in formative experiments is related to the duration of data collection and analysis. For example, the present study collected data across 2 years in several classrooms and schools.

Demonstrated results, another of Krathwohl's (1993) categories of internal validity, is particularly relevant to the quality of formative experiments. As summarized by Tashakkori and Teddlie (1998), this type of internal validity is "[judging] whether some results occurred and whether they were the ones expected" (p. 69). That judgement is integral to conducting formative experiments, because they are aimed at determining what factors enhance or inhibit progress toward a pedagogical goal. Therefore, success in negotiating those factors to achieve progress toward the goal comprises a measure of internal validity and, thus, quality.

External validity, often referred to as generalizability or transferability, is also part of determining the quality of studies using mixed methodologies. However, as Tashakkori and Teddlie (1998) pointed out, the view of external validity is decidedly different from a quantitative and qualitative perspective. Nonetheless, they argued that researchers using mixed methodologies should be held accountable for external validity in terms of generalizing from sample to population and from one setting to other settings. We believe the present study addresses this issue to some degree by examining the intervention across multiple contexts, especially in terms of representative variations in the configuration and availability of technology in the respective schools.

Our epistemological stance in conducting a formative experiment and in gathering and analyzing data was centered in pragmatism as it has been discussed in relation to social science research by contemporary writers such as Cherryholmes (1992). Formative experiments seem well matched to a pragmatic stance, which has been identified as a neglected alternative to positivist, postpositivist, and constructivist orientations to research (Tashakkori & Teddlie, 1998). Our stance can be summarized in Cherryholmes's (1992) statement that pragmatic views seek "to clarify meanings with an eye to consequences, forsaking foundational and essentialist conceits...peering beyond provincial and parochial categories, interests, boundaries and narratives" (pp. 13–14). Thus, our data collection, analysis, and interpretation focused prominently on the pedagogical goal and the pragmatic aspects of achieving it without limiting ourselves to predetermined categories, interests, boundaries, and narratives.

Also consistent with a pragmatic perspective, we did not adopt a specific standard for determining attainment of the goal. From a pragmatic view pedagogical goals are abstractions that may never be attained in an absolute sense. Thus, data collection does not stop when a goal has been achieved but stops at some arbitrary

point dictated by practical constraints (e.g., the school year ends). Newman (1990), arguing from a sociohistorical perspective, rejects the idea that the pedagogical goal must be a static endpoint for all students (see also Newman, Griffin, & Cole, 1989). Many different endpoints are possible; some may transcend the original goals.

To determine what factors were enhancing or inhibiting the intervention's effectiveness in promoting the pedagogical goal and to guide any needed modifications, we gathered and analyzed extensive qualitative data. The sources of qualitative data included (a) taped, semistructured interviews with teachers, (b) log books in which teachers recorded their observations about events related to the project, (c) focus-group discussions with teachers and students, (d) observational field notes, (e) videotapes of various project activities, and (f) student products.

At the outset, we imagined that data collection and modifications to the intervention would proceed through well-defined cycles. In practice, we found the process to be more fluid, even at times ad hoc, because adaptations were often based on the intuitive demands of the moment rather than on extensive reflection upon the accumulated data. We discovered that our research activities during the experiment were formative in many different areas simultaneously, such as the following: (a) logistical (e.g., How could we create more time in the daily schedule for students to work on the computer?), (b) methodological (e.g., Our observations of students working in the lab on one day might suggest that we needed to interview the teachers about something we observed.), (c) pedagogical (e.g., How might we adjust implementation to encourage more poor readers to create book reviews?), (d) technological (e.g., How can we make the database run faster?), (e) interpersonal (e.g., How can we as university researchers maintain good rapport with the teachers?), and (f) ethical (e.g., Should we adjust implementation based on our values or the teachers' values?). This experience reinforced our view of formative experiments as being valuable because they reveal the many interacting factors associated with the effects of instructional interventions.

To facilitate in-depth analysis, we identified 4 focus students in each classroom who represented the following categories: (a) above-average reading achievement and interest; (b) above-average achievement, below-average interest; (c) below-average achievement, above-average interest; and (d) below-average achievement and interest. Teachers were asked to identify one or two students in each category, and their selections were compared to our independent classification of all students based on observations. Teachers were informed of our final selection of focus students in each class. However, while we observed and recorded information about these students more intensively, we took care not to communicate to students that we were doing so.

We believe that data collection in a formative experiment, particularly given our pragmatic stance, is consistent with current thinking in qualitative and ethnographic approaches to research (e.g., LeCompte & Preissle, 1993). That is, we attended to data deemed most relevant to achieving the pedagogical goal from the standpoint of determining how the effects of the intervention and the educational environment interacted. Typically, our ongoing data collection and analysis led to the development of emerging interpretive theories about the status of independent reading, the intervention, and its effects (Glaser & Strauss, 1967). For example, in our field notes and audiotaped reflections (often recorded and discussed in the car as we returned from site visits), we employed a scheme described by Schatzman and Strauss (1973). In that scheme, notes and comments were categorized as observational, theoretical, or methodological, the latter of which we subdivided into notes about our data collection efforts and notes about how the intervention was implemented.

However, our pragmatic stance led us to vary theoretical frameworks and methods for data collection and analysis in response to ongoing developments within the project, our emerging theories, and our evolving understanding about conducting a formative experiment. For example, we began gathering observational data in classrooms using Glaser and Strauss's (1967) framework of local concepts as an approach to determining the amount and diversity of students' independent reading. As we transcribed and annotated field notes, we determined that this approach created too many gaps in our understanding of students' independent reading. Thus, we expanded our data collection and analysis to include focus-group discussions (Morgan, 1993). In short, our data analysis was also formative.

Implementing the intervention and achieving the pedagogical goal

In this section we present data addressing the question: As the intervention is implemented, what factors enhance or inhibit its effectiveness in achieving the pedagogical goal? Consistent with inductive methods, the data reported in formative experiments represent a synthesis and interpretation of events, which may be organized and presented in various ways. In this section, we are guided by a format referred to as *key events* (Patton, 1990), defined as critical incidents or major events, not necessarily presented in their order of occurrence. The

key events are in turn organized into themes indicated by subsequent headings.

To a lesser extent, we also address the question: How can the intervention and its implementation be modified to more effectively achieve the pedagogical goal? We do not provide a detailed account of modifications here, because they occurred fluidly in relation to our data collection, as described in the previous section. In addition, many of these changes, while of practical significance, were not significant to advancing pedagogical theory (see Reinking & Bonham, 1997, for more practical information about implementing the intervention). Finally, in this section, we report data that address directly the extent to which the pedagogical goal was advanced by the intervention.

Students' interactions with peers and teachers

It was clear from virtually all of our qualitative data that peer interaction was greater during the multimedia book review activity than during other academic activities, which is not surprising given that increased peer interaction is a common finding when instructional activities involve computers (e.g., Dickinson, 1986). However, more central to this investigation, we found that the interactions were qualitatively different from those that characterized other classroom activities and that they played a key role in advancing our pedagogical goal. For example, our analysis revealed that peer interactions mediated the effect of multimedia book reviews on independent reading, illustrated by the following event transcribed from tape-recorded observations:

> I worked with Aaron, Dee, and Tyrone to show them how to add audio to their reviews. I asked them who had a book we could use as an example. Aaron said he had *Where the Red Fern Grows* and got it from his desk. He told some of the story into the microphone, and I showed how his comments could be recorded while the others observed. Dee asked Aaron if she could look at the book after we had finished. [One week later] I saw the book *Where the Red Fern Grows* on Dee's desk and asked her if she was reading it. She said that she was and that she liked it. When I asked her why she picked it to read, she said that she didn't know why and didn't seem to remember the incident with Aaron.

We frequently observed similar instances when working with the technology led to incidental sharing of information about books and, for some students, to more reading. This finding was important because we had not anticipated that the process of creating book reviews would directly enhance independent reading. Originally, we thought that using the database would promote awareness of and interest in books read by students' peers. The realization that working with the technology itself could facilitate our pedagogical goal allowed us to capitalize on this awareness as implementation proceeded. For example, we encouraged the natural tendency for students to work cooperatively in creating their book reviews to facilitate peer interaction.

The interactions we observed in the computer lab were also qualitatively different from classroom interactions. Dealing with technological challenges seemed to generate a heightened sense of camaraderie and helpfulness among students. In the computer lab they seemed genuinely interested in the achievements of their classmates and in the products they were developing. Discovering special effects on the computer screen or creative applications of HyperCard tools were often cause for special attention and spontaneous sharing. For example, at Hartwig School, Betty, a student who had a Macintosh computer at home, created a special presentation on the computer as a valentine to Ms. Pearson, her teacher. The whole class gathered around a computer to enjoy her presentation, frequently asking, "How did you do that?"

To encourage helpful interactions among students and to promote the possibility that interactions would mediate more independent reading, the teachers at Hartwig School attempted to enhance this positive effect by systematically referring students to another knowledgeable student when they sought technical assistance. This conscious decision, a result of systematic data collection and analysis, illustrates the methodology of formative experiments in action. Also illustrative is that while having students depend on one another for technical assistance did have the desired effect, a similar action did not. That is, to increase students' interactions, teachers also decided to pair students to debug each other's reviews using a guide sheet. Instead, this adaptation encouraged students to look for surface level mistakes in spelling and punctuation and seemingly had no effect on independent reading; thus, the teachers discontinued that activity.

We also noted other differences in the way students and teachers interacted, which seemed to create an atmosphere conducive to positive engagement with and sharing of reading and writing centered on books. For example, we noted that the interactions of lower achieving students with their peers were different while working on the multimedia book reviews when compared to other classroom activities. Many of these students gained considerable technological expertise, and their assistance was sought out during computer-based activities, but rarely at other times during the school day. For example, in our field notes while observing Shawn, a focus student classified as low-reading achievement and interest, we made the following observation: "Shawn has been ready to assist others in reading what was on their screens in

order to figure out what should be done next, and he was not at all inhibited about helping someone new to the class with what needed to be done." Importantly, the assistance offered by lower achieving students frequently involved reading and interpreting texts.

Interactions between teachers and students were also affected by participation in the multimedia book review activities. For example, unlike during other instructional activities, teachers often willingly and naturally became learners while students taught them how to deal with some technological aspect of the activity. The following statement by Ms. Ellers from an October meeting of the teachers and research team illustrates this type of interaction:

> ...they love to show me because even with the demonstration this week of the new fields, you know [giving rapid directions on how to do fields], well then I said you need to do that each time. Well, then today, and this was the first time that I even knew it, they said "oh, you don't have to do that for a new field, you just go up to new field and automatically go over there on the tool palette." Like wow [laughing]. I didn't know that. But hey, they really get a kick out of that.

Effects related to reading achievement

Reading achievement often figured prominently in understanding the effects of the multimedia book review activity, although these effects were complex and often varied across classrooms. For example, Ms. Broward's class at Collins School had a disproportionate number of students reading below grade level when compared with other classes in her school. In her log Ms. Broward noted that many of the poor readers in her class did not seem interested in entering book reviews. In a subsequent interview, James, one of the focus students classified as a poor reader, stated, "All I can read is easy books anyway, so why put them on the computer?" Acting on these data from the perspective of a formative experiment, we hypothesized that poor readers' lack of involvement may be due to their embarrassment in being limited to entering books below grade level, thus publicizing their reading problems. In a discussion with Ms. Broward she agreed with our hypothesis and suggested a solution; she announced to her class that second- and third-grade students would eventually be using the database and suggested that some students consider entering easier books for them to read. Following this announcement, we noted an increase in the number of book reviews entered by poor readers. In fact, within several weeks, James had entered more books than any other student in the class. Because he tended to be a leader among his poor-reading peers, his sanctioning of the activity seemed to encourage others.

On the other hand, as noted in the previous section, many low-achieving students seemed to gain confidence and self-esteem immediately from working on the computers, and this confidence seemed to have a positive effect on their engagement in literacy activities. For example, Robert, a focus student in special education at Hartwig School, one day presented a member of the university research team with an illustrated poster printout he had made on the computer that stated "I love computers." Follow-up discussions with his classroom teacher and special education teacher revealed that Robert was enjoying his new status as a computer expert not only in the lab but also in his classroom showing others how to use the computer for word processing. Ms. Pearson, his teacher, wrote in her log, "When we got a word processor to use, Robert was the one who showed the rest of the class how to use it. He was proud of himself, and so was I." We also found evidence that Robert's attitudes toward reading and his subsequent independent reading increased. His score on the ERAS increased from the 62nd percentile in September to the 78th percentile in the following May, and his special education teacher in a May interview reported that "[Robert] has been much more involved in reading books since he began sharing his multimedia book reviews with other students in our group."

We also found that creating multimedia book reviews tended to obscure differences in reading achievement that were more visible in other academic activities. For example, it was not possible to verify teachers' selection of the focus students (selected partly on the basis of reading ability) only by observing students working in the lab, as indicated in our October field notes: "[Question to myself] What about [the four] selected students? I can't tell who they might be in here [the computer lab].... Does anyone appear to have a problem with reading? Doesn't look like it in here." On the other hand, it was possible to make distinctions by observing students in the classroom as indicated again from our October field notes: "Aide is assisting students who are having trouble with their work. Teacher monitoring/checking students comprehension—[especially] poor students." The teachers' comments and our own observations repeatedly converged to indicate that distinctions in reading achievement were less apparent in the computer lab than in the classroom and that the fading of this distinction created a positive environment for literacy activities including independent reading.

For example, Shane, a focus student, when observed in his classroom, clearly exhibited difficulties in reading but those difficulties were not apparent in the

computer lab. We observed him avoiding reading and answering questions in the classroom but not in the computer lab. Ms. Ellers, who directed the computer lab, observed that he "was always actively involved in all of the activities." Even lower achieving students not particularly adept at using the technology actively participated. As Ms. Burton states in her log, "Even my slow ones are doing a good job. Lee and David [special education students] have some good ideas for creating stacks."

We also found that the multimedia book review activities tended to stimulate creativity among the high-achieving readers and to increase or reinforce independent reading. For example, Elizabeth (E), a focus student identified as having high achievement and interest in reading responded to a researcher's (R) interview questions as follows:

R: Have you told anyone about this HyperCard project?

E: I've told basically friends and family.

R: What have you told them?

E: I told them all the things that we had been doing that day in the computer lab, and how I couldn't wait until the next time we go in there. It's real fun.

[discussion about the previous HyperCard lesson on audio buttons].

E: That was fun. I did mine. I did all my voice impressions. I did my Zsa Zsa Gabor impression, I did a real sophisticated lady impression, and Mrs. Morris was saying, Go on, keep going.

Ms. Ellers, who directed the project in the computer lab, also noted in her log that Elizabeth brought her a book to read over the holidays due, she thought, to the book review project. Likewise, transcriptions of a tape-recorded April meeting of the university research team (R) and Ms. Ellers (Ms. E.) aimed at discussing how to increase students' sharing information about books revealed that good readers were already doing this:

R: Could we have the students exchange book reviews...

Ms. E: They've already done that. One'll hear what another says, or they will tell me about their books—but these are the top students.

Student engagement

A related finding that affected implementation was that students were at first clearly more engaged in creating multimedia book reviews than in many other academic activities during the school day. That finding is illustrated by comparing our field notes while observing Shane, a low-achieving, low-interest focus student, in the classroom and in the computer lab:

[notes from a single 5-minute classroom observation]

Shane does not appear to be working at all on his math problems...is turned around in his seat to talk to his neighbors...is the first one done with his math...is sitting and tapping some pencils. Shane is looking at what a neighbor is drawing...playing with two blue highlighters...checks lunch menu.

[notes from computer lab observation, 2 days later]

Shane passes out the template guide at the beginning of class.... All students working now; no one off task. A new student gasps. Shane [in a neighboring seat] says, "What's wrong?" Antoinette says, "I don't know." Shane immediately scoots over to help her...(later that class period) Antoinette: "You left out your 'E'." Shane: "Where?"

Another example is Jason, whom his teachers considered to be hyperactive because of his extreme distractibility in the classroom. In a video segment he sits almost motionless, staring at the computer screen for more than a minute, apparently contemplating his next keyboard command. Examples of increased attention were found typically among poor readers. For example, Ms. Ellers stated in an interview, "this child is at least 2 years behind grade level, but when he comes [into the lab] he's totally tuned in to what [we're] doing."

Many students seemed to acquire a different, more active, persona when involved with project activities, often becoming less inhibited, more verbal, and more cooperative. In an audiotaped focus group discussion with the teachers, Ms. Morris observed: "the ones that answer questions in the media center...you know they raise their hands and they wanna answer, they are those that [are] not real verbal in class as far as answering something that we've discussed." Students who were shy and reserved in the classroom seemed more willing to take risks and to ask questions when involved in creating multimedia book reviews as indicated from the following reflection from our field notes:

I find it interesting that, having watched [them in the classroom], that they WILL ask questions. Because there are some students, that if they don't understand, they won't even ask questions. But in [the computer lab], it seems that nobody's afraid to ask.

The technological challenges of using HyperCard seemed to enhance students' engagement as opposed to

creating frustration. As Ms. Swanson stated in a focus-group meeting, "I haven't seen anybody get really frustrated. They do in the classroom on other things, but not on this." In fact, students' frustration surfaced mainly if something prevented them from working on the computers. Ms. Swanson observed in the same meeting, "[the students] just threw a fit if they didn't get to come to [the lab].... They really got upset because they didn't think they were gonna come, and when I tried to explain, I mean they were just so [upset]."

Students' motivation and engagement were reflected in their almost uniformly positive comments about creating multimedia book reviews. However, their positive responses were almost always related to using the computer, particularly HyperCard, as opposed to specific comments about the book reviews or their independent reading. Typical comments were, "it gives you a chance to do more activities and funner stuff," "It's like, you can draw...you can pick pictures to draw and stuff. You can do your own voice and it [HyperCard] has all sorts of stuff on it," "[Be]cause you get to draw and don't do no work."

In fact, as students mastered HyperCard skills and began to focus more on entering book reviews, we found that motivation and enthusiasm moderated. For example, well into the project, Ms. Palmer at Hartwig School noted in her log that one of her students suggested having an occasional "nonstructured day in the lab, just to have fun," which was a suggestion she noted would have been unlikely earlier in the project. Further evidence of this diminished enthusiasm was that it became the subject of one of the occasional meetings we had with teachers to discuss what was working, what wasn't working, and what might be changed in the way that the activity was being implemented. We discussed how to channel students' increased engagement in using HyperCard toward increased engagement with book reviews. For example, at Hartwig School the teachers decided to insist that students enter new information about the books they were reading during the first 20 minutes of the weekly hour-long session in the computer lab; during the remaining time students were free to incorporate multimedia presentations into existing book reviews if they chose to do so. However, it is important to note that we did not find any evidence that students disliked entering book reviews or that the intriguing aspects of using multimedia on the computer distracted students from reading books.

Variations among schools and teachers

As can be expected, the effects of the multimedia book review activities, like any instructional intervention, varied among the schools and classrooms participating in the project. Collecting data in several classrooms and schools allowed us to observe effects across different environments and to speculate about variations that intensified or mitigated those effects. In this section we discuss these variations. Our findings are limited by the fact that the intervention was modified between year 1 in Collins and Hartwig schools and year 2 in Borders School. They are also limited by the inability to impose certain changes in classrooms and schools, which is a common limitation in any investigation of an instructional intervention.

We devoted much attention to analyzing our data to seek explanations for the clear differences we observed between Collins and Hartwig schools during year 1. Teachers at both schools had unmitigated enthusiasm for the project in its early stages. For example, as the project began, teachers in both schools wrote enthusiastic comments in their logs indicating that they had high expectations for the project and were looking forward to their participation. However, as the year progressed, enthusiasm and morale steadily deteriorated at Collins School, but not at Hartwig School. By the spring, Ms. Andrews at Collins School, who initially had greater competence and parental assistance for using computers and higher achieving students in her classroom than did her colleague Ms. Broward, had fallen far behind, almost abandoning entirely the project activities. At Hartwig School and the following year at Borders School project activities extended into other areas of the curriculum, but this was not the case at Collins School.

Drawing on our observational and interview data, the following factors seemed relevant in explaining the difference between these two schools:

The professional climate of the two schools was distinctly different. For example, although principals and central office personnel were highly supportive of the project in both schools, the administrative style in Collins School was more top down. In addition, administrators' interest in the project seemed related more to its value for public relations and its implications for test scores than for its potential to enhance curricular goals or to promote students' and teachers' development. Teachers seemed constrained, pressured, and sometimes even intimidated by this administrative stance. We conducted interviews with six teachers at Collins School early in the school year. When asked about possible negative outcomes of the project, virtually all of them expressed concern that they might not have time to work the project activities into their set schedules. For example, Ms. Andrews justified her preference for using computers in a lab setting by stating that "the lab guarantees everybody the right to 45 minutes." Although teachers at the other schools also discussed the pressures they were under to meet mandated curricular goals, they were willing to seek

out ways to accommodate the computer activities into their schedules and seemed to expect cooperation from their administrators.

In addition, we did not observe a strong sense of teamwork and mutual support among the teachers at the school. There was little sharing of expertise and resources that proceeded from joint problem solving. In our interviews and informal interactions with other teachers at the school we often heard of criticisms, jealousies, and disagreements between and among teachers. In addition, there was noticeable turmoil in Collins School due to the principal's campaign for school superintendent and the uncertainty about who would be her successor, and also about which teachers would be assigned to a new school that was to open the following year.

The Collins teachers perceived that they were not getting as much attention from the university research team. Collins teachers perceived that when compared to the Hartwig teachers they were at a disadvantage because they only had one computer in their classroom instead of a computer lab. The event that seems to have initiated these perceptions was a joint presentation involving teachers from both schools at a national conference in January. During the presentation, Collins teachers saw that they had not accomplished as much as the Hartwig teachers and from that point seemed dissatisfied with their own situation as evidenced by frequent references to Hartwig's superior resources during our subsequent interactions with them. To a certain degree their perceptions were accurate. The research team did spend more time at Hartwig because more time was necessary to teach students how to use HyperCard, whereas we delivered more finished products to Collins. The greater distance to Collins School also limited the number of visits by the university research team. As the year progressed, we found it increasingly necessary to reassure teachers at Collins that we were not disappointed with their progress; yet, our reassurances over time became less convincing to the teachers and to ourselves. Nonetheless, we believe the differences in morale were due more to the teachers' perceptions than differences in resources or support. Nor are we convinced that the multimedia book review activity faces insurmountable problems in a classroom with only a single computer.

Teachers at Collins School seemed to be more conscious of whether the research was being conducted properly and whether the activities were successfully meeting our expectations. We explained the concept of a formative experiment to teachers at both schools early in the project, emphasizing that we did not expect the project activities to succeed uniformly in every context or without formative adjustments based on our data. Teachers often seemed uncomfortable with pointing out difficulties with project activities or with suggesting ideas for improvement with members of the university research team, to whom they often deferred. For example, during January, Ms. Pearson at Hartwig School wrote in her journal: "I had my interview with [one of the researchers] today. I was very relieved to find that they [the university research team] were pleased with our progress. A lot of apprehension was relieved." However, the Collins teachers seemed to be more concerned about how the data were being collected, whether we thought the project was successful, and whether we approved of their involvement. Their concern and doubt may have reflected their decreasing morale and likewise exacerbated it. Consequently, the Collins teachers seemed to rely heavily on our direction and support. Ideas for extending the project were discussed with enthusiasm but were not often implemented without direct support and follow-up from the university research team.

Implementing project activities within their own classrooms may have decreased the need for joint planning, cooperation, and mutual support. In Hartwig School teachers needed to coordinate their individual schedules and planning to accommodate project activities in the computer lab. Having the flexibility to work independently within their own classrooms, the teachers at Collins had less need to collaborate and less resistance to foregoing the project activities when they felt pressures to complete mandated instruction.

Another major variation across teachers and schools, which influenced project effects and which helps explain the difficulties at Collins School, is our finding that teachers could be classified into several distinct categories regarding their role in the project activities. During the course of the project, we found that teachers gravitated toward several identifiable roles. Each of the following roles seems salient in understanding the effects of the multimedia book review activity and how it might be effectively implemented (cf. Hadley & Sheingold, 1993):

1. *The technology expert.* A teacher at each of the three schools spontaneously assumed this role early in the project by virtue of greater interest and quicker success in mastering the hardware and software, accompanied by a greater commitment to work on the computer beyond the minimal requirements for the project. The other teachers not only acknowledged this role, with comments such as "[Ms. Ellers] will help us do that," but also seemed to need the technology expert to sustain their own efforts (e.g., "I know I couldn't have done that without [Ms. Burton's] help."), sometimes in a way that seemed to prevent them from extending their own technological expertise (e.g., "I couldn't do this next year myself.").

Having a teacher in the role of technology expert at each school was instrumental in extending project-related

literacy activities into other areas of the curriculum or other school activities. For example, Ms. Burton, who became a technology expert at Hartwig School, used her new HyperCard skills to create a tutorial directing students how to create a display for the school science fair. Similarly, Ms. Andrews's disillusionment and withdrawal from the project, because she initially fulfilled the role of technology expert, seemed to have a negative effect on the project's success at Collins School.

2. *The emerging or marginal technology expert.* This role was filled by teachers whose early involvement in the project activities was enthusiastic but passive, deferring almost entirely to members of the research team and to the teacher in the role of technology expert. Gradually, however, teachers in this category seemed to become more comfortable using the technology and more enthusiastic about the intervention's effects. Ms. Pearson's involvement during the project at Hartwig School is illustrative. Our field notes early in the school year state:

> [Ms. Pearson] sat at the table away from the computers in the lab today counting money and filling out book orders. She seemed to put us [members of the university research team] in charge with no intention of participating in learning how to use the HyperCard stacks or of working with students.

As the year progressed, however, Ms. Pearson's involvement increased greatly as she became more comfortable with the technology and she saw the enthusiastic response of her students. She did not define herself as a technology expert and relied on Ms. Burton, but she did move far in that direction over the year. We wrote in our field notes at the end of the school year:

> I told [Ms. Pearson] that next year we would be moving on to another school and that Hartwig teachers would be on their own. I thought it was significant that now she didn't seem that concerned. She kind of made a little face when I told her, but it wasn't at all a negative reaction...more like "I'm not sure, but maybe I can."

3. *The facilitator.* Some teachers assumed the role of a facilitator, that is, a teacher who is not especially intrigued with the technology, but who is interested in discovering and enhancing the nontechnological effects of the program. For example, Ms. Pearson's movement towards technology seemed to originate with her attempts to facilitate the positive effects she was seeing on her students in the classroom. We also classified Ms. Sievers at Borders School as a facilitator because she did not indicate more than passing interest in the computer, but she attempted to connect classroom reading and writing activities with students' multimedia book review activities in the computer lab.

4. *The passive participant.* Teachers in this role seemed to be enthusiastic about the project and its potential benefits, but they relied primarily on others for explicit direction and guidance. Their personal investment in the project was low in terms of independent effort to engage in creative problem solving to address logistical, practical, technological, and pedagogical problems. They did not contemplate possibilities for extending or adapting the multimedia book review activities or coordinating those activities with other curricular areas; or, if they did, such extensions had to not create too much of a disruption to their current instructional routines. Teachers assuming this role devoted little effort to mastering the technology. They also had a relatively low tolerance for dealing with developments that prevented the activity from meeting their expectations of success. This role tended to be assumed more often by the teachers in Collins School, especially as the project progressed.

Changes in the amount and diversity of students' reading

We gathered qualitative and quantitative data prior to implementing the intervention in order to set a baseline for determining if the intervention was advancing the pedagogical goal. During implementation, we gathered qualitative data to determine progress. After implementation we gathered quantitative data as a point of comparison to the baseline data. As explained in a previous section, the pre- and postexperimental quantitative comparisons were not conducted to establish causal relations independently, as in a conventional experiment. Instead, consistent with mixed methodologies, quantitative analyses complemented qualitative analyses in service of making reliable inferences.

Findings from the quantitative data. Tables 2–4 show pre- and postexperimental results on quantitative measures. Gains and losses from the beginning to the end of the study are shown along with changes that are statistically significant using *t*-tests for correlated samples.

The results of the ERAS shown in Table 2 indicate that for the intervention classes statistically significant gains in mean raw scores were evident in one class on the recreational reading subscale, in two classes on the academic reading subscale, and three classes on the total across both subscales. In the two comparison classes where a computer program was used to award points for reading books, statistically significant decreases in raw scores were evident in one of the classes on the recreational reading subscale, in both classes on the academic subscale, and in one class on the total score across both subscales. Changes in raw scores on the ERAS from the beginning to the end of the school year must be interpreted in light of the tendency of elementary school stu-

dents' raw scores to decrease over time (Foertsch, 1992; McKenna, Kear, & Ellsworth, 1995). For example, a raw score of 52 on the ERAS results in percentiles of 35, 42, and 49 for fourth-, fifth-, and sixth-grade students, respectively. Therefore, the present data suggest that students' attitudes toward academic and recreational reading tended to increase, or not to decrease at expected levels, in the classes involved in the multimedia book review activities while decreasing on at least one of the subscales in the two classes using an alternative computer-based activity aimed at increasing independent reading.

Means and standard deviations by class on variables from the Parent questionnaire are shown in Table 3 (see Appendix A for the questionnaire and coding scheme). Among the seven classes in which the intervention was introduced, statistically significant gains on variables included on the parent questionnaire were as follows: free time reading (one class); ratio of time spent watching TV and reading (three classes); estimate of their child's reading ability (one class); number of children's books in the home (one class); range of reading materials (one class); possession of a library card (one class); number of trips to the library (one class); and reading for enjoyment at home (two classes). None of the decreases in means were statistically significant. Among the seven classes, the following pattern of increases was noted: One class had four statistically significant increases (Ms. Palmer at Hartwig), one class had three statistically significant increases (Ms. Broward at Collins); one class had two statistically significant increases (Ms. Sievers at Borders School), and three classes had one statistically significant increase (Ms. Andrews at Collins School, Ms. Burton at Hartwig, and Ms. Morris at Borders School). No statistically significant increases or decreases on the variables identified in the Parent questionnaire were observed in Ms. Pearson's class at Hartwig School or in either of the comparison classes. The statistical significance of any one pre- to postintervention comparison reported here is limited by the number of comparisons, by the small number of comparison classes, and by the fact that students were not assigned randomly to classes. Nonetheless, there is a pattern of statistically significant comparisons for the experimental classes suggesting some consistent measurable increase in independent reading.

Means and standard deviations by class for the Choosing Things to Read student questionnaire (Appendix B) are shown in Table 4. Pre- and postexperimental means for four classes involved in the intervention decreased, two of which were statistically significant, and means for three classes increased, one of which was statistically significant. The mean for one comparison class increased and one decreased, neither of which was statistically significant. These quantitative data provide no clear evidence of changes in the diversity of students' reading that might be linked to the intervention.

Findings from qualitative data. Throughout the investigation we found evidence that the intervention was advancing the pedagogical goal, sometimes only after determining inhibiting factors and adapting its implementation accordingly (e.g., see the previous section on effects related to reading ability). Much of the data supporting that conclusion came from teachers and parents who were in a good position to determine changes in students' independent reading. Their comments in interviews, audio- and videotaped meetings, project logs, and their offhand remarks recorded in our field notes consistently refer to positive changes in individual students' independent reading. For example, transcriptions of our audiorecorded notes from Hartwig School include the following incident:

> I was talking [with a parent who helped in the lab] and she said she didn't know if it was due to this project, but she had noticed a very significant, noticeable improvement...in her daughter's reading at home. She had said that her daughter had many books at home before and would occasionally read parts of them...whereas now she observed her daughter doing much more reading, finishing the books and talking more about them.

Likewise, Ms. Pearson recorded the following in her log:

> Several parents told me throughout the year how pleased they were that we were involved in this research project. They said their children had always had plenty of books at home, but they never seemed to completely read their books. They were able to see drastic changes in their children throughout the year. Their children were now completely reading books and asking for more. The parents were very excited about the changes.

And, on another occasion she wrote again in her log:

> I tutor a third grader. One afternoon when I took her home from tutoring, her mother wanted to know if we would be doing the research project with the computers when [her younger son] got to fifth grade. She wanted us to because Karen, her older daughter in [Ms. Palmer's] class, had greatly benefitted from this year's project. She said that Karen was reading at home all the time. She also said that Karen's writing skills had greatly improved this year due to using computers to do book reports.

Ms. Burton wrote in her log in February:

> Today I noticed that Candace had a collection of books on her desk. I asked her if she was reading now and did she enjoy it. She showed enthusiasm about reading and told me about her books. I asked her if she felt the computer

Table 4 Means and standard deviations for students' scores on the choosing things to read questionnaire

Time of administration			
School/teacher	Fall	Spring	Gain/loss[a]
Collins School			
Andrews	56.00 (12.64)	53.64 (12.16)	(2.36)
Broward	61.61 (13.09)	49.83 (11.05)	(11.78)*
Hartwig School			
Burton	52.55 (14.43)	44.45 (14.89)	(8.09)*
Palmer	31.27 (11.88)	44.91 (10.68)	13.64**
Pearson	54.35 (17.49)	51.39 (17.57)	(2.96)
Borders School			
Morris	52.51 (13.40)	56.00 (18.45)	3.79
Sievers	47.33 (14.45)	53.81 (16.41)	6.48
Comparison classes			
Teacher 1	51.25 (11.51)	52.00 (13.86)	.75
Teacher 2	58.00 (12.47)	46.68 (9.27)	(11.32)

[a]Δ=gain(loss)
*$p < .05$ **$p < .001$.

book reports had aided her in choosing to read and she said she liked putting her work on the computer.

During a visit to observe in Ms. Broward's class at Collins School, she pointed out that Mitch, a low-achieving, low-interest focus student, had unexpectedly started bringing abridged classics to school to read. We discovered that he was asking his mother to buy these books when he accompanied her to the supermarket. He was anxious to show us his new book each week and explained that he wanted to get them entered into the computer.

Some of the teachers observed positive changes across all of the students in their classes, which they attributed to the project activities. For example, Ms. Burton wrote in her log, "I saw a lot of growth in my class in many ways. Toward the end of school, I saw kids [who had finished their] work reading books. I saw them completing work in order to read their book." As discussed in a previous section, other teachers observed that the effects were more obvious with high- or low- achieving readers. For example, Ms. Pearson stated in an interview that she thought the project "encourages students to read, especially those with lower reading abilities." Ms. Ellers, on the other hand, saw more of an effect on the better readers as evidenced from her response when we asked her if she had seen any progress toward the pedagogical goal: "With the top readers, yes, this [project] is a hit. With the high-achievement, high-interest readers it amplifies that effect."

Teachers frequently observed connections between project activities and classroom events that they perceived as positive changes related to the amount of children's reading. For example, Ms. Pearson stated in a videotaped interview,

> Today two low-average readers turned in Troll book orders. What impressed me most was that these two students ordered Troll [book club] at home for the summer. It is now February. In 13 years of teaching fifth grade, I have never had any students order Troll at home even closer to the summer time.

The qualitative data that we gathered provides little evidence of an increase in the diversity of students' independent reading, at least in terms of books. Teachers

rarely made comments related to diversity in their logs or brought up this aspect of the pedagogical goal. In fact, when asked directly about the diversity of students' reading, the teachers indicated that they were not seeing any changes positively or negatively. For example, Ms. Ellers responded as follows:

> I'm not seeing a whole lot of diversity because they're [into] series books and you know some little girls like the Sweet Valley Twins or whatever...they're coming in here with a notebook or sheets of papers, so amount I've seen more, but not diversity.

In the same discussion, Ms. Sievers agreed, adding "I'm seeing not much diversity. They kind of read the same things: fourth-grade books, chapter books."

Nonetheless, teachers occasionally saw changes that might have indirect effects on diversity. For example, Ms. Palmer commented in her log that as a result of the project students were beginning to realize "that this [activity] was not about book size (number of pages)—but to read whatever interests them and use this reading to relate or pass on to other students their opinions of various literature." We also observed that focus students read diverse materials. For example, we recorded the following in our field notes: "Elizabeth [a high-achieving, high-interest student] was observed having different types of paperback books in her desk on three occasions." However, this diversity did not seem to be connected directly to the multimedia book reviews or influenced greatly by that activity. Effects in this area seemed to be indirect at best.

Several possible explanations may account for this finding. First, teachers seemed to relate more directly to the goal of increasing independent reading than to increasing diversity. This orientation may have subtly affected the way they implemented or reinforced project activities or perhaps selectively influenced their perceptions. Also, the project activities focused on books, not other reading materials such as magazines, which may have given an overly narrow view of students' reading. Likewise, because the database activity was not fully implemented, students did not participate for an extended time in an activity with greater potential to increase diversity.

Changes in the educational environment

Newman (1990) has argued that an important dimension of formative experiments involving technology is to determine the extent to which an educational environment becomes organized differently as a result of an intervention. In other words, has the computer-based intervention been assimilated into the educational environment, leaving it relatively unchanged? Or, has the intervention been accommodated, thus fundamentally altering the educational environment (see Reinking, Labbo, & McKenna, in press)? This question is important because technology has often been argued to stimulate, if not demand, positive transformations in instruction (cf. International Society for Technology in Education, 1998; Means et al. 1993; Papert, 1993). It is also important because literacy researchers have documented some cases in which interventions designed to positively transform instruction have not done so (e.g., Bruce & Rubin, 1993) and some cases in which they have (e.g., Garner & Gillingham, 1996; 1998). Thus, in this section we present data related to the question: Has the instructional environment changed as a result of the intervention?

Throughout the project, we found that teachers viewed the multimedia book review activity as embedded within a conventional schema for instruction that dictated what students ought to be doing and learning in school. For example, teachers were concerned that students acquire skills, be held accountable for teacher-assigned work, and be formally evaluated for their knowledge and skills. However, simultaneously they enthusiastically embraced aspects of the multimedia book reviews that had potential to subvert that schema. That is they saw the multimedia book reviews as promoting less tangible goals such as increasing students' self-direction, creativity, technological awareness, and response to literature. This dual focus is seen in a quote from Ms. Burton's log: "I felt [students] needed to see some different possibilities [for creating book reviews]. I want them to be creative!" One page later she wrote, "I am having students record pages read each week and having parents sign."

On the one hand, teachers tended to see the project activities as meshing with existing activities and routines. For example, despite the research team's continual use of the term *book reviews* instead of *book reports*, the teachers almost always referred to "book reports on the computer." They seemed satisfied with conventional responses to books such as writing summaries, as long as they were technically correct. They were reluctant to provide the research team with disks containing students' work until they had been proofread and corrected. In her log Ms. Pearson stated, "They are not proficient writers. Their writing skills are very poor. They refuse to use dictionaries to check their spelling. I am embarrassed to let some of them take their work to the computer lab." Some of the teachers sent home reports of students' progress on the book review activity to parents and expressed concern that students not enter magazine articles or joke books on the computer.

On the other hand, we found evidence that teachers' enthusiasm for the benefits of the project led them to forego, displace, or extend more conventional activities

in their classrooms. For example, although they often emphasized the pressure they felt to cover content, except for the teachers in Collins School they rarely opted out of the project activities, even though we invited them to do so if necessary. At Hartwig School especially, we saw evidence that the teachers were integrating computers and extending the book review activity into other areas of their teaching. Contrary to conditions at the beginning of the year when computers in the classrooms were used almost exclusively for drill and practice or games after other work was completed, the classroom computers began to be used for other purposes.

The most notable example occurred in Ms. Pearson's class. In February Ms. Pearson announced that she planned to break students into groups to create a class multimedia review of a book that students were going to read for a social studies unit on the U.S. Civil War. Her log states:

> Today I gave all of my students a copy of *Shades of Gray*. They are going to do a book report on the computer. They were very excited and immediately began to read. I am going to let them group together to do different parts of the book report. They are going to make the decisions on the way the book report should be done. Almost everyone uses any spare moment to read this book.

Students also decided to create a video based on the book, and they took charge of all aspects of the production, which included elaborate costumes and staging; according to Ms. Pearson, "they were willing to give up breaks to organize the video." This activity led students to explore independently aspects of books that they would have been unlikely to encounter in doing the conventional book reports. For example, Ms. Pearson stated in her log that one of the groups involved in this class project dealt with "problems of main character—and how they would react if faced with same challenges." The multimedia book review project clearly stimulated involvement in this rich, less conventional literacy activity.

Nonetheless, the general enthusiasm for and commitment to the project tended to balance, sometimes precipitously, on its relation to conventional instruction. Teachers often expressed the benefits of the project in terms of conventional instructional goals while enjoying its less academically oriented effects, occasionally linking the two as when we pointedly asked the Borders School teachers in a meeting: "Does the need to make the book review presentable play any role in dampening students' enthusiasm?" Two teachers answered "no" loudly in unison. Students, too, were affected by this balance. If the multimedia book review activities began to take on the characteristics of conventional classroom activities, enthusiasm waned. For example, in a February interview Ms. Ellers observed, "several [students] don't come in [the lab] as much anymore because they know that is the requirement now; if they don't have their book review ready or [haven't yet] written it, then they're not ready to go to the lab."

The challenge of using technology, particularly HyperCard, seemed to play a major role in tilting the balance away from conventional instruction. Sustaining conventional modes of instruction was difficult when teachers and students were engaged in exploring the capabilities of the computer. For example, as we pointed out in a previous section, teachers were less inclined to see themselves as experts in the computer lab, often deferring to students. In addition, students' and teachers' work on HyperCard involved highly engaging and interesting activities in a nonthreatening academic environment that was separate from the classroom where participants carried out most of their daily routine. Students who had academic problems in the classroom frequently excelled in using the technology, and students' increased interactions with their peers and with their teachers were frequently supportive and positive. The cumulative effect of these characteristics seemed to override teachers' concerns associated with conventional instruction. However, entering information about books, as a more conventional activity, seemed to remind participants of more academic concerns, which in turn evoked more conventional responses.

As the emphasis on learning and using HyperCard decreased, concerns related to conventional academic goals and achievement increased, thus perhaps negating some of the potential of the multimedia book review activity to transform instruction. At Hartwig School this effect was mitigated by the fact that the intervention clearly extended into other classroom reading and writing activities and indeed into other areas of the curriculum. At Collins School, where students were not systematically taught HyperCard and where students completed project activities in their classroom, the technology remained firmly entrenched within the context of conventional classroom activities. This, too, may account for the relative lack of involvement by teachers and students at Collins. We see Borders School as representing a middle ground where interest in technology was high and sustained the activity much of the year, but where there was little evidence that the intervention was influencing instructional activities beyond the specific book review activities. Consequently, some students seemed to lose interest in the book review activity later in the school year.

Comparing our experiences within and among schools, we hypothesize that the initial contribution of the intervention toward accomplishing the pedagogical goal depended on how involvement with technology estab-

lished a positive context that transcended conventional academic activities as well as teachers' and students' typical responses to them. Multimedia book reviews, perhaps representative of similar computer-based activities that have the potential to transform instruction, are associated positively with such an environment and contribute to the pedagogical goal as mediated by factors such as increased interaction. However, as emphasis shifts away from learning and using the technology and toward completing book reviews, a more conventional mindset emerges. Teachers begin to associate the project's benefits with conventional academic skills such as writing and conventional practices such as requiring a minimum amount of reading. However, these effects may be mitigated when teachers more fully integrate computers into their classroom teaching and extend the multimedia book review activities into other areas of the curriculum.

Unanticipated effects and other possible pedagogical goals

Formative experiments focus on data relevant to the stated pedagogical goal, but the instructional intervention may produce other unanticipated outcomes and perhaps advance other pedagogical goals (Newman, 1990). In this section we address the final question guiding formative experiments as we have interpreted them: "What unanticipated positive or negative effects does the intervention produce?" Our findings related to this question may suggest additional research investigating other pedagogical goals related to multimedia book reviews or similar computer-based literacy activities.

One prominent finding was that students attended more to the technical aspects of their writing, which pleased their teachers. Our field notes are replete with observations that students attended more closely to spelling, grammar, capitalization, and punctuation when creating their reviews. For example, soon after students began entering their reviews at Hartwig School, one of us observed:

> I've noticed that students are much more careful with their writing. They ask how to spell words when writing. [Ms. Burton] noticed too that students working in the lab are more concerned about their spelling. [She felt that] students feel some ownership over their book reviews.

Students seemed conscious of the multimedia book reviews as public documents intended for real use by adults and other students. Jason, one of the focus students at Hartwig School, stated, "I have to fix that [spelling error] because I don't want anybody to think I'm dumb." Teachers regularly stressed technical correctness in students' writing throughout the school day, but we found that their admonitions were more likely to be followed while creating book reviews. This finding is consistent with the long-standing principle that students are more likely to engage in and attend to reading and writing activities that are personally meaningful (Kirby & Kirby, 1985). From comments in their logs and in focus-group interviews, it was clear that this outcome was an important benefit of the project for the teachers, especially because they believed that it carried over to other writing activities in the classroom.

Another clear finding was that participation in this project promoted professional involvement. For example, all of the teachers presented at least once at a professional conference (to our knowledge, none had done so before); one teacher began an advanced degree program in conjunction with the project; three teachers submitted proposals to a state conference on their own in the year after the project. Several teachers noted in their logs that these activities were professionally meaningful and rewarding. The active role of teachers in formative experiments such as this one may be beneficial in promoting professional growth.

In addition, parental involvement in the classroom and school increased. The project generated much enthusiasm among students' parents in all three schools. Literacy and technology seemed to be especially important topics to parents. For example, we had no difficulty recruiting parents to become trained lab assistants for the project at Collins and Hartwig Schools during year 1. Parental involvement took other forms as well. Parents were involved in making costumes and props for the students' video production in Ms. Pearson's class. At Borders School, where parents were not recruited to assist with the day-to-day multimedia book review activities, many parents attended a school technology fair because they wanted to see their children's multimedia reviews, which were one of the displays. Parental involvement was valued by teachers, administrators, and students, which is consistent with using technology to create a community of learners as has been proposed by writers such as Keeler and Alexander (1994).

Finally, we found that the project heightened students' and teachers' awareness of electronic forms of reading and writing. In this project, students and teachers became familiar with how texts might be incorporated with other media to create electronic documents, and there was some evidence that their familiarity carried over to other reading and writing tasks. For example, Ms. Burton created a computer tutorial to guide students' preparation of their science fair projects, and a student in Ms. Pearson's class created an electronic valentine shared with the class. This finding is important in light of calls for increasing attention to digital, representational, and

visual literacy (The Cognition and Technology Group at Vanderbilt University, 1994; Flood & Lapp, 1995; Leu, 2000). That students and teachers expanded their conception of reading and writing also complements and extends to the middle school level the findings of Labbo (1996) in the primary grades and Tierney et al. (1992) in the secondary grades.

Discussion

In presenting categories of our results in previous sections, we discussed interpretations, previous research, limitations, and some future directions. In this section we summarize what we believe to be the most important conclusions that can be drawn from our findings and how this study adds to the existing literature.

Both the quantitative and qualitative data indicate that the multimedia book review activity contributed to advancing the pedagogical goal of increasing independent reading. However, our formative approach led us to discover that the mechanism of this contribution was not as we had anticipated at the outset of the project. That is, progress toward the pedagogical goal was often mediated by students' and teachers' responses to the challenges of the technology, particularly HyperCard, not exclusively by their involvement in creating multimedia book reviews and sharing them with others. The introduction of the multimedia book review activity represented a novel intrusion into normal classroom routines, which was greeted with much enthusiasm by teachers, students, administrators, and parents. That climate seemed to facilitate an increased engagement in literacy-related activities among students and teachers, which was supported by positive changes in social interaction patterns among students and between students and teachers. This conclusion was foreshadowed in the following transcription from one of our audiotaped field notes at Hartwig School during February:

> [Ms. Pearson's comment] leads me to think that maybe some of the effects of the project are indirect in the sense that teachers' involvement with the project is leading them to emphasize independent reading more, which filters down to the students, so that some of the effects we're seeing...are not directly due to the students entering book reviews but the total impact that the project is having on the school or the teachers such that independent reading is emphasized more.

The pedagogical goal of increasing the amount of independent reading was advanced more by connecting books to an engaging, challenging use of the computer than by the technology's capability to enable sharing of information about books. This realization gradually led us to conclude that the considerable time and effort devoted to helping teachers and students learn HyperCard was not just a frustrating distraction from our intended goal but was an important mechanism to enhance it.

This conclusion has implications beyond our pedagogical goal and the instructional intervention investigated. A useful pedagogical principle regarding computer-based instructional activities in general may be that various curricular goals can be advanced by embedding relevant content within technologically challenging and engaging tasks such as learning to use HyperCard. Seeing involvement with technology as a way to mediate the accomplishment of a valued pedagogical goal is consistent with the perception of many educators that technology can be valued intrinsically for that purpose (Means et al., 1993).

This conclusion is also important because it counters the reservation that developing technological expertise can occur only at the expense of other curricular and pedagogical goals. It also mitigates the findings of previous research suggesting that even carefully designed computer-based literacy activities implemented over an extended time are not likely to transform instructional practice and learning (Bruce & Rubin, 1993; Miller & Olson, 1994). Although the degree to which the intervention and its accompanying technological perspectives positively transformed instruction differed markedly across teachers and schools in this study, we did find some evidence that transformations were occurring and, perhaps more important, we have some basis for speculating about what conditions might enhance or inhibit such transformations. For example, our finding of increased student engagement and positive changes in social interactions, especially among low-achieving and low-interest students, suggests that involving students with technologically challenging literacy activities may provide an important foundation for literacy development. Importantly, increased engagement and positive social interactions were evident consistently across all classrooms and schools when students were involved with project activities.

Several factors may explain why this transformation in social interaction patterns was a springboard for extending project activities into other areas for some teachers but not for others. These factors include the following: (a) the active involvement and leadership of a teacher who assumes the role of technology expert; (b) supportive, collaborative colleagues and administrators who work in an environment that encourages independent thinking and flexibility in meeting instructional needs, and (c) sufficient access to needed hardware and technological support. Furthermore, the differences in the degree to which teachers appropriated the technology beyond project activities supports the point of view that

teachers must independently conceptualize extensions of computer-based literacy activities into other curricular areas or aspects of their teaching (Bresler & Walker, 1990). Teachers tended to see the multimedia book review activity in light of conventional goals and would respond with marginal enthusiasm on the few occasions that the university researchers informally offered ideas for extending activities beyond the project. However, as illustrated by Ms. Pearson's extension of the project to her social studies unit, teachers might appropriate technology for literacy activities when they see connections to their personal teaching goals. These findings add nuance to the broad categories found in previous work suggesting that teachers go through distinct stages in the process of integrating technology into their teaching (Dwyer, Ringstaff, & Sandholtz, 1991).

Thus, although this study adds support to previous findings that computer-based activities alter positively the social dynamics surrounding instructional activities (e.g., Hadley & Sheingold, 1993), this transformation alone does not appear to transcend teachers' commitment to conventional instructional goals and activities. Such findings are consistent with Newman's (1990) description of a formative experiment's possible outcomes when he stated, "[the educational environment] may also retain goals and organization in spite of the technology designer's concerted efforts to support alternative models" (p. 10). Nonetheless, it may be that teachers are more receptive to transforming their instruction within the context created by a computer-based activity that points in that direction, although the data in this investigation only support that contention indirectly. One development supporting such an interpretation is that the project activities continued to be implemented at Hartwig and Borders schools during the following school year after the project was completed.

Beyond the findings related to this particular computer-based literacy activity and how it might increase independent reading, we believe this study adds to the literature on several levels. First, it responds to the dearth of research investigating new technologies in relation to literacy instruction (Kamil & Lane, 1998), which, given the rapid infusion of those technologies into literate activity, is of increasing concern (Leu, 2000). Moreover, it provides additional insights into why some computer-based interventions aimed at positively transforming literacy instruction have been successful in doing so (e.g., Garner & Gillingham, 1996; 1998) and some have not (e.g., Bruce & Rubin, 1993). The results of this study also extend and complement the research investigating independent reading among students in the middle grades. For example, in addressing the limited research in that area, Ivey (1998) has documented the complexity of middle school readers' views towards and engagement in independent reading. Our results with children who are at or on the threshold of becoming middle school readers are consistent in documenting that complexity in the context of a technology-based intervention.

Beyond extending understanding about a particular intervention and computer-based literacy activities in elementary classrooms, we hope that this investigation has promoted understanding and awareness of formative experiments as a research methodology. We believe it fills a methodological gap in existing intervention research that is only beginning to be explored by literacy researchers (e.g., Jiménez, 1997; Neuman, 1999; Reinking & Watkins, 1998). We encourage researchers to consider conducting formative experiments to study classroom interventions aimed at enhancing literacy. Doing so, we believe, would enrich findings from other approaches to research by addressing questions and revealing insights not typically associated with alternative methodologies.

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APPENDIX A

Parent questionnaire

We appreciate your cooperation in taking 10–15 minutes to complete this questionnaire, which should be returned to your child's teacher. This information is important to participation in the special computer project. If you have your child deliver the completed questionnaire to her/his teacher, you may want to seal it in the attached envelope. Thank you for your assistance.

Your child's name: _____

1. Of the following activities, check the three that your child is most likely to do during free time at home.

____	play outside	____	talk on the telephone
____	work on arts and crafts	____	listen to music
____	read a book or magazine	____	play video games
____	work on a hobby	____	watch TV
____	play a musical instrument	____	play with toys
____	dramatic or pretend play (skits, playing house, outerspace, etc.)	____	other (describe) _____ _____

2. Circle the activity in number one that your child does most during free time.

3. On average, how long does your child spend reading for enjoyment each day?

   ____ hours ____ minutes

4. On average, how long does your child spend watching TV each day?

   ____ hours ____ minutes

5. Of the following statements, check the one that best applies to your child:

   ____ My child rarely, if ever, reads anything for enjoyment.
   ____ My child reads for enjoyment once in a while.
   ____ My child reads regularly for enjoyment, but not a lot compared to other activities.
   ____ My child reads regularly and often for enjoyment.
   ____ My child reads for enjoyment almost all the time he/she has an opportunity to do so.

6. How would you rate your child's reading ability? (Check one.)

____	Well above average	____	Below average
____	Above average	____	Well below average
____	Average	____	I'm not sure

7. Are there children's books in your home for your child to read? ____ yes ____ no
   If so, about how many?

   fewer than 5 5–20 20–50 50–100 more than 100

8. Does your child use a computer at home? ____ yes ____ no
   If yes, what kind?

9. Rate on a five-point scale how often your child does the following? (Circle a number for each statement.)

	Never				Very Often
Order books from book clubs.	1	2	3	4	5
Look at books/magazines in stores.	1	2	3	4	5

(continued)

APPENDIX A

Parent questionnaire (continued)

	Never				Very Often
Ask for books/magazines as gifts.	1	2	3	4	5
Complain about having to read a book for school.	1	2	3	4	5
Bring home something from school to read for enjoyment.	1	2	3	4	5
Talk about something he/she has read.	1	2	3	4	5
Ask to go to the library to find something to read.	1	2	3	4	5
Look up information in the dictionary or encyclopedia.	1	2	3	4	5
Read something to you.	1	2	3	4	5
Read something in the newspaper.	1	2	3	4	5
Give someone reading material as a gift.	1	2	3	4	5
Read to another child.	1	2	3	4	5
Say he/she doesn't like reading.	1	2	3	4	5
Recognize or talk about a particular author.	1	2	3	4	5
Go to movies or watch TV programs about books he/she reads.	1	2	3	4	5
Write her/his own books or stories for enjoyment.	1	2	3	4	5
Read about places he/she will visit/is visiting on a trip.	1	2	3	4	5
Say that reading is boring.	1	2	3	4	5
Read cereal boxes or other materials while eating.	1	2	3	4	5
Read in front of the TV.	1	2	3	4	5
Choose Halloween costumes based on book characters.	1	2	3	4	5
Use his/her own money to buy a book.	1	2	3	4	5

10. Have you observed other behaviors (positive or negative, like the ones above) that indicate how much your child reads and how he/she feels about reading? If so, please describe them. (Use the back of this questionnaire, if necessary.)

11. Does your child have a library card? _____ yes _____ no

12. About how many times a month does your child go to the library? (Circle one.)

    0 1 2 3 4 5 more than 5

13. If your child went to the library, about how many books would you expect her/him to check out?

    0 1–3 4–10 more than 10

14. How much does each of these statements sound like your child? (Circle a number.)

    a. He/she always reads the same kind of reading material on the same topic (for example, just comic books about the same character or just books about horses.)

    Not at all like my child 1 2 3 4 5 Very much like my child

    b. He/she reads one type of reading material (for example, just books or just newspapers), but reads about a variety of topics.

    Not at all like my child 1 2 3 4 5 Very much like my child

(continued)

c. He/she reads many types of reading materials (for example, books, magazines, newspapers, encyclopedias, etc.), but reads mostly on one topic.

Not at all like my child	1	2	3	4	5	Very much like my child

d. He/she reads many types of reading materials on many different topics.

Not at all like my child	1	2	3	4	5	Very much like my child

15. Do you subscribe to any magazines for children? ____ yes ____ no
If so, how many? (Circle one.)
1 2 3 more than 3

16. Most of the adults that my child knows outside of school (Check one.)
____ hardly ever read for enjoyment.
____ read once in a while for enjoyment.
____ read often for enjoyment.
____ read very often for enjoyment.
____ I don't know.

17. Most of the children that my child plays with outside of school (Check one.)
____ hardly ever read for enjoyment.
____ read once in a while for enjoyment.
____ read often for enjoyment.
____ read very often for enjoyment.
____ I don't know.

*18. During the past school year, how often has your child talked about using the computer for reading at school? (Check one.)
____ never
____ often
____ occasionally
____ almost every day

*19. During the past school year, how has your child's out-of-school reading changed? (Check one.)
____ reading much less than before
____ reading a little less than before
____ reading about the same amount as before
____ reading a little more than before
____ reading a lot more than before

*20. During the past year, how has your child's interest in reading changed? (Check one.)
____ much less interested in reading
____ a little less interested in reading
____ about the same interest in reading
____ a little more interested in reading
____ much more interested in reading

*21. Comment, if you wish, on your child's reading, use of the computer, and so forth. We are especially interested if you believe you have seen any connection between reading activities on the computer at school and reading-related activities outside of school.

*These items were on the end-of-year survey only.

APPENDIX B

Choosing things to read questionnaire

Part 1

Directions: Suppose that your teacher says you must choose a book to read from the library. From the list below, check any of the kinds of books you might choose to take home to read. Remember, check any kind of book you might want to read. But, don't check a kind of book if you probably wouldn't want to read it.

____ a book about how to play a sport
____ a book about an event in history
____ a story that is a mystery
____ a make-believe story
____ a story about a pet
____ an encyclopedia
____ a book about cars or trucks
____ a book about a person in history
____ a science fiction story
____ a book about a movie or TV star
____ a story about Indians
____ a book of beautiful poems
____ a story about someone my age
____ a story about people in other countries
____ a book of fairy tales or myths
____ a book on science experiments
____ a story about scary things
____ a book about animals
____ a story about a horse
____ a book about planes
____ a story that makes me laugh
____ a book about dinosaurs
____ a book of jokes
____ a book of funny rhymes and riddles
____ a book about how to cook something
____ a book of cartoons
____ a book about trains
____ a story about someone in a war
____ a story about strange creatures
____ a story that takes place in the future
____ a story about an adventure
____ a book about caring for animals
____ a book about volcanoes
____ a story about someone my age
____ a story about kids getting along
____ a book with maps
____ a story about faraway places
____ a story about playing sports
____ a story about monsters
____ a book about my future job
____ a book about things that are strange but true

Part 2

1. What are some other kinds of books that you like to read?
2. What are your favorite kinds of books?

Part 3

Directions: When you choose a book to read, what do you think about?

1. How the cover of the book looks.
2. How many pictures the book has.
3. How long the book is.
4. What my friends say about the book.
5. What my teacher says about the book.
6. If I know the author of the book.
7. Whether I will like the characters or not.
8. Whether I think I will learn something from the book.

(continued)

APPENDIX B

Choosing things to read questionnaire (continued)

Part 4

When you read on your own, how often do you...

1. read books?
2. read magazines?
3. read newspapers?
4. look for information in books like encyclopedias, dictionaries, atlases?
5. read stories that have characters made up by the author?
6. read books that give information?
7. read about how to do something?
8. read about people who really lived and things that really happened?
9. read books that are funny?
10. not finish a book?
11. read poetry?
12. read about sports?
13. read about animals?
14. read about science?
15. read about adventure?
16. read stories that are make believe?

Note: For Parts 3 and 4, students were provided with the root for each item followed by these choices (scores are in parentheses): never (0), once in a while (1), often (2), always (3). Scores for items 1–3 in Part 3 were reversed. The total score was the sum of items checked or identified in Parts 1 and 2, and the values from Parts 3 and 4.