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**THE EFFECTS OF USING DIRECT INSTRUCTION AND COMPUTER-ASSISTED  
INSTRUCTION ON TEACHING DECODING SKILLS TO ELEMENTARY STUDENTS  
WITH LEARNING DISABILITIES**

by

Jessica L. Schramm

A Thesis

Submitted to the  
Department of Interdisciplinary and Inclusive Education  
College of Education  
In partial fulfillment of the requirement  
For the degree of  
Master of Arts in Learning Disabilities  
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Thesis Chair: Joy Xin, Ed. D.

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## **Dedications**

This paper is dedicated to my parents, James and Theresa Schramm, and my fiancé, Christopher Lucisano, for their support during this research.

## **Acknowledgement**

I would like to express my appreciation to Professor Joy Xin for her support and guidance during this research.

## Abstract

Jessica Schramm

THE EFFECTS OF USING DIRECT INSTRUCTION AND COMPUTER-ASSISTED  
INSTRUCTION ON TEACHING DECODING SKILLS TO ELEMENTARY STUDENTS  
WITH LEARNING DISABILITIES

2015-2016

Joy Xin, Ed. D.

Master of Arts in Learning Disabilities

The purposes of this study are to examine the effect of the *Project Read* program in teaching decoding skills to students with learning disabilities, and evaluate the effects of the supplemental computer program, *Explode the Code*. Three second grade students with learning disabilities participated in this study. Both interventions were administered to each student, at different times, during the school day. *Project Read* was administered followed by 15-20 minutes of *Explode the Code*. . A multiple baseline research design across students with A B phases was used in this study. The results of the current study showed significant growth in the area of decoding skills. The intervention programs can be used in special education classrooms, as well as in general education settings, for students who are struggling with foundational reading skills, primarily decoding skills.

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# **Chapter 1**

## **Introduction**

### **Statement of Problems**

Most students with learning disabilities (LD) have reading difficulties (Staudt, 2009). Working as a special education teacher for several years, I have noticed that there may be several factors that may impact on a student's reading performance. First, these students may have not been exposed to reading at a young age. Second, they may not have learned decoding skills to recognize words in their reading, or transfer their listening skills into their own reading. Their difficulty may continue when entering school, to impact their reading fluency.

As teachers, it is imperative that we work with our students to ensure they understand the foundational skills of reading. The foundational skills include: distinguishing long and short vowels, knowing sound-spelling correspondences, decoding words with vowels, common prefixes and suffixes, and recognizing irregular spelling (Common Core Curriculum Standards, 2010). The most common problem is that 80% of primary graders lack the necessary core phonological skills in reading (Regan, Berkeley, Hughes, & Kirby, 2014), and struggling readers have difficulty in decoding words. It is found that students with stronger phonemic awareness exhibit more progress in word identification than those with poor performance (Kuder, 1991). Thus, phonological awareness is the most important predictor of early reading (Carlson, Matheis, & Wilson, 2001).

Mastering phonemic awareness leads to reading with improved accuracy and speed that impact fluency (Regan et al., 2014). If these skills are not acquired, further remedial instruction is needed in later grades (Staudt, 2009). Phonemic awareness is the foundation for reading, which allows students to become fluent readers and increase their reading comprehension. The main skill of phonemic awareness is decoding. When decoding skills are taught, students are able to sound out and recognize words in the text to overcome pausing or hesitating during reading.

There are five components of reading instruction in elementary school (Armbruster, Lehr, & Osborn, 2003). These include phonemic awareness, phonics, vocabulary, fluency, and comprehension. The foundational skills in phonemic awareness include letter identification and decoding skills. It is believed that without mastering these skills, students would struggle with reading.

The English language consists of 41 phonemes that are made up of tiny, abstract sounds. Phonemic awareness involves using the alphabet letters to manipulate phonemes, such as blending and segmenting (Carnine, Kame'enui, Silbert, & Tarver, 2004). For example, initial word reading is completed in a vowel-consonant-vowel (VCV) pattern or consonant-vowel-consonant pattern (CVC). The letter-sound correspondence should be taught prior to decoding. When decoding is first taught, the students should be prompted to sound out the letters followed by practice until they are able to sound out on their own.

Phonemic awareness can be taught using explicit instruction. It builds the foundation for students to start reading text. According to Carnine, Kame'enui, Silbert, and Tarver (2004), students should receive approximately 20 hours of instruction each week to learn decoding skills to improve their overall reading skills. Small group activities are recommended as well as on going assessment to monitor student progress (Carnine et al, 2004).

Explicit instruction is encouraged in reading, such as Direct Instruction (DI). DI includes teacher's modeling and feedback given to students; guided practice, followed by independent practice and tests (Regan et al., 2014). It is found that programs based on DI are the most effective to students in the primary grades and to those with LD (Scarcelli & Morgan, 1999) because DI allows teachers to focus on specific skills in sequential steps to guide individual students based on their needs (Regan, 2014).

According to Carnine et al. (2004), DI is one way to teach phonemic awareness and decoding skills. The components of DI in reading include: teacher-directed instruction, sequenced materials, clear goals, sufficient time to practice, progress monitoring, and feedback (Carnine et al., 2004).

There are several reading programs implemented in school based on DI. One of these is called *Project Read*. *Project Read* includes multi-sensory components in Language Arts. According to the Florida Center for Reading Research (2007), *Project Read* provides visual, kinesthetic, auditory, and tactile methods, along with body language (2007). This multi-sensory approach embedded in the program

keeps students engaged in the lesson, and the body language and graphic symbols help students recall the reading context (What Works Clearinghouse, 2010). The program also integrates five components, such as comprehension, phonological awareness, vocabulary, fluency, and phonics into reading instruction (Florida Center for Reading Research, 2007). The lessons are organized in a structured manner for explicit instruction. The entire curricula are divided into three sets of grade levels and reading skills, from Early Education (pre-kindergarten to kindergarten), decoding (1<sup>st</sup> to 3<sup>rd</sup> grade), linguistics (4<sup>th</sup> to 12<sup>th</sup> grade), with phonics instruction provided at each grade level. The lessons can be taught in a small group or whole class setting each day (2007).

Each lesson includes practice to check for understanding, supplemental worksheets, guided reading and tests. A mastery assessment is administered after 43 units along with end of year tests. Each lesson begins with a review of skills that were taught in previous lessons, followed by modeling, guided practice, independent practice, and progress monitoring (Florida Center for Reading Research, 2007). *Project Read* uses a multi-sensory approach to engage students in learning the material. This multi-sensory approach includes kinesthetic activities such as using sand trays or sky-writing, which were identified as effective strategies for students with LD (Bruce & Salzman, 2002).

Currently, incorporating technology into reading instruction such as computer programs to teach decoding skills is found in school (Torlakovic, 2014). It is called Computer Assisted Instruction (CAI), which refers to using a computer

program as an instructional tool to teach, guide, and evaluate a student until the student reaches a determined level of proficiency (Torlakovic, 2014). It is found that CAI motivates students with LD's learning, for example, increasing student's engagement, and intensive practice in word recognition and decoding skills (Staudt, 2009). Computer programs are commonly served as a supplemental material to Direct Instruction. Sample programs include *Explode the Code*, *Megawords: Multisyllabic Words for Reading, Spelling, and Vocabulary* (Staudt, 2009).

*Explode the Code* is one of these computer programs. It builds the essential foundational literacy skills with a multi-sensory approach, which coincides with the material developed in *Project Read*. There are five components of CAI that are incorporated into the framework for *Explode the Code*. These include: correctly targeted instruction, explicit instruction, appropriate level of challenge, response opportunities, and immediate feedback (Torlakovic, 2014). The multisensory approach includes auditory and visual reinforcement, which is effective for students with disabilities. Students are also given an individualized, structured lesson plan that can be adjusted to meet their needs (Torlakovic, 2014). *Explode the Code* is designed to establish phonological awareness and decoding skills for learners to develop fluent reading.

### **Significance of the Study**

Phonemic awareness is taught using systematic and explicit instruction, such as Direct Instruction (DI) in reading. The *Project Read* program is one of the DI reading programs provided in school. Current studies have found that *Project Read*

when used with a supplemental program is effective in building students' foundational reading skills (Bruce, Snodgrass, & Salzman, 1999). Research has found that there is little to no increase in assessment scores when using CAI by itself (Stetter & Hughes, 2011). There is also little research on the effects of CAI in teaching decoding skills of students with LD, especially specific programs involved, such as *Explode the Code*. This study is designed to evaluate the effect of using DI called *Project Read*, and the supplemental computer program, *Explode the Code*, to teach decoding skills to students with LD.

### **Statement of Purpose**

The purposes of this study are to: (a) examine the effect of the *Project Read* program in teaching decoding skills to students with LD, and (b) evaluate the effects of the supplemental computer program, *Explode the Code*.

### **Research Questions**

1. Will students with LD improve their decoding skills when Project Read program is provided?
2. Will students with LD improve their decoding skills with the supplemental computer program, *Explode the Code*?
3. Do both *Project Read* and *Explode the Code* assist students in building their decoding skills?



## **Chapter Two**

### **Literature Review**

In elementary schools, the academic subject of reading is taught in five components: phonemic awareness, phonics, fluency, vocabulary, and text comprehension (Armbruster et al., 2003). Students with learning disabilities (LD) tend to have difficulty in each component, from phonemic awareness to comprehension (Selfridge & Kostewicz,, 2011). In the United States, 90% of students with LD have difficulty in reading independently (Stetter & Hughes, 2011).

Reading difficulty is the most common learning problem in school, which is the leading cause of student's academic failure, because reading is part of student learning in other subject areas. According to Ergul (2012), 88% of students who are poor readers in the 1<sup>st</sup> grade, continue to struggle in reading during the later grades when reading increases in difficulty levels. Phonological awareness is the area of foundational skills to teach students to manipulate parts of language (Armbruster et al., 2003). Different strategies are provided in phonics instruction. Of these, Direct Instruction (DI) and computer-assisted instruction (CAI) are two examples. This chapter reviews studies related to these strategies in reading instruction.

#### **Direct Instruction**

Direct Instruction (DI) is a skills-oriented approach to teaching reading. It is focused on teacher directed instruction using step-by-step format in small groups or individual learning with face-to-face feedback. The lessons are carefully articulated to break down skills into small and sequential units and taught explicitly (Carnine,

et. al., 2004). DI techniques include teacher modeling, unison reading, and systematic review and practice of skills with well-designed materials, specific presentations, and adequate instructional time (Carnine, et. al., 2004).

In Pullen, Lane, and Lloyd's study (2005), the effects of DI on pseudoword decoding rate was examined. The study consisted of 9, 1<sup>st</sup> graders who were at-risk in reading. The baseline assessment was a class-wide screening of invented spelling in which students were given 10 words to spell out. Those students who scored below the 20<sup>th</sup> percentile were selected as participants in the pseudoword reading assessment. Following the assessment, interventions were implemented to two classes at a private parochial school. The interventions were completed to groups of three students in a quiet area separate from the general classroom.

Students read lists of pseudowords each day and the number of words read both correctly and incorrectly was recorded. The explicit decoding instruction using manipulative letters was provided. Students were given books from the Reading Recovery system, accompanied by letters and magnetic boards to create words and pseudowords. Students were measured with the pseudoword-decoding list within a one-minute time limit. Both correct and incorrect responses were recorded.

The results of the study showed that the pseudoword- decoding rate changed gradually over time; representing a functional relationship between instruction and decoding variables. The limitation was limited time with sub-optimal materials. With extended time and different materials, the study may have been more successful.

DI was evaluated by Ashworth's study (1999) to examine reading achievement of 2<sup>nd</sup> graders using the Scientific Research Associates (SRA) reading program as compared to students who were taught with the Basal Reading Program. Two groups of 2<sup>nd</sup> graders participated in the study from two consecutive years; the first consisting of 23 students and the second of 19, attending a primary school.

The first year's students received instruction from a basal reader program as a control group, while the second year was taught using the SRA Reading Program as an experimental group. The baseline scores from the Georgia Kindergarten Assessment Program (GKAP) were examined to make sure all participants with the same intellectual ability were grouped. The Iowa Test of Basic Skills, which included sub tests relating to vocabulary, comprehension, spelling, and language was provided to evaluate student performance.

It is found that the students taught by the DI using SRA had achievement scores between 5-13% higher than those taught with the Basal Reading program. It is indicated that DI focused on decoding skills, building learners' confidence to allow the teacher to monitor progress in intervals, and integrate systematic procedures to correct student errors.

Further, Ryder, Tunmer, and Greaney (2008) compared student performance with the use of explicit instruction in phonemic awareness and decoding skills to compare with whole language instruction. It involved 24 children aged 6-7 who were at-risk in reading in New Zealand. The students were given the Burt Word Reading Test to collect the baseline. Twelve students were chosen and divided into

two groups with six in each for the experimental and control groups. The intervention included 56 highly sequenced, semi-scripted lessons in phonemic awareness and phonemically based decoding strategies in a single session for two days each week. The control group received whole language instruction.

The results of this study showed that both groups made gains, but the experimental group outperformed the control on the post-test. Two years later, the same group of students was tested again and the experimental group displayed significant gains. It seems that DI is effective in teaching foundational reading skills, such as phonemic awareness, to students with and without learning disabilities. Some specific programs were developed based on DI, such as Project Read.

Project Read is a program with a systematic, multi-sensory approach to teach phonemic awareness. The program was developed based on the idea that children learn in different ways. It involves teaching decoding and encoding words to students who are at-risk and those with LD (Bruce et al., 1999).

Bruce, Snodgrass, and Salzman's study (1999) examined how two programs, Project Read and Reading Recovery, can be used together to teach at-risk students to develop literacy skills. The study focused on four areas of literacy: word identification, writing, vocabulary, sentence dictation, and text comprehension, as well as the use of reading comprehension strategies.

A total of 11 students identified as at-risk by their previous teachers, participated in this study. All participants were given Clay's Observational Survey of Early Literacy Achievement as a baseline assessment to test seven areas of literacy:

print orientation, letter identification, letter-sound correspondence, writing vocabulary, word identification, sentence dictation, and text comprehension. Additional assessments were running records and sign tests. The reading teacher provided instruction to all participating students using guided reading followed by Project Read.

For the first part of instruction, these students were divided into guided reading groups. With the reading teacher, students reread familiar stories and then were introduced to new stories. The reading teacher also recorded each student's reading strategy used during reading. Students were guided to retell the story, discuss story elements, and find out phonemic patterns in words. Guided reading books were sent home for their parents to read with their child together to reinforce reading activities. In Project Read lessons, students were divided into two groups to work on foundational literacy skills, such as consonants, short vowels, consonant blends and digraphs, and long vowels. Each lesson was taught using DI, with multi-sensory activities such as writing in sand while saying letter sounds and skywriting letters and words.

The results showed that all students made significant gains in the four areas of literacy and improvement in their use of strategies such as self-regulation and self-correction during their reading. Although this study was conducted with 1<sup>st</sup> graders, it may also be applicable to those at higher grades. Further research may be necessary to examine continued growth in the students' phonological skills and reading comprehension skills.

## **Computer Assisted Instruction**

Computer Assisted Instruction (CAI) refers to instruction using a computer. CAI illustrates concepts in different ways, provides differentiation and feedback, and paces the student's learning until they reach the mastery level. Computer programs can be used as supplemental instruction for reading (The Access Center, 2004). It has been shown that students with LD benefit from supplementing reading instruction with computer programs and repeated practice (Stetter & Hughes, 2011).

In Gibson, Cartledge, and Keyes's study (2011), students at risk for potential reading failure were provided a computerized supplemental reading program to improve their oral reading fluency, reading growth rates, and comprehension. The participants were chosen based on scores obtained from the Dynamic Indicators of Basic Early Literacy Skills (DIBELS). A total of 8 students, from two different urban charter schools, were chosen based on the results of this benchmark assessment and received interventions 3-4 times each week for a total of 14-16 weeks.

The DIBELS was administered in the winter to collect baseline data. The assessment was administered a second time in the spring. The core-reading program used in the schools was Reading Mastery. As an intervention, Read Naturally Software Edition (RNSE) was used as a computerized reading program for all participating students. This computer program followed a structured plan, which involved key words, 1-minute independent reading, reading along, reading practice, comprehension test, and a reading check out. The instruction was provided in quiet

rooms equipped with the necessary materials, and the benchmark assessments were administered individually.

The variables evaluated in this study were the number of words read each minute, oral reading fluency growth rates, and the number of correct responses to comprehension questions. The results of this study showed an overall increase in reading fluency, for example, 5 out of 8 students reduced their risk status in reading, 7 out of 8 increased their reading rate, and all students increased their reading comprehension scores. The findings indicated that the computer program, Read Naturally, could be successful in improving reading skills, but the results may also contribute to maturation of the students and the regular classroom instruction.

In Cullen, Keeseey, Alber-Morgan, and Wheaton's study (2013), the effects of CAI on the acquisition of sight words for 4, 4<sup>th</sup> graders with mild disabilities were evaluated. The 4 participants, 3 boys and 1 girl, who were receiving special education services in a resource setting for 20 to 50% of the school day. The study used Kurzweil 3000, which is a text to speech program to target sight words by allowing students to highlight spoken words on the computer screen, read and say sight words into a microphone, and read a cloze passage.

The baseline was established by having students identify sight words on the Dolch sight word list that were presented on a power point slide. Based on the baseline, students were chosen to participate in the intervention. Approximately 2-7 intervention sessions took place in 20-25 minutes in the resource room where students completed computer activities with headphones. Feedback was provided

to the students during the computer activities. At the conclusion of each intervention session, a probe was administered.

The dependent variable in this study was the percentage of accuracy on a 10-14 word probe, which was administered following each intervention session. The results of the study showed that 2 students acquired 20 new sight words and 2 students acquired 15 new sight words. Four weeks after the study, 3 students demonstrated maintenance of sight words. This study was effective because it used known and unknown sight words to decrease student's frustration, provided active responses to students with continuous feedback, and gave students the opportunity to take part in multiple activities, which were motivational and engaging. The weaknesses that may have been present in the study were giving students differing amounts of time to complete activities, providing too much variety, and the price is high for school districts to implement this program.

In Stetter and Hughes' study (2011), students with LD used computers to learn a reading comprehension strategy of story mapping to improve their reading comprehension skills. The participants were randomly selected from a large urban high school. Of these, 9 students between the ages of 14 and 15 were selected.

The baseline assessment was developed with 20 comprehension questions administered by the computer. These questions targeted character's facts, vocabulary, and story grammar with inferential questions. The instructional materials included 35 stories based on their reading levels and story maps saved in the computer. During the baseline, the students met with the researcher every day



in a small group. The researcher modeled the process of reading a story and answering comprehension questions, reviewed procedures, and gave students time to answer questions independently. Students were able to use the story and vocabulary list to answer questions. The intervention was following the same process as the baseline, but added a review of the answers from the previous day's lesson.

The results of this study showed little or no increase in quiz scores as the students moved from the baseline to intervention. Although a slight increase was found in their quiz scores, students without receiving the intervention showed a slight decrease in scores, but one student increased slightly.

This study involved high school students with LD to examine the effects of computer instruction on reading comprehension. The intervention may be effective if the teacher instead of a researcher was the instructor and if there was more teacher instruction along with the computer-based activities. Students in the study appeared to lack motivation because this program did not impact their grades. Further research would be beneficial if implemented for students in primary grades.

### **Direct Instruction and Computer-Assisted Instruction**

Martin, Elfleth, and Feng (2014) compared two programs, a computer-based program, Read Naturally, and a paper-based program, Six-Minute Solution, to determine the effect on 3rd graders struggling with reading fluency. Read Naturally utilizes repetition with teacher modeling, repeated reading, and progress monitoring. Six-Minute Solution is a student driven, paper-based intervention using

repeated reading as a strategy for reading fluency. Both programs were provided to track reading fluency with repeated reading. The baseline assessment was completed using the Achievement Improvement Monitoring System (AIMSweb) which is a universal screening to track words read correctly per minute (WCPM). Progress monitoring was conducted throughout the intervention process using AIMSweb.

Participants in this study were chosen randomly and divided into two groups. The groups were made of 5, 3<sup>rd</sup> and 4, 3<sup>rd</sup> graders. Two teachers were randomly assigned to teach either Read Naturally or Six-Minute Solution for 4 days a week. As students progressed, the instruction moved to the following stories or segment of the program.

The results of the study showed that students demonstrated growth after learning both programs, but there was a more significant growth in WCPM in the Read Naturally group, because it is teacher-driven with both teacher modeling and computer-based instruction, while Six-Minute Solution was a student driven program with only incorporated teacher instruction for the pre- and post-tests.

Torgensen, Wagner, Rashotte, Herron, & Lindamood (2010) compared the effects of two reading programs, Read, Write, and Type (RWT) and the Lindamood Phoneme Sequencing for Reading, Spelling, and Speech (LIPS), on 1<sup>st</sup> graders at-risk in reading. LIPS includes phonemic awareness through explicit instruction that associates gestures with each phoneme, whereas RWT is designed for beginning alphabetic reading skills through writing and spelling activities.

The participants included two groups, each made up of 36, 1<sup>st</sup> graders in three different elementary schools. Screening took place at the beginning of the school year and assessed letter-sound knowledge to identify students at-risk for reading difficulties. After the first round of screening, the lowest 35% of students were screened again on phonological awareness, rapid automatic naming, and vocabulary development. Students were taught in groups of three by teachers who had been trained for this study. Six teachers were randomly assigned to teach these groups. The instruction time was split in half, with partial Direct Instruction and partial CAI using a computer.

The results showed that students who received LIPS outperformed those receiving RWT. It is found that students who received both the LIPS and RWT interventions showed stronger outcomes in phonological awareness, rapid naming, phonemic decoding, word reading accuracy and fluency, spelling, and reading comprehension.

Limitations in this study were that the computer instruction was not fully integrated with instruction. Students were pulled out of the general education classroom for the interventions on purpose. Further research may consider including these interventions in general education classrooms.

## **Summary**

Reviewing the research articles on DI and CAI, it is found that these programs are effective when appropriately used in reading instruction in the classroom. For example, research on DI has shown the effectiveness on reading of students with LD,

students at-risk, and those in the general education setting. DI has been regarded as the effective strategy in teaching foundational reading skills in a systematic manner, and students are able to learn these skills through a multi-sensory approach.

Computer-assisted instruction has been examined based on student performance in sight word identification, comprehension skills, and oral reading fluency. It is found that such instruction can provide an engaging way of teaching reading and motivate students to complete their assignments and activities.

Little research has been found to examine the effectiveness of a DI program together with supplemental computer programs, specifically when targeting decoding skills of students with LD. The current study will evaluate the effects of using a DI program, *Project Read*, with a supplemental computer program, *Explode the Code*, to teach decoding skills to students with LD.

## **Chapter 3**

### **Methodology**

#### **Setting**

**School.** The study was conducted in a public elementary school located in southern New Jersey. The school, built in 1958, holds approximately 550 students from pre-school to 5<sup>th</sup> grade. There are general education classrooms, as well as resource, self-contained, and basic skills settings for students with learning disabilities. These students are placed in different classrooms based on their test results and the Child Study Team's decisions.

**Classroom.** This study was conducted in a second grade resource room for language arts. There are two students, one special education teacher, and one teacher assistant in the classroom. The instruction followed a Direct Instruction model accompanied by the school's general reading curriculum for 90 minutes in Language Arts each day

#### **Participants**

**Students.** Three, second graders with LD, participated in this study. These students were diagnosed by the district's child study team according to the state administration code. Each student had an Individualized Education Plan (IEP) with goals and objectives in reading. Table 1 presents the general information about participating students.

Table 1

*General Information of Participating Students*

Student	Age	Gender	STAR Reading Scaled Scores (SS)	Classification
A	7	M	85	Communication Impairment
B	7	F	72	Communication Impairment
C	7	M	69	Communication Impairment

*Note.* The *Standardized Test for the Assessment of Reading (STAR) Enterprise*, from Renaissance Learning (2016), is a computerized assessment administered to students at the end of each marking period. Scores are reported in the form of Scaled Scores (SS). The scores of the STAR assessment are divided into: At/Above Benchmark (At/Above 192 SS), On Watch (Below 192 SS), Intervention (Below 130 SS), and Urgent Intervention (Below 87 SS).

Student A read at a first grade level. He exhibited strength in sight word recognition, but had difficulty with decoding and reading comprehension. He had some difficulty staying on task during assignments and lessons. He needed teacher’s prompts and reinforcement to complete assignments.

Student B read at a first grade level. She exhibited strength in letter recognition and sounds, but had difficulty with decoding words and blending sounds together. This student had difficulty in reading comprehension and required extra time on comprehension activities. With extra time, she was able to answer the comprehension questions if the stories were read aloud. She also had difficulty decoding words, which appeared to contribute to her poor reading comprehension skills.

Student C read at a Kindergarten level. He had difficulty with letter identification, decoding skills, reading fluency, and reading comprehension. A positive reinforcement system was provided to this student to encourage positive behavior and participation in class. He learns best using multisensory strategies in small group activities, and individualized instruction.

**Teacher.** One teacher in the resource classroom participated in the study. The teacher had four years of teaching experiences with students with disabilities in inclusion, resource room, and self-contained settings. She delivered all instruction during the study.

## **Materials**

### **Instructional Materials.**

***Direct Instruction Program.*** *Project Read* was used as a direct instruction program in teaching Language Arts in the resource classroom. This program focuses on decoding skills and reading comprehension through the use of multisensory strategies ([www.projectread.com](http://www.projectread.com)) with scripted lessons in a sequence based on each student's baseline performance (See Appendix A).

***Computer Programs.*** *Explode the Code* was used as a supplemental computer program to reinforce phonological awareness, decoding skills, vocabulary development, reading fluency and comprehension, and spelling skills. Multisensory instruction was provided to provide feedback with a direct, systematic instruction ([www.explodethecode.com](http://www.explodethecode.com)). It served as a supplement to the instruction for students in the *Project Read* program (See Appendix B).

## Measurement Materials

**Decoding Assessment.** The assessment is comprised of 5 parts including letter identification, decoding isolated words, words in text, and consonant digraphs. The first section was comprised of a list of letter identification and letter sound identification with 21 consonant and 5 vowel sounds. The rest of the four sections were short passages and lists of nonsense words to increase the difficulty level. The assessment scores were worth 142 possible points presented in percentages based on the number of correct responses (See Appendix C).

**Survey.** A survey was comprised of five questions, asking students' opinions about their experiences in learning decoding using both *Project Read* and *Explode the Code* in a "yes" and "no" format that was considered to be easy to respond for the 2<sup>nd</sup> graders. Table 2 presents the survey questions.

Table 2

### *Survey Questions*

---

1. Did you like completing the lesson in Project Read?	Yes	No
2. Did the Project Read alphabet cards and word cards help you with reading?	Yes	No
3. Did you like completing the games on Explode the Code?	Yes	No
4. Did you find the sounds helpful?	Yes	No
5. Did you like the pictures on Explode the Code?	Yes	No



## Procedures

**Instructional Procedures.** The instruction followed the school's six-day cycle. *Project Read* was provided each day of the cycle to each student individually. One student began the lesson at the beginning of class. The second student was taught the lesson 40 minutes later, then the third. Each day, the teacher instructed each student using one lesson of the program. Each lesson began with a review of the skills taught previously followed by teacher's modeling the new skill and student's practice. At the end of each lesson, students completed a worksheet that involved building words and sentences, or a review of a comprehension strategy.

Following the *Project Read* lesson, the computer program *Explode the Code* was provided. Each student was given 15-20 minutes to complete activities in this computer program. An assessment was provided after five lessons to decide whether the student should move to the next level or stay at the same to review skills. A Chrome Book was used for students to complete the assessment.

The decoding assessment was given to the students both at the middle and end of the intervention to evaluate their progress. Table 3 presents an example of the instructional procedures

Table 3

*Instructional Procedures in 1 Week*

Week	Days	Program	Description
1	1	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 1 to Student A. 15-20 minutes computer program to review decoding skills.
1	1	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 1 to Student B. 15-20 minutes computer program to review decoding skills.
1	1	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 1 to Student C. 15-20 minutes computer program to review decoding skills.
1	2	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 2 to Student A. 15-20 minutes computer program to review decoding skills.
1	2	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 2 to Student B. 15-20 minutes computer program to review decoding skills.
1	2	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 2 to Student C. 15-20 minutes computer program to review decoding skills.
1	3	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 3 to Student A. 15-20 minutes computer program to review decoding skills.
1	3	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 3 to Student B. 15-20 minutes computer program to review decoding skills.
1	3	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 3 to Student C. 15-20 minutes computer program to review decoding skills.
2	4	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 4 to Student A. 15-20 minutes computer program to review decoding skills.
2	4	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 4 to Student B. 15-20 minutes computer program to review decoding skills.
2	4	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 4 to Student C. 15-20 minutes computer program to review decoding skills.
2	5	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 5 to Student A. 15-20 minutes computer program to review decoding skills.
2	5	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 5 to Student B. 15-20 minutes computer program to review decoding skills.
2	5	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 5 to Student C. 15-20 minutes computer program to review decoding skills.
2	6	<i>Project Read Explode the Code</i>	Teacher led instruction on Lesson 6 to Student A. 15-20 minutes computer program to review decoding skills.

Table 3 (continued)

Week	Days	Program	Description
2	6	<i>Project Read</i> <i>Explode the Code</i>	Teacher led instruction on Lesson 6 to Student B. 15-20 minutes computer program to review decoding skills.
2	6	<i>Project Read</i> <i>Explode the Code</i>	Teacher led instruction on Lesson 6 to Student C. 15-20 minutes computer program to review decoding skills.

*Note.* Weekly procedures follow the same 6-day schedule each week. In *Project Read*, students move in a sequential order of lessons each week. The *Explode the Code* program moves to students to new lessons when they reach a certain level on each segment of the program. Students will individually complete one lesson of *Project Read* each day of the cycle. Student A will complete the lesson and then student B will be taught the lesson.

**Measurement Procedures.** Baseline data was collected using the decoding assessment given as part of the *Wonder Works* reading curriculum. All students in the resource department are given this assessment at the beginning of the school year and retake the assessment at the end of each marking period. The teacher conducted the assessment and students answered the questions verbally. The assessment was given to students multiple times prior to the intervention.

In addition, the decoding assessment was administered prior to the intervention. Testing was administered individually to each student. The assessment was made up of 5 parts for approximately 20 minutes. During the first part, the student was asked to identify letters by reading a list of 26 letters and identified letter sounds for the same list. During the second part, the students were required to read from a list of 10 nonsense words written in a vowel consonant (VC) or consonant-vowel-consonant (CVC) pattern. The student then read sentences,

which include 20 words from these patterns. Third, the student repeated the same process as part 2, but read words with consonant digraphs. There were a total of 20 words in this part of the assessment. In the fourth part, the student read nonsense words that had a consonant-vowel-consonant-consonant pattern (CVCC) or a consonant-consonant-vowel-consonant (CCVC) pattern followed by a short passage made up of words with the same patterns. This section was comprised of 20 words. The fifth part followed the same procedures as Part 4, but the student was asked to read words with the silent “e” (both nonsense words and words in text). Part 5 was also made up of 20 words.

Following the decoding assessment, students were given a survey, which included five “yes” and “no” questions regarding the presentation of the material in both programs, *Project Read* and *Explode the Code*. Students were questioned on how the presentations, images and sounds helped their learning reading. They were read each question, then required to circle either “yes” or “no” for their response.

### **Research Design**

A multiple baseline research design across students with A B phases was used in this study. During Phase A, student A was given a decoding assessment at three different times before the intervention. The scores were recorded as the baseline data. During Phase B, student A was taught decoding skills using the Direct Instruction program. After one lesson, the student used *Explode the Code* to reinforce decoding skills. Students B and C were provided the same process, but at

the different time period, after Student A. Both students were given the decoding assessment to evaluate their performance.

### **Data Analysis**

Means and standard deviations (SD) were calculated and presented in a table, as well as a visual graph to demonstrate each student's performance across phases to compare the difference. In addition, the student survey responses were calculated into percentages and presented in a table too.

## Chapter 4

### Results

#### Decoding Skills

Student performance was assessed using a decoding assessment as a baseline measure during Phase A, followed by administration of this same assessment in Phase B, the intervention when students were instructed using *Project Read* and *Explode the Code*.

Table 4 presents the means and standard deviations of student assessment scores across phases. The results show that all three students increased their scores on the decoding assessment compared to the baseline.

Table 4

#### *Means and Standard Deviations of Student Assessment Scores*

Student	Baseline		Intervention	
	M	SD	M	SD
A	110.5	(2.1)	125.2	(0.7)
B	60	(16.2)	126.5	(4.9)
C	26.6	(19.2)	82	(7.1)
Class	58.8	(37.6)	111.3	(23.1)

Overall, the students showed gains from Phase A to Phase B. Student A's average score increased from 110.5 in the baseline to 125.5 in the intervention when *Project Read* and *Explode the Code* were taught. Student B's average score increased from 60 in the baseline to 126.5 in the intervention, when *Project Read*

and *Explode the Code* were taught. Student C's average score increased from 26.6 to 82 in the intervention when *Project Read* and *Explode the Code* were taught. The overall class average was 58.8 during the baseline and increased to 111.3 when the intervention *Project Read* and *Explode the Code* were provided. Figure 1 presents each student's performance across phases.

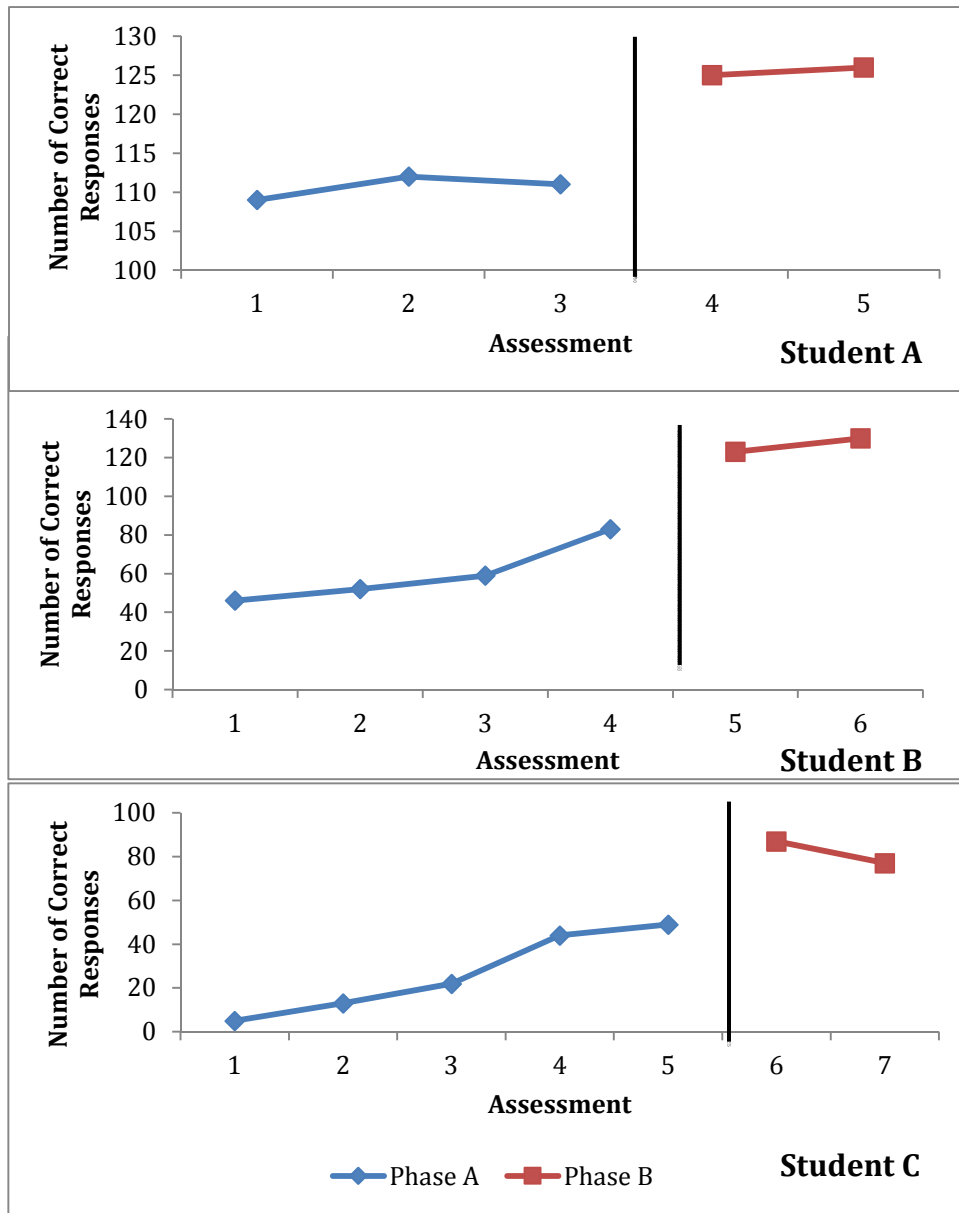


Figure 1. Individual student's decoding scores across phases.

Figure 1 shows student performance on the decoding assessment based on each student's correct responses with a total of 142 possible points. Student A was administered three times in baseline. His correct responses ranged from 109 to



111. Student B was administered four times in baseline. Her correct responses ranged from 46 to 83. Student C was administered five times in baseline. His correct responses ranged from 5 to 49.

The interventions were completed over four-weeks. During this time, students received the same intervention, but at different time periods throughout the day. The interventions were completed for three days each week. Students completed a lesson with the teacher using the *Project Read* program and then completed 15-20 minutes on the computer program, *Explode the Code*. Following the intervention period, the decoding assessment was administered to students.

Figure 1 shows that Student A answered 126 out of 142 questions correctly, which demonstrated 72-points increased from the baseline. Student B answered 130 out of 142 questions correctly, with 84-points increased. Student C answered 77 questions correctly with 17-points increased.

### **Student Survey**

To conclude the study, students completed a 5 questions survey, which focused on students' opinions about their experiences in learning decoding using both *Project Read* and *Explode the Code*. The questions were presented in a "yes" and "no" format that was considered to be easy to respond for 2<sup>nd</sup> graders. Table 5 presented their responses in percentages.

Table 5

*Percentages of Student Responses*

Survey Questions	Yes	No
1. Did you like completing the lesson in Project Read?	100	0
2. Did the Project Read alphabet cards and word cards help you with reading?	100	0
3. Did you like completing the games on Explode the Code?	100	0
4. Did you find the sounds helpful?	100	0
5. Did you like the pictures on Explode the Code?	67	33

The survey responses showed that all three students (100%) enjoyed completing the *Project Read* lessons. All of the students (100%) liked to use the word and alphabet cards that accompany the lessons in the *Project Read* program. Questions about the program, *Explode the Code* were also asked in the survey. All three students (100%) responded that they liked the computer games on *Explode the Code*. They all (100%) responded that they indicated that the sounds on *Explode the Code* were helpful. Two of the students (67%) liked the pictures used in *Explode the Code*, except one student (33%).

## Chapter 5

### Discussion

#### Discussion of Results

The purpose of this study was to examine the effect of the *Project Read* program in teaching decoding skills to students with LD, and to evaluate the effects of the supplemental computer program, *Explode the Code*. The results showed that all three students (100%) made improvements during the period of study.

The first research question asked if students with LD would improve their decoding skills when the *Project Read* program was provided. Results show that three students (100%) improved their scores on the decoding skills' assessment when being instructed using this program. Their improvement may be based on the opportunity for them to work in a one-to-one setting with the teacher while using a direct, explicit instructional program. Previous research, such as Ashworth's study (1999) showed that direct instruction focuses on decoding skills, monitoring progress, and systematic procedures to correct student errors leading to significant improvements in areas of reading, such as decoding skills. The results of the current study show consistent findings to support the previous study by Ashworth (1999).

The second research question examined if students with LD would improve their decoding skills when using the computer program *Explode the Code*. All three students (100%) improved their scores of the decoding skills' assessment when using *Explode the Code*. Reasons for this may have been the pictures and sounds that the program provides to engage the students in the lesson. In a previous study,

Stetter and Hughes (2011) indicated that students with LD benefit from the use of computer programs and repeated practice. The results of the present study added information on using technology in teaching decoding skills to students with LD and support the previous findings by Stetter and Hughes.

The third research question was answered by students' survey responses to show that the programs *Project Read* and *Explode the Code* could assist students in building their decoding skills. All three students (100%) stated that they enjoyed using the lessons and playing games on both programs. Three students (100%) shared that the alphabet and word cards in *Project Read* were helpful. They all stated that the sounds on *Explode the Code* were helpful and two students (67%) liked the pictures on *Explode the Code*, except one student. The pictures in this program led students to some uncertainty as to what the correct response was that correlated with the picture on the screen.

### **Limitations**

Despite the positive results of the study, there are some limitations that should be addressed. One was the sample size of 3 students participated in the study in a resource room. A larger sample size may need to validate the results.

Another limitation was the instructional duration of only four weeks during the course of the school year. Students may learn and improve their decoding skills in a longer period of time, such as an entire school year.

Lastly, the program *Explode the Code* was completed with a computer, there was a few times when the computers froze and had to be restarted. There were also

times when the Internet in the district was not working and the students were not able to access the program for that day. This problem could be solved if the teacher obtained assistance from the school.

### **Implications and Recommendations**

The results of this study showed that the programs *Project Read* and *Explode the Code* are effective instructional programs for teaching students with LD. Such programs can be used in special education classrooms, as well as in general education settings, for students who are struggling with foundational reading skills and primarily decoding skills. These programs can also be used as part of small group instruction or as an enrichment activity in the classroom. Future research that involves a longer course of time and a larger sample size would be beneficial in examining the effects of the direct instruction program with technology in teaching decoding skills of children with learning disabilities.

### **Conclusion**

Overall, this study provided support for the use of direct, systematic instruction and computer technology to improve decoding skills of students with LD. *Project Read* and *Explode the Code* are programs that, when used together, can provide instruction to students in both the general education and special education settings to build decoding skills, especially for those with learning disabilities.

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# Appendix A

## Direct Instruction Program

**UNIT 1: SOUND/SYMBOL RELATIONSHIP**  
*Lesson 1*  
**SKILL: Short vowel *a***

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CONCEPT:	Every word must have a vowel.
GOAL:	Sound/symbol relationship of [ a ] and / <i>ă</i> /
TEACHING OBJECTIVE:	1. Knowledge and understanding that [ a ] is a vowel 2. Knowledge and understanding that [ a ] represents the short sound / <i>ă</i> / like in the word [ at ]

---

ANTICIPATORY SET: Display alphabet:

★   ★   ★   ★   ★

a b c d e f g h i j k l m n o p q r s t u v w x y z

Question: What job do these letters have?

Answer: They capture the sounds of our language. We build words with letters.


Question: Why do five letters have stars above them?

Answer: They are the five vowels. They work very hard.

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**SKILL INSTRUCTION**

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INPUT:	We learned that <b>every</b> word has to have a vowel. (clap)
STATE TEACHING OBJECTIVE:	We will build words with the vowel [ a ].
SOUND/SYMBOL INPUT:	<b>STEP 1:</b> Display the <span style="border: 1px solid black; padding: 2px;">a</span> from the Large Phonics Sound Pack.*
	<b>STEP 2:</b> Using the alphabet line on the cover of the Writing the Alphabet Book <sup>®</sup> , locate the letter [ a ] and classify as a vowel. (Notice if the letter is at the beginning, middle, or end of the alphabet. Identify the letter before and after the letter you are introducing.)
MODELING:	<b>STEP 3:</b> Model the sound with body language. <b>Teacher states:</b> The letter [ a ] captures the sound / <i>ă</i> / <b>Hand signal:</b> Pull sound gently out of mouth with hand. 

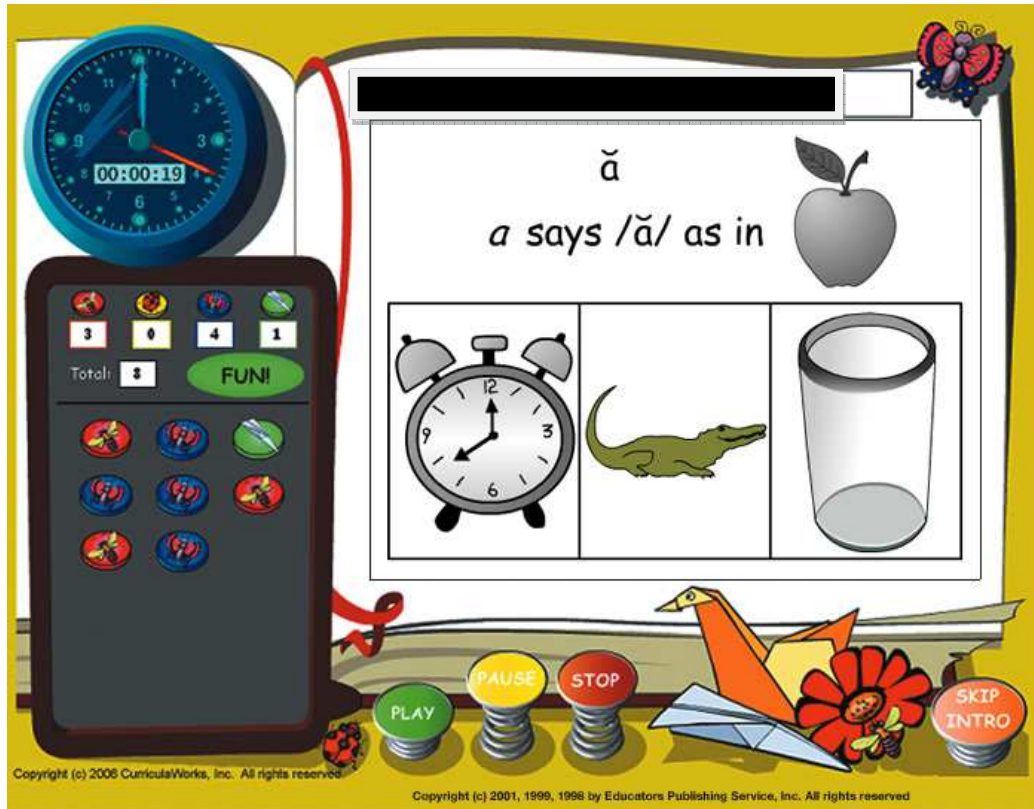
*(Skill instruction continues on next page)*

Phonics Guide and Lesson Plans

1-1

# Appendix B

## Computer Program



## Appendix C

### Decoding Assessment

Task 1 (a)	<i>Read the letters.</i> m t a s l r d f o g l h u c n b j k y e w j p v qu x z
Task 1 (b)	<i>Letter sounds.</i> m t a s l r d f o g l h u c n b j k y e w j p v qu x z
Task 2 (a)	<i>Read the list of nonsense words.</i> wat fod leb tum pon sib cug raf mip hev
Task 2(b)	<i>Read the following sentences.</i> Sam and Ben hid the gum. Pat had a nap in bed. Mom had a top on a big pot. Tim can sit in a tub.
Task 3 (a)	<i>Read the list of nonsense words.</i> shap ming gack whum pith chan thog kosh mich whaf
Task 3 (b)	<i>Read the following sentences.</i> That duck had a wet wing. Dad hit a log with a whip. When can Chip pack? A fish is in that tub.
Task 4 (a)	<i>Read the list of nonsense words.</i> clab trin snaf greb slad fosp lonk mant jast sund
Task 4 (b)	<i>Read the following sentences.</i> Glen will swim past the raft in the pond. The frog must flip and spin and jump.
Task 5 (a)	<i>Read the list of nonsense words.</i> sice nole fune moze vate rine lade sile gane fote
Task 5 (b)	<i>Read the following sentences.</i> Mike and Jane use a rope to ride the mule. Pete had five tapes at home.