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The Effect of Antecedent and Consequent Strategies on Increasing Student Homework Compliance and Academic Achievement.

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THE EFFECT OF ANTECEDENT AND CONSEQUENT STRATEGIES ON INCREASING STUDENT HOMEWORK COMPLIANCE AND ACADEMIC ACHIEVEMENT

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for degree of Doctor of Philosophy in

The Department of Psychology

by

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Abstract

The primary purpose of this investigation was to evaluate the effects of homework and alternatives to homework on student math completion, accuracy and fluency for low socioeconomic students. To examine possible causes of homework problems as well as the effect of different treatments on math fluency, this study used an idiographic protocol to systematically examine the effects of antecedent and consequential strategies on different types of homework performance problems through several phases. First, a brief experimental analysis was conducted for each student to identify whether poor homework performance was due to a skill deficit or a performance deficit. Next, an alternating treatments design was used to compare two conceptually related interventions to determine if the outcome of the brief experimental assessment had treatment validity. In cases where the homework intervention was not effective, two primary reasons for homework failure were identified and subjected to further analysis in this study. First, it was hypothesized that failure of the homework protocol may have been due to the protocol being used improperly or not at all. For four children, this was confirmed by implementing the protocol at school under conditions of 100% treatment integrity. Second, it was hypothesized that the accuracy-based homework protocol used frequently by schools failed to effectively enhance fluency for some students. This was investigated by exposing children to a fluency-based protocol with a reward component that was effective for seven of the eleven cases. Although the number and type of individual treatment components differed among students, all students in this study obtained a mastery criterion. Finally, this study investigated whether classroom-based response opportunities could be an effective alternative to homework and whether the use of
peers would make in-class practice an efficient alternative for the teacher. Interventions maintained their effectiveness when implemented by a peer.
Chapter 1

Introduction

A consistent finding within the effective teaching literature is that active student engagement with academic tasks enhances student academic achievement. Generally, efforts to enhance response opportunities have focused on in-school activities such as peer tutoring, cooperative learning, computer-assisted instruction, and response cards (Gardner, Heward & Grossi, 1994; Greenwood, Carta & Hall, 1988; Slavin, 1991). Another option, homework, has not been studied as extensively but offers not only the possibility of increasing opportunities to respond but can also increase the time available for learning. However, many students at risk for failure have difficulty successfully completing homework assignments (Salend & Gajria, 1995). Homework difficulties often begin during elementary school years and commonly persist during later grades (Olympia, Sheridan, & Jenson, 1993). In addition, difficulties with completion and accuracy of homework are commonly cited as a one of the academic concerns when students are referred for special programs.

Due to a decline in average scores on standard achievement tests, the importance of assigning homework for additional academic practice has been stressed in a number of government education reports (Callahan, Rademacher, & Hildreth, 1998; Miller & Kelly, 1991). For example, the National Commission on Excellence in Education (1983) recommended that students should be assigned more homework. As a result, teachers have increased the amount of homework assignments (Kay, Fitzgerald, Paradee, & Mellencamp, 1994). Yet, teachers continue to report problems with homework completion and accuracy especially with low achievers or students with
learning disabilities. Moreover, teachers and parents often report dissatisfaction with current homework outcomes for these children.

To address teachers' concerns with homework, an emerging research base supports the use of programmed incentives, goal-setting or self managed strategies to increase homework completion (Miller & Kelly, 1994; Olympia, Jenson, Sheridan, & Andrews, 1994; O'Melia & Rosenberg, 1994). Despite the positive findings, many challenges remain. First, there are a number of homework interventions that seem to effectively increase homework completion, but these interventions often fail to consistently increase academic performance for all students. Moreover, studies commonly find that an increase in compliance is not always associated with an increase in homework accuracy. Fewer studies have examined the effects of homework on fluency or skill mastery. Second, few studies have investigated what type of homework intervention specifically works for different academic problems. For example, the lack of homework completion may be because the student is choosing not to do the work although he or she is capable of doing so (i.e., a performance deficit). On the other hand, the student may lack the skills needed to complete the required work (i.e., skill deficit). Although effective teaching methods are available for promoting student learning, the effectiveness of different methods may vary between individuals and for different skills taught. Finally, many parents and teachers may not employ these interventions or fail to use the interventions with integrity. Effective homework strategies rely on parent skill level, communication modes, and resources that are unavailable in many low socioeconomic family environments. While a survey of elementary teachers found that for contact with parents, teachers often rely on the use of phones, school-home notes or parent attendance at school functions, these
modes of communication are not always possible for parents who are non-readers or do not have a phone (Epstein, Munk, Bursuck, Polloway & Jayanthi, 1994). Family variables such as educational level and socioeconomic status have been found to correlate with students' success with homework (Cooper, 1989). Shinn (1998) reported that the vocabulary level of a five-year-old child from an upper middle class family might be equal to the parent of a child from a low socioeconomic family. This suggests that at the very start of a child's school experience, a student from a low socioeconomic family might be exposed to fewer academic skills at home and as a result be further behind than a student from a middle or upper socioeconomic family.

Although homework is or should be a means to increase opportunities to respond and increase learning trials, this does not always happen for all students. Greenwood (1996) reported that current instructional practices are not benefiting low socioeconomic students. In fact, Greenwood found that current practices are providing low socioeconomic students with less time devoted to instruction per day and less time engaged in academic responding than high socioeconomic students. Moreover, teachers of low socioeconomic students use teaching practices that decrease opportunities to respond more often than practices that have been shown to increase opportunities to respond. These ineffective practices may not only be maintaining, but also contributing to, the present achievement gap that exists between high and low socioeconomic groups (National Center on Children in Poverty, 1991).

Although effective use of basic skills instruction is often lacking for low ability students, there are sound instructional strategies that can be integrated into individual academic program to enhance performance (Brophy, 1986; Gettinger, 1988; Greenwood, 1996). Daly, Lentz, & Boyer (1996) have suggested that a teacher's role is
to first teach a student how to initially perform a skill and to perform the skill with accuracy. Once a student has acquired a skill, the teacher provides students with practice opportunities to enhance skill competency. Further practice at this point is fruitless unless it results in a proficient and efficient use of the skill and the ability to proficiently use the skill in a more complex task. Once accuracy is established, a second alternative measure, skill fluency, provides more information about student learning. Skill fluency is the combination of accuracy and rate of responding and is related to the degree that a student is able to retain the skill over time, use the skill for longer periods of time regardless of distractions, and to apply the skill to more complex tasks (Binder, 1996). After a student has already demonstrated accuracy in class, then the purpose of future practice would be to increase response rates. If a student is able to perform a basic prerequisite skill but it takes a long time to complete it, then that student will continue to have difficulty learning more complex tasks that require the efficient use of basic skills.

Clearly, on the surface it seems easier for the teacher to rely on homework as a means to increase the school day since it may also increase another factor related to student success, parent involvement. The effectiveness of homework with parental involvement has yet to be demonstrated for low socioeconomic students. The few studies that have investigated parent involvement are typically based on surveys or personal opinion. Few of these studies have empirically demonstrated successful gains in parent involvement that result in skill mastery, particularly for inner city students or low socioeconomic parents. Communication difficulties, time restrictions, and limited ability levels are a few of the barriers reported by both parents and teachers (Jayanthi, Sawyer, Nelson, Bursuck, and Epstein, 1995). Zady, Portes, DelCastillo, & Dunham,
(1998) observed that low socioeconomic parents who tried to assist their children on homework were often ineffective mainly due to their literacy level. Hence, low socioeconomic students may be particularly vulnerable to homework failure given parent involvement problems. Moreover, they are further behind academically and are in need of additional academic support. A need for alternative methods for increasing academic engagement is emphasized by the growing population of children living in poverty in the United States (National Center on Children in Poverty, 2000).

If a student is failing, instructional procedures must be systematically examined as a possible contributing factor. Although teachers are unable to manipulate many of the possible contributors to low achievement, such as low socioeconomic status or parent’s educational level, instructional practices are readily under a teacher’s control. Instructional effectiveness research has empirically identified a number of teacher strategies that can be implemented to help promote the performance of students who are at-risk (Wolery, Bailey, & Sugai, 1989). Given the failure to see improvements for all students in the literature with homework-based assignments and interventions, important questions remain about the conditions under which the use of homework can produce improvement. Using tools from behavior analysis, it is possible to explore a variety of antecedent and consequential manipulations that may be used to help improve specific individual homework programs. Thus, an idiographic analysis of effective instructional practices may help identify the source of a homework problem that, in turn, would lead to the development of a focused intervention. The goal of this intervention would be to provide each student with increased response opportunities with the instructional support needed to enhance skill competency.
This study is based upon the supposition that structured practice sessions for at-risk students will enhance not only a student's opportunity to respond but also increase his or her fluency performance in math. The present study was designed to investigate effective antecedent and consequential homework modifications for at-risk students experiencing homework problems that would result in academic progress. First, an initial study was designed to assess the relative effectiveness of brief testing conditions for predicting the effectiveness of interventions on academic performance of students who were having difficulties with homework. Second, this study applied sound instructional strategies in an ideographic manner to determine individualized treatment recommendations for students who continued to experience difficulties mastering skills with homework practice. It was hypothesized that subjects would display differences in performance across the two treatment options depending on the type of homework problem the child was having.
Chapter 2

Review of the Literature

What is Homework?

In the literature, homework has been defined as work assigned that is to be completed outside of the normal class period or during non-school hours (Keith, 1987). Although homework may be completed in study hall or during other classes, it is assumed the work is completed at home or under adult supervision during after school programs (Cooper 1989). Although there are a number of possible reasons to assign homework, teachers report that they typically assign uncompleted classroom work as homework. In a survey conducted by Polloway, Epstein, Bursuck, Jayanthi, & Cumblad (1994), 51% of the 441 teachers surveyed reported that they most frequently assign unfinished classwork whereas only 22% assigned homework for additional skill practice. Teachers reported that homework designed to prepare students for the following day’s lesson was rarely assigned since few teachers found this type of homework to be helpful. Olympia, Sheridan, and Jenson (1993) further stress the importance of using homework as an extension of the practice of academic skills into other environments (i.e., generalization of academic performance).

Why is Homework Used?

In evaluating the usefulness of homework, several critical questions have been investigated in the literature. Is homework effective for all students? Does homework enhance academic performance? Under what conditions are additional practice opportunities beneficial?

Answers to these questions are tentative at best. The current literature on the effectiveness of homework is limited and relatively few homework studies are...
empirical. Definitive conclusions on homework's effect are impeded by the reliance on evidence based on correlational studies that impedes the identification of causal relationships (Doyle & Barber, 1990). Also, most homework results are based on self-report, and thus questions about the reliability and validity of the results are justified. Overall, results of the few empirical studies available suggest that the average student doing homework will likely outperform approximately 60% of the students who do not do homework (Cooper, 1989). However, studies reveal a difference in effect across age groups such that older students benefit from additional homework more than younger students do (Cooper & Nye, 1994; Holmes & Croll, 1989). A meta-analysis of homework studies reported that homework had very little effect on achievement in elementary schools. Moreover, the correlation between time spent on homework and achievement for grades two through five was nearly zero (Cooper, Lindsey, Nye, and Greathouse, 1998). Cooper further examined the results of empirical studies comparing homework with a supervised classwork condition. Although in-school supervision varied in the amount of instructional assistance given among studies, the meta-analysis of these studies revealed that teacher supervised work was superior compared to gains achieved when work was completed at home. Moreover, when comparing the effect of supervised study with homework across grade levels, supervised study appeared to have a more positive effect on achievement for elementary students than either junior high or high school students. These results further support the finding that the best predictor of success is the amount of time spent in learning activities supervised by a teacher (Sindelar, Smith, Harriman, Hale, & Wilson, 1986). Despite the questionable benefits of homework for elementary students as compared to supervised study, the
practice of assigning homework continues and is becoming more prevalent (Cooper, 1989).

One of the basic assumptions concerning the positive effect of homework is that homework extends the school day by giving students additional opportunities to use skills. The amount of learning has been found to be a function of both the amount of time a student is actively engaged in an academic task and the amount of time that is needed to master the task (Brophy, 1986; Gettinger, 1988). It has been well documented that higher rates of learning are related to the frequency with which the students actively respond (Gardner, Heward, & Grossi, 1994). The additional opportunity to practice a skill leads to skill mastery for students with mild educational disabilities (Greenwood, 1991). Furthermore, children will vary in the amount of time and the number of opportunities required for skill mastery (Gickling & Rosenfield, 1995).

Observational studies have found that students are often not given adequate opportunity to respond in the classroom (Hall, Delquadri, Greenwood, & Thurston, 1982; Ninness & Glenn, 1988). Ritschl, Grinstead, and Whitson (1980) observed that time spent on computing basic math problems was less than five seconds per day. Instead of independent responding, most of the time was spent listening to the teacher, copying from the board, attending to overhead projectors, and participating in other ancillary activities. Furthermore, Greenwood (1991) reported that students who were referred to special education had less academic response opportunities than students who were not referred to special education classes. Instructional strategies including worksheet practice, small group instruction and peer tutoring have been shown to accelerate engagement and achievement. Yet, teachers of low socioeconomic
students spend more time on lectures and demonstrations (Greenwood, 1991). While other teaching strategies such as lectures and demonstrations are critical for enhancing skill acquisition, skill proficiency results from skill use.

Homework is one potential solution for providing the additional time and response opportunities students need to master a skill. However, the substantial number of difficulties reported with homework by parents and teachers stresses the need for variables that effectively increase homework completion for students with poor academic performance. Students who are at risk for failure are the most needy but may benefit the least from homework for a number of reasons. First, teachers may be giving homework to students who are already not doing the work when first assigned in class. Students may not be completing the work for a number of reasons. For example, the students may not be able to complete the work due to lack of prerequisite skills necessary to perform the homework. Second, some students can do the work but do not want to and are just as unlikely to do it at home. When work is not completed as expected in class, then homework may not be the optimal strategy for increasing academic time and response opportunities. Instead, it may produce better results to assess the reason why the child is not doing the work in class before expecting the child to generalize the skill in other settings without effective instruction components. Alternative instructional factors that promote work completion need to be further investigated before giving work to a child who cannot or will do the work when it is first presented to him or her.

Why is Homework Ineffective for Some Students?

The reason why some students learn while other students fail is complex. A common finding in the homework literature is the lack of consistent homework
accuracy when homework interventions are empirically examined. The few studies that monitored gains in fluency had similar mixed results. However, most studies investigating homework interventions failed to directly assess or intervene for different types of homework problems. Individual differences in skill acquisition and efficiency, background knowledge and practice opportunities influence instructional outcomes (Gickling & Rosenfield, 1995). Due to these individual differences, there are several potential barriers that may hinder the effectiveness of homework on academic performance that need to be considered when assessing and designing homework interventions. Factors that may interfere with homework performance may include differences in individual skill or performance deficits, the variable effectiveness of treatment components for different students, the time and effort required for implementation of an individual treatment, and lack of home resources or support.

Differences in Individual Skill and Performance Deficits

The first barrier that may influence the effectiveness of homework is that poor academic performance may be due to different types of academic problems. A lack of adequate academic performance can be simplified into two kinds of student problems. One type of problem resulting in poor performance is that a student may not have acquired the skills to the degree that is necessary to perform the task (i.e., a skill deficit). Second, the student may be able to do the work, but chooses not to do the work assigned (i.e., a performance deficit). Skinner (1998) suggested the lack of performance may also be related to the student's fluency level. For example, a student who is fluent is able to do the work quickly with little effort. A non-fluent student, however, may be able to do the work accurately but will take a longer time to complete the same task. Hence, it will take the non-fluent child longer to get praise,
feedback, or any other reward that may occasion completed work. A student exhibiting a performance deficit may be choosing not to exert the time and effort needed to attain available reinforcement. Few studies have examined individual differences with regard to motivation or choice and its effect on homework performance (Cooper 1989).

Homework interventions that include an incentive program would be more likely to enhance academic progress for students exhibiting a performance deficit. The mixed findings from those homework studies that focused primarily on incentive strategies may be due to a lack of instructional components to enhance possible skill deficits (Olympia, Sheridan, Jenson & Andrews, 1994). If a student has a skill deficiency, small gains may be obtained with incentives but the child's performance is limited by the degree that he or she can perform the required skills.

A student exhibiting a skill deficit may be in need of additional instructions, prompts, or practice in order to perform the skill as expected. Research literature on effective teaching strategies shows that learning is enhanced by several basic teaching strategies including management of student behavior, instructional presentation, guided practice, instructional monitoring, and instructional feedback (Rosenberg, 1989; Wolery, Bailey, & Sugai, 1988). The inclusion of these instructional factors in a homework program will likely influence homework success. Yet, the effectiveness of these methods may vary between individuals and for different skills taught. Homework requires the additional ability to retain the skill across time and in a different setting. Hence, the regularity of effective instructional practices may be more critical for independent home study than for work conducted in the classroom. Frequent monitoring and evaluation of student progress are needed to determine the
Effectiveness of the available teaching methods for each individual in a classroom. If an individual student is not adequately learning, instructional changes are needed.

**Effectiveness of Specific Treatment Components at Different Rates of Student Responding**

The second barrier that may influence the effectiveness of a homework program is the degree that the intervention components promote different levels of responding. Although active student engagement is associated with achievement, recent studies are indicating that different instructional variables result in mixed outcomes among students given the same number of opportunities to respond. What is needed is a conceptual model for describing how different variables affect different rates of responding. A promising model suggested by Haring, Lovitt, Eaton, & Hanson (1978) proposes an instructional learning hierarchy of mastery levels based on behavior rates. According to the instructional hierarchy, students first acquire a new skill by learning to do the skill and increasing the accuracy of the performance (i.e., an acquisition stage to increase accuracy). Once the skill is acquired, the rate of the performance can increasingly become more fluent (i.e., fluency building stage to increase the rate of the correct responses). Fluency is the combination of accuracy plus rate of responding that enables students to function efficiently and effectively on academics. Next, students are able to generalize the fluent skills to more novel settings, stimulus materials or with more complex tasks (i.e., a generalization and application stage).

Research has also demonstrated a number of benefits for fluency building including retention, endurance and application of skills, often termed REAPS (retention-endurance-application-performance standards) (Binder, 1996; Lindsey, 1992). Retention, the first effect of fluency building, refers to the continued ability to use a
skill over time (Ivaric, 1986). For example, college students who recited calculus formulas and rules above 50 facts per minute, performed twice as accurately on tests six weeks later than those students who cited facts below 50 facts per minute (Orgel, 1984). Thus, students with fluent knowledge of calculus rules retained more information over time than students who were able to perform accurately but at a slower rate. Endurance, the second effect of fluency building of performance refers to the ability to perform at fluent levels and to stay on task for longer periods of time. Several relationships have been identified between the duration of working period and the speed and accuracy of responses (Binder, Haughton, & Van Eyk, 1990; Binder, 1996). First, students who have mastered a skill are able to work for longer periods of time than students who are accurate but slower. Second, students who are not yet fluent tend to make more mistakes during longer working periods. Third, learning rates can also decrease over time with longer working periods if students are not yet fluent. Application of skills, the third effect of fluency building refers to the integration of prerequisite skills or responses into a more complex response or group of responses. A complex skill can be broken down into smaller subsets of the complex skill to be programmed for acquisition and fluency. These fluent components can then be readily applied or combined to enable a student to perform the more complex skill (Johnson & Layng, 1992; Haring, Lovitt, Eaton, & Hansen, 1978). Numerous studies have demonstrated that the increase in fluency of prerequisite skills enhances the rapid learning of more complex skills (Binder, 1996; Lindsey, 1992).

The instructional hierarchy model proposes that there are different instructional treatments that better promote learning at each of the four learning stages (i.e., acquisition, fluency building, generalization, and application). For example, studies
have demonstrated effective teaching practices such as previewing material, the use of prompts, guided practice, and presentation of examples for promoting skill acquisition and accuracy (Binder, 1988). A later study demonstrated that modeling increases accuracy more effectively than prompting (Espin & Deno, 1989). Fluency, however, improves more dramatically with interventions that include a drill component (Skinner and Shapiro, 1989). When comparing three different instructional treatments, Daly and Martens (1994) found that a treatment incorporating modeling, drills and a generalization component produced larger reading fluency gains on new material than the treatments consisting of modeling or drill alone. Additional studies have demonstrated the effectiveness of practice, feedback and reinforcement on fluency building once a skill is acquired (Binder, 1988). Students' rates are enhanced over time when given opportunities to practice particular skills in a rapid manner on a daily basis and are immediately informed of their progress. As a result of these practice sessions, student fluency increases (Binder, 1996; Mercer & Mercer, 1985). Once prerequisite skills are fluent, subsequent learning and application of these skills becomes easier (Johnson & Lang, 1992). Haughton (1980) found that students increasingly benefit from independent practice as fluency increases for a given skill. Moreover, previously identified reinforcers failed to enhance performance of higher complex skills when students were not yet fluent on prerequisite skills. In summary, these studies suggest that the effect of an academic intervention may be dependent on intervention components and on the level of performance that the student is able to perform within the instructional hierarchy.

Most homework studies, however, have investigated the general effectiveness of a homework program on a class or a group of students regardless of student...
response level. Although positive findings are reported for some students, few studies have failed to further identify effective strategies for students who were not responding to the homework treatment presented to the whole class. Currently, assessment strategies are beginning to emerge in the literature to evaluate specific treatment components that would most likely optimally remediate individual problems. For example, McComas, Wacker, Cooper, Asmus, Richman, & Stoner, (1996) identified effective treatment components by examining the effects of various instructional strategies on the academic performance of four students with poor reading and spelling performance. Several potentially effective treatments were introduced sequentially within a multi-element design until performance gains were obtained. At least one effective treatment was identified for each child although different treatments were effective among students. The variability of treatment effects suggests that there are individual differences in the types of instructional assistance students may need to increase homework performance. Noell, Gansle, Witt, Whitmarsh, Freeland, LaFluer, Gilbertson, & Northup (1998) demonstrated the utility of brief test conditions for identifying the instructional components or reinforcement contingencies that are required to increase performance level or skill level of oral reading rate for three students. In a later study, Noell, Freeland, Witt, and Gansle (in press) examined the intervention recommended on the basis of a brief analysis to that recommended by a more extended analysis for 15 students. Results indicated that for 87.5% of the students, the interventions recommended by the brief analysis were congruent with the interventions recommended by the extended analysis. Daly, Martens, Hamler, Dool, & Eckert (1999) introduced instructional treatments in a hierarchical manner from simple to more complex treatments by gradually adding,
additional components to subsequent treatment conditions. Each treatment was briefly probed within a multi-element design such that different treatment effects on oral reading were compared in order to identify the treatment that would generate performance gains while requiring a minimum amount of an adult's involvement in treatment implementation. Differentiated response patterns were obtained for all participants. Furthermore there was at least one treatment that had improved oral reading rates relative to baseline performance for each subject. Initial findings of studies examining the utility of brief experimental analysis for academic problems holds promise for identifying ineffective treatment components as well as treatment recommendations. However, additional studies should be conducted to evaluate the long term effects of the intervention recommended on the basis of the brief assessment.

**Time and Effort Required for Individual Treatments**

The third barrier that may influence the effectiveness of homework is the monitor student progress, and provide immediate feedback for interventions that target individual homework problems (Olympia, Sheridan, Jenson & Andrews, 1994; O'Melia & Rosenberg (1994). Based on teacher and parent report, educators have failed to consistently use effective homework strategies (Salend and Schiff, 1989). A well-designed homework program incorporating empirically sound strategies will have little chance of benefiting the child if the plan is not implemented properly. Few studies examining the effects of homework systematically assessed whether or not homework programs were implemented accurately (Olympia, Sheridan, & Jenson, 1993). Assessing the degree to which a treatment is implemented as planned is termed treatment integrity (Gresham, 1989). Without verification of treatment integrity, it
cannot be empirically demonstrated that the child’s behavior change is a function of
the intervention or some other external variable.

However, the positive evidence supporting homework practice has increased
interest in investigating ways to minimize a teacher’s time and effort needed to
implement homework progress while maintaining effective homework performance.
For instance, studies have examined the effect of using students to manage a number
of the homework components such as grading and graphing their own progress. In a
recent study, Olympia, Sheridan, Jenson and Andrews (1994) evaluated the
effectiveness of a self-managed individual and group contingency procedure on
homework completion and accuracy. Sixth grade students were organized into
cooperative learning teams and were trained to assume various roles including coach,
scorer, and manager. Each team earned reinforcers for exceeding a daily goal. Goals
and team scores were based on the summation of all team members’ homework
accuracy scores. Homework completion improved for the majority of the students,
however, accuracy results were mixed. The authors proposed that the lack of directly
testing if students had a skill deficit rather than a performance deficit might have
contributed to the inconsistent accuracy results. In this study, the self-managed
homework package provided incentives to prompt behavior for students who may have
a performance deficit, but students who lacked the ability to perform the skill were not
given additional instructional components they may have needed. Finally, curriculum-
based measures of classroom performance were administered several times during
each experimental phase. Although the mean percent of correct scores during
treatment had increased over baseline scores, individual scores were not reported.
Lack of Home Resources and Support

The fourth barrier that may influence the effectiveness of homework is the necessity of parental assistance to implement effective instructional conditions at home. For some students, work completed at home may not be as effective without the conditions or contingencies that enable a student to complete tasks in the classroom environment. However, 39% of 88 surveyed teachers reported that they experienced problems when recruiting parent assistance (Salend & Schiff, 1989). To identify the parent’s perspective on homework difficulties that may be hindering parent involvement, several surveys questioned parents’ concern with homework (Kay, Fitzgerald, Paradee, & Mellencamp, 1994). In general, parents report that they do not have adequate skills to assist their child (Christenson, Rounds, & Gomey, 1992). Parents felt ill prepared to handle homework problems since they lacked information about their child’s curriculum and believed special training is needed to solve academic problems (Kay, Fitzgerald, Paradee, & Mellencamp, 1994). Parents report that homework requirements are often difficult to understand and their child does not seem to know what to do. Unfortunately, many parents fail to seek additional assistance from the school since they lacked the confidence and a sufficient comfort level with the school system. There are several parent-training packages, but few studies have empirically investigated the use of parents as an additional resource for teachers (Olympia, Sheridan, & Jenson, 1993). Moreover, little is known about the specific role that a parent should take (Doyle & Barber, 1990; Epstein, 1988). Although there are a number of possible parental roles suggested in the literature, few of these suggestions are empirically supported (Callahan, Rademacher, & Hildreth, 1998; Patton, 1994). Most reviews on homework agree that homework programs should consider the home
situation since the type of parental assistance may vary between individual families due to a parent's education, confidence in their ability to help and availability of educational items and books influence a parent's effectiveness. A formal role of the parent may depend on the parent's time, skill level, and ability to communicate with the school.

The family situation also affects the availability of resources in the home environment. Baer and Bushell (1981) suggest that certain populations, such as poor children, may be provided with fewer resources needed for success from their home. Many children may not have adequate lighting, a quiet setting, additional books, parental and sibling assistance, and/or a phone available at home. As a result, these children work in less than ideal environments and get less assistance, fall further behind, and soon are designated for remedial or "special" programs.

**What Antecedent and Consequential Strategies Enhance Academic Performance?**

Given the individual differences in skill level, motivation, and available home resources that may influence the effectiveness of homework on academic performance, the planning and implementation of a homework program is a complex activity. Knowledge of the conditions that influence the effectiveness of homework is vital when designing and implementing homework programs that will optimize response accuracy or fluency. However, when examining variables that influence homework's effectiveness, educational researchers have relied heavily on data based on correlational relationships, self-report or studies that failed to include adequate treatment integrity measurements. Hence, much of the research may be misleading or inconclusive. The reliance on inadequate measures limits our confidence in the
research on homework's effectiveness and calls into question whether a functional relationship exists between homework and its variables and child outcomes.

While few studies have empirically examined the effect of instructional variables on homework performance, there is a wealth of treatments that have proven to be empirically effective on academic performance in the classroom. Examining the effect of instructional variables on homework performance from a behavioral analytic perspective may be desirable for a number of reasons. First, in order to implement homework with maximum success, three requirements are needed: an accurate identification of the homework problem, an intervention addressing the variables controlling the problem and the implementation of the intervention with fidelity (Noell & Witt, 1998). A defining feature of behavioral research and practice is the reliance on direct measurement of both child performance and the variables that produce the desired outcome. The use of direct measurements provides a more reliable and accurate index for confirming that the problem is valid, the intervention is used, and the treatment is effective. Second, the enhancement of student performance depends on the understanding and manipulation of the antecedent events and consequences that potentially influence student outcomes on homework assignments. Ample evidence exists supporting instructional practices based on behavioral principles such as correct practice, goal setting, immediate feedback, and continuous performance monitoring. The manipulation of instructional variables represents a viable alternative for investigating and designing homework interventions that would most likely increase academic performance for all students.
How Should Homework be Planned and Prepared to Increase its Effectiveness?

Initial antecedent strategies that might influence the practice of homework and its effectiveness have received little attention in the research (Cooper, 1989). However, several reviews have suggested that strategies such as the alteration of task difficulty, development of a homework routine, and the provision of clear instructions with goal setting may enhance the likelihood that students from poor families or students who are slow learners will use a homework intervention (Jenson, Sheridan, Olympia, & Andrews, 1994; Patton, 1994).

Alteration of task difficulty. The effectiveness of a homework program is influenced by the demand level (i.e., difficulty) of the homework assignment relative to student ability. Patton (1994) proposes that homework assignments that are complex or novel would hinder student understanding and possibly a parent's ability to help the student. Preliminary evidence based on studies demonstrating stronger effects for subjects such as reading and math than for social studies and science suggests that students may benefit from homework consisting of simple skills rather than complex tasks (Cooper, 1989). Moreover, researchers report that learning more complex material is slow and frustrating if basic prerequisite skills are not fluent (Binder, 1996). Learning rates may also be impeded when difficult or novel tasks are first practiced without adequate prompts or error correction procedures (Wolery, Bailey, & Sugai, 1988). For example, Rosenberg (1989) observed that classroom math performance increased only when students completed 70% or more of the homework assignment and attained an accuracy score at or above 70%. These results suggest that students may need a minimum competency level in order for a homework program to be successful.
Organize a classroom routine. The organization of a consistent homework routine when giving and receiving homework may increase the likelihood of homework completion. The use of a routine serves several purposes. First, a routine can include a systematic presentation of instructions. Regular teaching practices such as a preview of skills, prompts, guided practice, and samples have effectively promoted skill acquisition and accuracy (Binder, 1996; Johnson & Layng, 1992). Second, a routine also can include the consistent provision of materials that the student has previously used with in class supervision with success. The provision of materials that are familiar to the child may lessen the reliance on parent tutoring skills. Finally, a routine helps to establish predictable teacher and student steps that may reduce confusion about homework requirements.

Provide clear instructions. The literature suggests that the provision of instructions when presenting assignments will increase success (Brophy, 1986; Wolery, Bailey, & Sugai, 1988). More specifically, simple and sequential instructions followed by demonstrations of a sample problem enable the student to complete the work accurately (Wyne & Stuck, 1982). A step by step format provides the student with the cues needed for the retrieval of knowledge and the organization of skills to be performed (McKee & Witt, 1990). Additionally, a short session of guided practice will allow a student to practice the skill while the teacher monitors his or her progress and provides immediate corrective feedback. Hence, the teacher will be able to measure directly whether or not the student understands the homework directions and content. Finally, Patton (1994) suggests that the student be told the date due, the materials needed, and how the work will be evaluated. Providing a student with the sufficient
information enhances the likelihood that the student will be able to do the homework at home with little parent assistance.

Set an academic goal. One procedure that has enhanced student performance while providing teacher expectation is goal setting. For example, Miller and Kelly (1994) trained parents to divide homework assignments into small, specific goals and to provide daily and weekly rewards if the goal is attained. Both homework completion and accuracy were enhanced for the four students using a multiple subject baseline design. In a second study, the aforementioned goal setting procedure was compared to a parent training program without goal setting as well as a monitoring intervention with intact middle-class families (Kahle & Kelley, 1994). The authors observed that the goal setting procedure improved mean accuracy and the mean answers correct per minute over pre-treatment mean scores. However, the parent training program and monitoring interventions failed to significantly change performance. There are several advantages to goal setting. For example, a goal provides parents and students with the expected rate of progress. Also, parents or teachers can immediately respond to student accomplishments and provide immediate praise or feedback.

What Strategies Should Be Implemented after Homework is Completed to Increase its Effectiveness?

The events following completion of academic work are also related to the effect of homework on overall achievement (Doyle & Barber, 1990). Consequential strategies are important for informing students about response accuracy and for providing the incentives to increase academic performance. Various consequences can be employed by either the teacher or the parent to increase homework completion and performance. Strategies shown to influence homework’s effectiveness include grading
completed work, systematically monitoring a student's progress and providing incentives for homework performance.

**Grade completed homework.** Students are more apt to complete assignments and return quality homework when their homework is reviewed and evaluated (Harris & Sherman, 1974; Walberg, 1991). Walberg (1991) reported an effect size of 0.28 when homework was assigned without feedback but the effect size substantially increased to 0.78 when homework was graded and to a 0.83 when a teacher’s comments were added. Paschal, Weinstein, & Walberg (1984) reported that the results of fifteen empirical homework studies indicated that completed homework assignments that were graded produced an effect that was three times as large as family socioeconomic status.

Interventions that have students’ grade their own work also provides them with immediate feedback and the added benefit of decreasing grading time for the teacher. Studies that examined the effects of students scoring their own work suggests that academic performance increases when students immediately grade their own work (Trammel, Scholl, & Alper, 1994; Van Houten, 1980). Miller, Hall and Heward (1995) also demonstrated that student self-grading further enhances students’ rate of performance on math skills.

**Monitor academic progress for individual differences in response to homework treatment components.** While effective teaching methods are recommended for promoting student learning, the overall effect of these methods may vary between individuals and for different skills taught. Frequent monitoring and evaluation of student progress are needed to determine the effect of the available effective teaching methods for each individual in a classroom. A critical component that significantly
improves student academic achievement is the inclusion of a systematic formative evaluation of the instructional program. In a meta-analysis study of over a dozen investigations that examined the effects of formative evaluation, the results indicated that the use of formative evaluations reliably increased students' school achievement (Fuchs & Fuchs, 1986). Moreover, evaluation systems that incorporated graphical results and reinforcement further enhanced students' progress. For example, Trammel, Schloss, and Apler (1994) found that self-graphing enhanced homework completion for high school students. Teachers providing immediate feedback are better able to monitor when students master a skill. This, in turn, allows the teacher to modify instruction if skill mastery is not accomplished.

Monitoring systems that measure how fast the student is able to complete the task may be more advantageous than the accuracy measure that is typically used in the classroom. Although student academic progress has typically been evaluated with accuracy measures in homework studies, the literature is not consistently supportive of the sole reliance on this measure for various reasons (Binder, 1996; Howell, Fox, & Morehead, 1993; Johnson & Lanyg, 1992). Alternative approaches claim that accuracy may not be a sufficient criterion for measuring student mastery of the skill (Howell & Lorson-Howell, 1995). An accuracy measure indicates only whether the responses were correct. However, measuring a student's rate of responding is a more informative indicator of skill mastery levels by gauging how well a student knows the skill and how many problems are completed accurately in a certain amount of time. The faster the skill is performed the greater the skill efficiency. For example, two students may be able to perform at 100% accuracy, but one student may be able to complete the work more quickly than the other student. Moreover, fluency measures are sensitive to
small but meaningful academic performance changes within a short period of time. Measures of behavior rates, in general, can be 10 to 100 more times more sensitive to changes in procedural variables than accuracy measures (Lindsey, 1990). Also, this sensitive measure can be frequently administered enabling the evaluation of student progress on a regular basis. Hence, individual instructional programs can be altered in a timely manner to prevent student use of incorrect strategies and to promote continuous increases in learning rates. Finally, studies suggest that fluent responses positively influence task endurance, retention, and application (Binder, 1996; Johnson & Layng, 1992).

**Provide incentives for homework performance.** The inclusion of an incentive program may prevent motivational problems that may arise from practice that can become dull and fatiguing (Wolery, Bailey, & Sugai, 1988). Programs that provide incentives for homework performance more effectively enhance academic achievement than programs that provide incentives for homework completion. For example, Harris and Sherman (1974) examined the effects of the following four conditions on homework completion, accuracy and rate of classroom performance: no homework, addition of homework alone, homework with a consequence for completion, and homework with a consequence for work accuracy. With the introduction of homework, the authors found that approximately 50% of the students did the assigned homework. In addition, the mean class percent of student performance in class increased from a range of 5% to 15% to a range of 30% to 40% when homework was assigned. In the second study, the authors allowed the students to go home ten minutes early if homework was completed. When the early-home consequence was employed, 85% students returned homework. However, accuracy only increased by 2% compared to
the homework alone condition. When students were allowed to go home early for accurate work, homework return dropped, on the average, to 51%. Yet, accuracy increased by 21% for students who did return homework. Moreover, the rate of student performance increased on class work whenever homework was given. These findings suggest that behavioral targets such as accuracy or rate of performance are more strongly associated with achievement than is completion of homework. However, the percentage of students that still consistently failed to return homework with an incentive contingency suggests that additional intervention components may be needed for those students.

An Analysis of the Conditions Under Which Homework is Either Effective or Ineffective

Given the complexity of academic problems and the mixed findings in the homework literature for elementary students, individual differences in the effectiveness of homework programs is not surprising. Requiring students to complete work at home decreases the in-class control of work conditions and immediate contingencies that are effective in the classroom environment. Assigning homework assumes that the student is able to generalize academic skills developed in the classroom to the home environment with minimal support. If a homework protocol is not effective, however, alternative strategies are needed to enhance student performance. If the treatment is not effective at home, other alternatives may include implementation of a treatment by the teacher or possibly by peers.

Step 1: Testing for Treatment Integrity Problems

If a student’s performance is not enhanced after an intervention program is initiated, it may appear that the treatment needs to be modified. However, the child’s lack of response may not be a problem with the treatment per se, but rather a lack of
correct implementation of the treatment. Once an intervention plan is in operation, it is important to monitor if it is being used as planned (Gresham, 1989; Noell & Witt, 1998). While a teacher's implementation of the plan can be monitored at school, it is difficult to measure the conditions at home that may be influencing a treatment outcome. An alternative method for further evaluating treatment effectiveness is to implement the treatment in the classroom under conditions where 100% integrity can be maintained. Briefly, the students may be given “homework” in the classroom that can be presented and collected in the same manner as they are normally required to complete work at home. In this scenario, students would independently complete the assignment in the classroom with minimal supervision and in a quiet environment. After evaluating the student's performance under 100% treatment integrity conditions, it can then be determined whether or not the treatment has potential to effectively increase academic performance for that child. If the treatment is deemed successful, then the treatment can continue to be implemented in class until a skill mastery level is obtained. However, if the treatment is ineffective, then this validation of treatment integrity suggests that the treatment is not appropriately addressing the homework problem. Hence, the treatment program needs to be altered (Deno, 1985; Fuchs, Fuchs, Hamlett, Phillips, & Bentz, 1994; Fuchs, Fuchs, Hamlett, & Allinder, 1991; Howell, Fox, & Morehead, 1993; and Shapiro, 1996).

**Step 2: Enhancing Treatment Protocol Effectiveness**

There are three outcomes of an ineffective homework program. The student is either not returning the work, not doing the work accurately, or not increasing the proficient use of the skill (i.e., developing fluency). According to Daly, Martens, Dool and Hintze (1998), a conceptual framework would help guide the identification of
academic treatment components that would most likely enhance performance when one of these three outcomes occurs. The Instructional Hierarchy Model of learning stages provides a useful framework for selecting treatment components that is based on the students' current level of responding. For example, if the problem is inaccurate work, then treatment modification would include strategies that ensure skill acquisition. To first acquire a skill, students need information before they respond and information after they respond. Once acquisition has occurred, instructional strategies may need to be altered to increase skill fluency. Strategies such as modeling, drill and reinforcement has been shown to effectively increase fluency (Daly & Martens, 1994). Homework as traditionally practiced may not effectively increase fluency gains. Few studies have investigated the effects of homework on increasing fluency gains up to skill mastery levels. According to findings in the fluency literature (Binder, 1996), skill mastery levels would be the level that best predicts when a student will retain the skill over time, increase endurance, and apply the skill to complex tasks.

According to Skinner, Fletcher & Henington (1996), students who are failing are often learning but are not learning as fast as the other students are. He further proposes that the degree of learning gains over time can be enhanced qualitatively as well as quantitatively. Homework, for example, is a strategy that is used to increase the quantity of opportunities to respond. However, quality, the amount of learning between each practice opportunity, can be enhanced by increasing the rate at which opportunities to respond are presented. As a result, the slower student will have more response opportunities in less time thereby making more fluency gains more quickly. For example, in the classroom setting, choral responding with a fast paced
presentation enhanced verbal learning compared to individual student responding (Sindelar, Bursuck, & Halle, 1986).

Opportunities to respond can also be increased when students are working independently (Greenwood, Delquardi & Hall, 1984). For example, Van Houton, Hills and Parsons (1975) found that students completed as much of their writing assignments during 10 minute sessions as longer 20 minute sessions. A follow up study demonstrated that shorter time limits during math class increased both rate and accuracy (Van Houten & Little, 1982). Haughton (1980) recommends that practice sessions be brief but frequent for optimal quality gains in performance over time. Moreover, contingent reinforcement for increased rates of responding may be necessary for maintaining gains in responding rates over time (Skinner, Fletcher & Henington, 1996; Wolery, Bailey & Sugai, 1989).

Although these strategies have proven to be effective in the classroom (Binder, 1996; Johnson & Layng, 1994; Haughton 1980), it has not been demonstrated whether or not these strategies are more effective than homework. Although homework may be an efficient strategy for teachers to use as a means to increase opportunities to respond, it may not always increase fluency. If homework is not effective for subsets of students, then more information is needed to assess whether or not there are other alternatives that can promote the expected degree of fluency progress.

Step 3: Reducing Implementation Time Using Peer Tutors

Unfortunately, developing alternative classroom-based interventions can lead to significant disruptions in regular classroom routines. Nonetheless, for many students to achieve academic expectations, it may be necessary to provide them with practice
opportunities that are effective in the classroom. When initially planning a practice program in the classroom, the type of intervention may be a factor that influences teachers' use of the intervention on a daily basis. Correlational studies suggest that teacher treatment integrity may be influenced by the complexity of the intervention, the time necessary to carry out the intervention and the intrusiveness of intervention relative to established classroom routines (Zins and Erchul, 1995). Basic effort-response research suggests that interventions that lower the amount of required effort may result in higher treatment integrity levels (Friman & Poling, 1995). Not surprisingly, subjects prefer lower effort requirements as opposed to higher effort requirements. In the classroom, the practice session would need to be efficient as well as effective for a number of reasons. First, the child will be taking time out of the school day to get the additional practice. Next, the teacher will lose teaching time when managing these additional sessions.

One approach that minimizes these difficulties is to use a peer-managed intervention. Interventions employing peer tutoring have the advantage of decreasing the amount of teacher time and effort needed to achieve academic progress. In addition to decreasing response effort, there are a number of benefits to peer-tutoring such as providing individualized instruction, increasing academic progress for at-risk students, providing multiple opportunities for students to respond, and providing frequent corrective feedback (Wolery, Bailey, & Sugai, 1988). Peer tutoring has been demonstrated to be a viable approach in increasing teachers' usage of Curriculum-Based Measurements and academic interventions (Bentz, Shinn, & Gleason, 1990; Greenwood, Carta, & Hall, 1988).
In addition, interventions that focus on having students grade their own work allows teachers to provide feedback immediately while decreasing grading time. Studies that examined the effects of students scoring their own work suggested that academic performance increased when students immediately grade their own work (Van Houten, 1980). For example, Hillman (1970) conducted a study with a group of students who graded their own math work. The students waited until everyone had completed their work before the teacher dictated the answers. A second group of students had their teacher grade their work and received the grade the following day. The results indicated that the group that graded their own work showed more improvement on a standard math test than the teacher graded group.

**Summary of the Problem**

In summary, a common finding among homework studies for elementary students is the lack of consistent academic progress across all students. It is assumed that students are practicing a skill already acquired in class and are now further honing this skill. However, few studies have investigated whether or not homework effectively enhances a student's skill mastery or fluency. Moreover, teachers report that they are assigning work not completed during class as homework. This finding suggests that a student who is not doing the required work either in class or at home is getting even fewer opportunities to respond. Further, research reflects that the lower performing students are often children from low socioeconomic families who lack adequate resources at home. When home resources and support are inadequate, homework may be more likely to expand, rather than narrow, the achievement gap between low and high socioeconomic students (Baer & Bushell, 1981; Cooper, 1989; Greenwood, 1996).
Traditional homework practices may also further hinder student progress. The traditional monitoring of accuracy will provide information about whether homework was completed or not, but may not necessarily reflect whether a child has mastered the skill. Without skill mastery, some students quickly forget what was taught. Students fall further behind because either more time is wasted in a learn-forget-learn-forget cycle or the student is never re-taught the material. The student is then expected to acquire more complex skills with weak prerequisite skills. If homework is not increasing skill mastery, then alternative methods are needed that enable low performing students to do well in school. While factors such as family variables cannot be directly altered to affect achievement, teachers do have the ability to alter factors such as progress monitoring, practice opportunities, academic materials, and performance feedback all of which can increase academic performance. The present study offers a method to assess and evaluate viable alternatives for increasing response opportunities that lead to skill mastery for individual students who are not benefiting from traditional homework practice.

The primary purpose of this investigation was to systematically evaluate the effects of homework and alternatives to homework on student math completion, accuracy and fluency. This study investigated the effects of antecedent and consequential strategies on different types of homework problems and different levels of responding for low socioeconomic students.

In this study, treatment selection was initially based on a brief assessment of academic performance. Students were first assessed to determine if a performance deficit was present (Noell, Gansle, Witt, Whitmarsh, Freeland, LaFluer, Gilbertson, & Northup 1998; Noell, Freeland, Witt, & Gansle, in press). For students identified as
having a performance deficit, programmed reinforcement was prescribed as the indicated treatment. If students’ performance did not increase during the performance deficit assessment, it was presumed that students were unable to perform the task due to a skill deficit. Students exhibiting a skill deficit were prescribed an instructional intervention to improve basic skills. All students received both the indicated and the contraindicated homework interventions within an alternating treatment design to examine and compare whether the effects of the two treatments were supported by the brief assessment.

If homework was ineffective for any student, this study was designed to determine why homework might have been unsuccessful by systematically examining the conditions under which improvements in student performance could be established. Effective treatments continued to be implemented until all skills reached a skill mastery criterion.
Chapter 3

Method

Overview

Homework requires that a student works independently without prompts, retains the skill across time, transfers the skill to more difficult problems, and generalizes a skill to a new setting. However, research on fluency rates suggests that students are more likely to successfully use a skill independently, at a later time and in different settings once they can perform at fluency mastery levels (Binder, 1996). While behavioral strategies have been shown to effectively increase homework completion, a consistent increase in the accuracy with which the homework is completed is often lacking (Cooper & Nye, 1994; Harris & Sherman, 1974; Epstein, 1988; Olympia, Sheridan, Jenson, & Andrews, 1994; Rosenberg, 1989). Results from proficient learning research suggest that students' accuracy is inconsistent when they are not yet able to do the skill automatically or fluently (Binder, 1996). Few studies have examined the effects of homework practice on fluency acceleration. Moreover, there may be individual differences in the type of problem that the student is having with homework which would lead to differences in relevant homework intervention components that would benefit different individuals. This study examined several possible functions of incomplete homework and the effect of different treatment effects on fluency performance while monitoring accuracy. First, a brief experimental analysis was conducted to identify if the student's poor homework performance was most likely due to a skill deficit or a performance deficit using brief test conditions. Next, two conceptually related interventions were used in an alternating homework treatment phase to determine if the outcome of the brief experimental assessment had
treatment validity. Finally, a Fluency Training Package was implemented if the homework protocol proved to be ineffective.

Throughout this study, both accuracy and fluency progress was monitored. However, the change in fluency was the primary measure used to determining whether or not a student is mastering a skill. A fluency measure was preferred since it is the more sensitive measure and predicts when a student is more likely to maintain and generalize a skill (Miller, Hall, & Heward, 1995.). All students in this study were provided with two homework treatment programs that incorporated either an instructional component for students exhibiting a skill deficit or a motivational component for students exhibiting a performance deficit. Treatment effects for each participant were determined through consideration of individual fluency performance. Treatment effects were evaluated at various points in the study and decisions about intervention phase changes were based on student fluency performance data. A treatment phase change was made if the following occurred for the fluency measure: a) a downward trend in performance or if performance within phases stabilized suggesting stalled learning, b) a weak change in level or magnitude when compared with the Baseline or previous treatment effects, c) a weak increase in performance (i.e., slope) within the phases and/or d) poor differentiation between treatments within phases.

Figure 1 depicts the decision making process adapted throughout this study. The decision to introduce a phase depended on student fluency performance in the previous phase. After evaluating the effects of Instruction and Contingent Reward Homework Treatment conditions, subjects were expected to fall into one of four groups. First, if one or more of the homework treatments effectively increased
Figure 1. Decision-making flowchart for Cohorts One, Two and Three
homework fluency rates, the homework practice would continue until a student met the mastery level. In this study, no student fell into this group.

Second, student lack of academic performance may be due to lack of treatment integrity or intervention inappropriateness. The first experimental cohort was designed to test the possibility that the homework protocol sent home for use by parents failed to produce results because the protocol itself was ineffective. Hence, the same protocol was applied at school with implementation at or near 100% integrity. A problem with previous homework research is the lack of measurement of the independent variable. Therefore, when homework produces marginal results, it is impossible to determine whether the problem is with an ineffective treatment protocol or whether an effective protocol was poorly implemented. In Cohort One, if the homework protocol was effective under conditions of high treatment integrity, then it could be inferred that a lack of efficacy in the home is attributable to treatment integrity and not the efficacy of the protocol. Another important reason for including this group was merely to evaluate the effects of "additional practice" at school on student achievement. Ostensibly, teachers assign homework in order to provide additional opportunities for the student to respond. Given the disappointing literature on homework, perhaps the home setting is not an optimal environment for practice for some children. If this is true, then a time efficient and effective method for teachers to provide additional practice at school is needed. Hence, for students who failed to respond to practice sessions conducted at home, the treatment effects were further examined to evaluate if the treatment would be effective if implemented with 100% integrity. Before a decision was made to implement a more intense treatment, the treatment that addressed the child's hypothesized skill or a performance deficit was
conducted in the classroom with the teacher. Students were monitored while they completed a practice assignment independently, in a quiet setting and with adequate light. If the treatment proved to be effective in the classroom, then the teacher continued to provide practice in class until the student obtained fluency mastery level. On a second skill, students were trained to work in pairs to evaluate if treatment effects would still be effective within the school setting but with little teacher assistance. In this study, four students met these criteria and are reported as Cohort One in this study.

The second experimental cohort was designed to evaluate the effect of a Fluency Training Package for students who failed to improve performance with the Instruction and Contingent Reward Homework treatments. It was expected that some students would have difficulty increasing fluency rates with interventions that used a percentage metric as opposed to a fluency or rate metric. Hence, these students were presented with a practice package that emphasized strategies based on empirical findings that have shown to increase fluency rates (Binder, 1996; Johnson and Layng, 1992; Wolery, Bailey, & Sugai, 1988). The Fluency Training Package included goal setting, time delayed feedback, practice with multiple sensory modalities to increase generalization, timed practice to increase speed while decreasing practice time, and practice of smaller segments of the original task. The treatment was continued if effective in the classroom. If the package was not effective, then the Fluency Training Package was supplemented with an incentive program. The teacher continued to provide the effective treatment in class until the student obtained mastery level if the Fluency Training Package with Reward proved to be effective. In this study, four students met these criteria and are reported as Cohort Two in this study.
Finally, the third cohort was designed specifically to evaluate possible ordering effects of treatments implemented. Three students were selected who initially failed to show adequate fluency gains and differentiation when alternating the Instruction and Contingent Reward Homework Treatments. These students were immediately presented with the Fluency Training with Reward treatment in their classrooms to examine the possibility that this treatment was effective only when it followed the sequence of an Instructional or Contingent Reward Homework Treatment or the Fluency Training Package.

**Subjects and Setting**

Eleven elementary students exhibiting poor homework performance participated in this study. Participants were selected based on the following criteria: a) the teacher reported that the student failed to complete less than 50% of the assigned homework on returned homework for the previous marking period and was at risk for failing math, b) the student performed in the lower 50th percentile on standardized IOWA test, c) the teacher reported difficulties with parent communication due to lack of phone and little response to notes sent home and d) parents failed to attend the required teacher-parent conference. None of the participating students were taking medication since the experimenter was unable to control possible medication influences (see Table 1).

This study was conducted in general education classrooms at an elementary school in a southeastern parish of Louisiana. The elementary school was an inner city school consisting of more than a 90% minority population of students. Most of the student's families fell into the low SES group and more than 95% of the student population was enrolled in the Federal School Lunch program. The principal initially
Table 1: Student Characteristics

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<td>Low</td>
<td>African American</td>
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<tr>
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*Low SES indicated by enrollment in the Federal School Lunch Program that is based on family income.

requested consultation due to low IOWA scores (i.e., below 15 percentile range) attained by students the previous school year. Experimental sessions, training sessions, and student screening sessions took place in each participating student’s classroom.

**Materials**

**Practice Assignments**

Throughout the study, students worked independently on a one-page sheet that consisted of a math skill that had been taught by their teacher prior to this study (see Appendix 1). Math skills were selected in combination with the Scope and Sequence charts from the school district, content of classroom math books, Iowa Test of Basic Skills (ITBS), and teacher input. Moreover, skills were selected such that students could be working on two skills that were similar in level of effort and task difficulty.
**Reinforcement Practice Assignments**

The problems on the reinforcement assignments were selected to ensure that a similar level of student effort and task difficulty was required as the skill practice on the instructional homework practice sheets. To control for possible effort effects across skills, the instructional and reinforcement practice sheets each had identical number of steps that were required to answer each problem. Additionally, both sheets required students to master different but an equal number of basic math addition or subtraction facts. For example, the third grade students were working on double digit subtraction problems with regrouping (See Appendix 2). In order to complete the sheet fluently, students were required to have mastered one digit subtraction facts. The basic subtraction facts were divided such that students were required to learn 12 basic facts. More specifically, the instructional sheet had only subtraction facts that subtracted from 11, 12, and 13 while the reinforcement fact sheet required students to know subtraction facts subtracting from 14, 15, and 16. The assignment sheets were also designed to increase students' ability to discriminate between the instructional and reinforcement assignments. For example, the reinforced practice assignments were the only assignments that were printed on bright pink paper. The assignments also were printed with the directions stating "You will earn a reward if you beat this goal: ___" at the top of the pink paper. A picture labeled "Treasure Chest" and a picture of a game labeled "Fun Activity" was also printed on top of each assignment sheet.

**Daily Math Probes**

Math probes were administered to students after practice assignments were collected on the next day. Problems were randomly selected for each daily probe from a pool of problems that were presented on the practice worksheets (See Appendix 3).
Fact Sheet

While students were learning to master facts, students were given a fact sheet to use when working on their practice assignments (See Appendix 4). The fact sheets consisted of the math facts that were needed in order to complete the problems on the practice assignments and daily math probe. The fact sheet was used to prevent students from practicing incorrect answers when working independently.

Flashcards

Sets of flashcards were supplied for student practice during each tutoring session with the Fluency Training Package. Each math skill was divided into a number of fundamental component elements or tool skills. For example, subtraction of whole numbers was divided into the following groups: subtracting from eleven, subtracting from twelve, and subtracting from thirteen. Students began learning four facts and up to four additional facts were added once the student had mastered the previous four facts as indicated by their performance on the Sliced Practice Sheet. Students were considered to have mastered the facts after obtaining a score at or above the 40 digits per minute mastery criterion used in this study.

Sliced Probes

Additional practice sheets were constructed for students to complete during the Fluency Treatment Package or Fluency Treatment Package with Reward. The sliced probes resembled the daily math probes but consisted of a group of problems that students were learning with the use of flashcards (See Appendix 5). Sliced Probes consisted of the initial subset of facts that the student had previously practiced during the Homework Treatment phase. After practicing answering problems on the flashcards, students completed as many problems as they could for one minute.
Students were considered to have mastered the facts after obtaining a score at or above the 40 digits per minute mastery criterion used in this study. Additional facts were added once the student had mastered the previous four facts as indicated by their performance on the Sliced Practice Sheet. The added facts always corresponded with facts practiced on the flashcards.

**Progress Chart**

A chart was maintained throughout the study to chart student progress. (See Appendix 6). The chart was a written record of the student daily practice goal, the practice scores, and the daily math probe scores for the teacher, student and parent to review.

**Reinforcer Survey**

A reinforcer survey was administered to identify preferred stimuli for each participant. The teacher read potential reinforcers aloud from a master list that was similar to the items found on the Child Reinforcer Survey (CRS: Fantuzzo, Rohrbeck, Hightower, & Work, 1991) (See Appendix 7). After the teacher read an item out loud, the student marked the items that they would like to earn for doing good work on their practice assignments. The chosen tangible and edible items were purchased and collected into a decorated box labeled the "Treasure Chest". Chosen activities were written on a card that was taped onto the top of the treasure chest (e.g., "play a game with a peer") (see Appendix 8).

**Dependent Variables**

Several student outcomes were measured in the present study including percent correct on the independent practice assignments and the number of correct digits per minute on one-minute daily math probes.
Fluency (i.e., number of digits correct per minute on one-minute probes)

The primary student target behavior in this study was the math performance on daily math probes. After a student completed a practice assignment, a math probe was administered on the following school day for one minute to gauge the speed that a student could perform a skill. The one-minute math probe consisted of math skills required by the school district scope and sequence charts. The probes were scored for the number of correct digits written correctly during the one-minute test. The number of digits correct per one-minute session (DCPM) was the dependent measure for analysis.

In this present study, a student was considered to be performing at a proficient fluency rate once they were able to obtain scores above a rate of 40 digits correct per minute. This fluency or mastery criterion was based on rates adapted from Shapiro (1996), Howell & Kaplan (1980), Mercer and Mercer (1985) and Wolery, Bailey, and Sugai (1988).

Accuracy

A secondary behavior measured was the number of responses (i.e., math problems) that the student completed correctly on the practice assignments. Accuracy was used on the practice sheets since the time measure for fluency rates was difficult to reliably measure at home. Percent accuracy was calculated by dividing the number of correct answers by the total number of problems on the practice sheet.

Percentages of Non-overlapping

The percentages of non-overlapping data were computed between treatment conditions during the multi alternating treatment phases. This percentage was used to compare the amount of times that the fluency (DCPM) scores for the hypothesized
treatment fell at or below the opposing treatment. The hypothesized treatment was the treatment that addressed the skill or performance deficit that was suggested with the brief academic assessment. A percentage of the non-overlapping data was calculated as a percentage by dividing the number of data points of the intervention that was supported by the Brief Assessment (i.e., if skill deficit then the instructional intervention would be supported), the Fluency Training Package or the Fluency Training Package with reward that fell above the opposing treatment data points answers by the total number of data points measured during the hypothesized treatment phase. The non-overlapping percentage was calculated during the following phases: Homework Treatments, In-Class and Homework Treatment, Fluency Training and Homework Treatment, and Fluency Training with Reward and Homework Treatment.

**Independent Variables and Treatment Conditions**

**Baseline**

During this condition, no additional intervention was provided. A practice assignment was given to each child at the end of math class in the same manner that the teachers had traditionally given students their practice assignments in the classroom. The students were told that the assignment was to be completed at home and would be collected on the following school day. On the school day that followed the practice assignment, the teacher collected all homework at the beginning of the day. The teacher graded the homework before the daily math session. During the math session, the practice assignments were returned to the students. Hence, the two required student steps during this phase were to complete the practice assignment at home and bring the assignment to school on the following school day.
After collecting the practice assignments, a daily math probe was administered to evaluate student performance rates before the implementation of one of the homework interventions. A skill probe consisting of problems that were solely on the current practice assignment was administered to each child. The teacher wrote the student's previous best score on the daily math probe and then gave instructions for the probe. The teachers told students to complete as many problems as they can in one minute. After the one minute passed, students were told to stop working. The one minute probes were immediately graded and students were told their scores. No incentive was provided for academic performance. Baseline continued until (a) student academic performance on the daily probes was stable, did not improve, or showed a downward trend and (b) student accuracy scores were consistently below 50% or showed a downward trend.

**Brief Assessment of Academic and Skill Performance**

After Baseline, student performance was assessed for all participating students to determine if the lack of homework performance was due to a skill deficit rather than a performance deficit. This brief assessment was similar to performance screening previously used by Noell, Freeland, Witt, & Gansle (in press) (See Appendix 9). Briefly, students were re-tested on one of their practice assignments that was not returned during a Baseline session without assistance. During this condition, students attempted to exceed their previous best Baseline fluency score by 25%. The students were told that if they worked hard and exceeded the goal (i.e., number of correct problems), then they could earn something from a treasure chest or can choose to play a game with the teacher. Before completing a math probe for one minute, the students were given an opportunity to examine the items in the Treasure Chest.
One of two hypotheses was developed based on the results of this brief assessment. If the student was unable to exceed the goal when offered an incentive on a skill worksheet, the lack of improvement was considered to be more likely due to a skill deficit rather than a performance deficit. Thus, it was hypothesized that the student was exhibiting a skill deficit and would most likely benefit from an intervention that provides effective instructional strategies. However, if the student was able to exceed their goal and was within the upper instructional or mastery range, then their problem was inferred to be more likely due to a performance deficit. Students that were hypothesized as exhibiting a performance deficit would most likely benefit from an intervention providing preferred rewards for improved academic performance.

Instruction Homework Treatment

During this experimental condition, after students turned in their homework, the teacher immediately graded the homework, told students their grade and administered the daily math probe in the same manner as the Baseline classroom probes. In addition, an instructional package was administered to students before receiving their practice assignment (See Appendix 10). The instructional practice package consisted of a number of components that represent effective instructional practices. First, problems were broken down into small sequential steps. In order to show students how to do a problem correctly, the teacher solved a problem in a step-by-step manner. The student was given the opportunity to solve a similar problem as the teacher monitored their work and prompted correct answers. While practicing, students were also given an addition or subtraction basic fact sheet to use while learning the math steps. Students were told to refer to the fact sheet to verify their answers. The teacher continued in this manner until the student was able to correctly
solve three consecutive problems. After obtaining three correct problems, the teacher instructed the students to complete the practice sheet as taught at home for homework and bring the assignment back to school on the next school day. An addition or subtraction basic fact sheet was also attached to the practice assignment for students to use when completing the practice sheet at home. When homework was collected on the following school day, the teacher graded the paper and immediately told the students their grade. Students were praised for correct answers and corrected any incorrect answers with the teacher.

As in Baseline, a daily math probe was administered each time that a practice assignment was collected and graded. These probes were conducted without additional instruction to examine the extent to which instructional gains would generalize to similar math problems that were not instructed in the session. After receiving their homework grade, students were given a probe with problems similar to the problems on the practice assignment. After receiving their grade, a daily math probe was administered to students in the same manner as during the Baseline condition.

**Contingent Reward (CR) Homework Treatment**

During this condition, a choice of one of the preferred items or activity cards from the Treasure chest was provided contingent upon student homework accuracy performance (See Appendix 11). Prior to this condition, preferred items or activities had been identified on the basis of choices made during the Reinforcer Assessment (See Reinforcer Assessment procedure section below). Purchased items were placed into a box labeled as the Treasure Chest. Activity cards with pictures of various activities were also used. After picking a card, the students would immediately
exchange the card with the teacher and get approximately five minutes to participate in a preferred activity. Specifically, students were given a daily goal that they would try to exceed. Students would either try to exceed their previous best accuracy score or get 100% of the problems correct. They were told that they would earn a chance to pick an item or activity from the "Treasure Chest" if they exceeded their daily goal or got 100% of the problems correct. The daily goal was then written on top of the practice assignment. This assignment was printed on pink paper and had a picture of the "Treasure Chest" on top of the paper. When homework was collected, the papers were immediately graded to determine if students had exceeded their goals. Specifically, if a student exceeded the daily homework goal, students selected a reinforcer from a treasure chest and the student placed a star on the student's Progress Chart by the student's name.

After receiving their grade, the students were administered a math probe in the same manner as the Baseline classroom probes. These probes consisted of problems similar to the problems on the practice assignment practice sheet. These probes were conducted without contingent reward to examine the extent to which gains would generalize to similar math problems.

**Instruction with Contingent Reward (I+CR) Homework Treatment**

During this condition, students were presented with the procedures that were implemented during both the Instruction and Contingent Reward Homework Treatments described in Cohort One. That is, students were shown how to do several problems, received assistance with several problems, and were given a basic fact answer sheet stapled to the practice sheet to complete at home. Students were also given a daily goal to try to meet or exceed. When the students returned their
homework practice sheet on the following school day, they earned a reward if they had exceeded their goal or obtained a score of 100%. This condition was implemented to compare the effect of the Fluency Training Package with the most powerful homework treatment that combined both instruction and reinforcement.

**Instruction In-Class Treatment**

This condition was implemented if a student's fluency performance failed to improve or trended downwards during either homework condition for students whose Brief Assessment indicated a skill deficit. During this condition, procedures identical to procedures used for the Instruction Homework Treatment were conducted in the classroom environment at 100% integrity with the teacher's supervision in order to validate the effectiveness of the hypothesized treatment before implementing modifications (See Appendix 12). The practice worksheets continued to function as an opportunity to practice skills independently, however, the practice assignment was completed in the student's classroom instead of at home. Moreover, students were observed completing the assignments independently, in a quiet setting and with adequate light. In this condition, students completed their practice assignment in school after instruction to verify that the treatment would be effective with 100% integrity. Instruction procedures were identical to procedures used in the Instruction Homework Treatment condition. The teacher modeled sample problems in a step-by-step manner until the student was able to correctly solve three consecutive correct problems. Students then worked on the practice sheets independently while the teacher remained in the classroom monitoring students working. After the student completed their work, they turned in the homework assignment. The teacher graded the assignment the next morning, and the student was told their grade. After receiving
their grade, students wrote their previous best score on a daily math probe. A one minute daily probe was administered and graded by the teacher.

**Contingent Reward (CR) In-Class Treatment**

This condition was implemented for students' whose Brief Assessment indicated a performance deficit or if the student's fluency performance failed to improve or trended downwards during either homework treatment condition. During this condition, procedures identical to the Contingent Reward Homework Treatment were conducted in the classroom environment at 100% integrity with the teacher's supervision in order to validate the effectiveness of the hypothesized treatment before implementing modifications (See Appendix 13). Hence, students continued to be given a daily goal before practicing a worksheet independently. The teacher monitored students as they worked in class. After the student completed their work, they turned in the homework assignment. The teacher graded the assignment the next morning and the student was told their grade. Students were also given the opportunity to choose an item or activity card from the Treasure Chest if they had exceeded their score or obtained a score of 100% correct. After receiving their grade and reward if earned, a one minute daily probe was administered and graded.

**Student Managed Package**

A Student Managed Package was introduced if a student had obtained the fluency mastery criterion used in this study during either the Instruction or Contingent Reward In-Class Treatment Condition (See Appendix 14). This phase was used to evaluate the effects of the effective treatment when peers were responsible for implementing the treatment steps. When treatments were shown to be effective with teacher implementation, a final phase was introduced on a second skill. To minimize
teacher time, peers were trained to conduct teacher steps that mirrored the effective
treatment package (i.e., Instruction or Contingent Reward Homework Treatment).
Working in pairs, students first received a folder containing the needed materials (i.e.,
progress chart, practice sheet, an answer sheet, and a one minute probe) from their
teacher. In Cohort One, the Brief Assessment indicted that all four students were
exhibiting a skill deficit. Hence, students followed procedures similar to those described
in the Instruction In-Class Treatment condition. Students began each session by
grading their partner’s practice assignment that was completed prior to the session
and recorded the score on their partner’s chart. The students then took turns
administering a one-minute probe to their partner. After writing the previous best
score on top of a daily math probe, students told their partner that they had one
minute to complete problems and set the timer for one minute. At the end of one
minute, the student told their partner to stop and proceeded to grade the probe. Each
probe was designed such that students could do their own grading. That is, next to
each problem there was a blank space that had the answer written in the box
“invisibly” with a white erase marker made by the Crayola Crayon Company®.
Students were unable to see the correct answer until they colored in the box with a
colored marker. After grading the one-minute probe, the student told their partner
their score and recorded the score on their partner’s chart.

Next, each student then took turns practicing the skill on a practice assignment
sheet. Students first guided their partner with several problems using an answer key
until three consecutive problems were correct. If their partner answered a question
incorrectly, the student told them to try again. If their partner continued to make an
error, then the student showed them the correct answer and steps using an answer
Both students then completed their practice sheets on their own. After the practice sheets were completed, students placed the assignment into their folder.

In order to ensure that each of the student steps was carried out, the teacher prompted students to implement any steps that were missed or implemented incorrectly. A Student Integrity for Student Managed Package Data Checklist (See Appendix 14) was used to ensure that students were implementing all intervention steps accurately during the session. This form consists of a list of each of the required intervention steps. Next to each step, an observer or the teacher marked a check if the behavior was observed during a math session. To ensure 100% integrity, the observer or teacher prompted the student to complete any incorrect step before the end of the session. Treatment integrity was calculated by dividing the number of completed intervention steps by the total number of intervention steps listed on the checklist, multiplied by 100 and written on the recording form. Finally, the permanent product produced by each step was collected to verify that all steps were completed as planned.

**Fluency Training Package (FTP)**

Following the implementation of either the Instruction In-Class Treatment or the Contingent Reward In-Class Treatment, a Fluency Training Package was introduced to students if fluency scores failed to increase, failed to increase at an adequate rate, failed to meet mastery levels, and/or showed a downward trend. The Fluency Training Package consisted of several effective teaching instructional strategies that targeted fluency practice by having students practice the skill with an increased pace and feedback before completing a one minute daily math probe (See Appendix 15).
During this condition, there were two brief practice steps that occurred before the administration of the daily probe. First, students practiced the skill with flashcards using a Time Delay method (Wolery, Bailey, & Sugai, 1988). Students were initially given a set of up to four flashcards to learn that consisted of four problems or basic facts that were also on the daily math probe. The teacher would present a problem on a flashcard to the student for three seconds. After the student answered the problem correctly, the teacher praised the student and presented the next card. If the student failed to give the correct answer, then the teacher told the student the correct answer and had the student try the task again. Next, the student was given a sliced probe that was a one minute probe consisting only of the problems that were practiced previously with the flashcards. Hence, students were required to first work on a smaller portion of the skill presented on the daily math probe. Students were given a one-minute time limit to complete problems on the Sliced Probe. Before setting a timer, the teacher wrote the student's previous best score on their sliced probe and prompted students to try to exceed this goal. After the student completed their one-minute worksheet, the teacher immediately graded the worksheet and told the student the number of digits correct per minute. Students were gradually given additional math facts to practice on both the flashcards and the practice sheet as scores improved on the practice sheets and they were able to get all presented flashcards correct.

After the two brief practice sessions, the student was given the daily math probe. Again, students were given their previous best score and were encouraged to try to exceed their score. The probe was graded immediately after the one minute test was administered.
These steps continued to be administered once a day until the student reached the mastery criterion. After the student responded at or above the mastery criterion, the next phase began to evaluate the use of peers for treatment implementation. If students failed to increase fluency rates, data points between the homework treatment and the fluency treatment frequently overlapped, or data points trended downward, then the Fluency Training Package with Reward was implemented that incorporated an incentive program.

**Fluency Training Package with Reward (FTP+R)**

A Fluency Training Package was introduced to students if fluency scores failed to increase, failed to increase at an adequate rate, failed to meet mastery levels, and/or trended downward during the Fluency Training Package condition. During this phase, an incentive component was added to the Fluency Training Package (See Appendix 16). As previously described, students continued to practice flashcards and were given a one minute Sliced Probe that consisted of the problems practiced on the flashcards. However, students were given an opportunity to earn a preferred item if they were able to exceed their previous best score. Immediately after the student was administered the one-minute Sliced Probe, the teacher graded the probe and told the student the score and whether or not they had exceeded their goal. If the student had successfully exceeded the goal, then they immediately chose a preferred object from the treasure chest or a preferred activity. Students were given a second opportunity to earn a reward when they were administered the one-minute daily math probe. These steps continued to be administered once a day until the student reached a mastery level. After performing at or above the mastery criterion, the Student Managed Implementation phase was introduced.
Student Managed Fluency Package

Student Managed Fluency Package was implemented after a student had obtained the fluency mastery criterion during the Fluency Training Package with Reward used in this study. This phase was implemented to evaluate the effects of the Fluency Training Package with Reward when peers implemented the treatment steps with 100% integrity on performance. Peers were trained to conduct the brief practice sessions with flashcards and worksheets. Working in pairs, students first received a folder containing the needed materials (i.e., flashcards, progress chart, practice sheet, an answer sheet, and a one minute probe) from their teacher. Each student then took turns presenting the flashcards for three seconds and gave correct answers to their partner whenever a problem was missed. After each student had practiced their flashcards, they set a timer for one minute and completed problems on a Sliced Probe. In the folder, each student was given a sliced probe that consisted of problems that he or she had just practiced on with the flashcards. After the Sliced Probe was completed, students graded their partner’s probe and recorded the score on their partner’s chart. The student then took turns administering a one-minute daily math probe to their partner. After writing the previous best score on top of a daily math probe, students told their partner that they had one minute to complete problems and set the timer. At the end of one minute, the student told their partner to stop and proceeded to grade the probe. Each probe was designed such that students could do their own grading. That is, next to each problem there was a blank space that had the answer written in the box “invisibly” with a white erase marker made by the Crayola Company®. Students were unable to see the correct answer until they colored in the box with a colored marker. After grading the one-minute probe, the student told their
partner their score and recorded the score on their partner's chart. The student's then reported the scores to the teacher and was permitted to choose a reward or activity from the treasure chest if they had exceeded their previous best scores.

In order to ensure that each of the student steps was carried out, the teacher prompted students to implement any steps that were missed or implemented incorrectly. A Student Integrity for Student Managed Fluency Package Data Checklist (See Appendix 17) was used to ensure that students were implementing all intervention steps accurately during the session. This form consists of a list of each of the required intervention steps. Next to each step, an observer or the teacher marked a check if the behavior was observed during a math session. To ensure 100% integrity, the observer or teacher prompted the student to complete any incorrect step before the end of the session. Treatment integrity was calculated by dividing the number of completed intervention steps by the total number of intervention steps listed on the checklist, multiplied by 100 and written on the recording form. Finally, the permanent product produced by each step was collected to verify that all steps were completed as planned.

**Experimental Design**

A multiphase alternating treatments design was used to compare different treatment conditions on the math performance of eleven students. As indicated in Figure 1, subjects were placed into three different cohorts depending on specific results found after practice assignments were given at home. In this study, the degree to which a student's fluency rate increased was the primary dependent measure. A secondary dependent measure, homework accuracy, was also monitored.
**Cohort One: Homework Treatment Group**

Students who fell within this cohort failed to improve fluency performance with either the instructional or contingent reward practice conditions conducted at home regardless of their hypothesized deficit. The purpose of this cohort was to examine the possibility that lack of a treatment effect at home might be attributable to inappropriate or inconsistent implementation. If a student's fluency levels effectively increased when the treatment was implemented with a 100% integrity level, then the experimental phase continued until students mastered the skill. Given that the intervention was more effective when practice sessions were implemented in the classroom, a second purpose of this cohort was to evaluate the use of peers as a time efficient alternative for a teacher wanting to provide additional practice. To evaluate the use of peers, a peer implemented treatment package was applied to a second skill. Four phases were implemented for students in Cohort One including Baseline, Homework Treatments, In-Class and Homework Treatments, and Student Managed Package.

**Baseline.** During Baseline, homework was presented with no additional intervention procedures. The teacher presented the practice assignments that were used in this study to students as a math homework assignment. Specifically, students were given the practice sheet at the end of math class. Homework was scored the following school day and correct answers were reviewed with the students. No specific contingencies other than a grade were in effect to increase homework completion or accuracy.

The daily math probe was administered to evaluate fluency progress immediately after students had received their homework grades. The teacher
immediately graded the one minute probe and students were told their score. Baseline continued until a student fluency performance either stabilized or showed a downward trend.

**Brief assessment.** After Baseline, student performance was assessed for all participating students to determine if the lack of homework performance was due to a skill deficit rather than a performance deficit. To summarize, students were presented with an opportunity to earn a preferred reward if they were able to increase their average baseline score on the daily math probe.

**Homework treatments.** The first alternating treatments phase was used to validate the hypothesis derived from the Brief Assessment that suggested that the subject's lack of homework performance was due to either lack of motivational incentives (i.e., a performance deficit) or effective instruction (i.e., a skill deficit). Based on the results of the experimental analysis, an instructional treatment was developed to address the suggested skill deficit while a treatment that provided a reward contingent upon academic progress was developed for students showing a performance deficit. Following the assessment, the Instruction Homework Treatment and Contingent Reward Homework Treatments were alternately presented during this phase. Although the practice assignments were of equal difficulty, students were presented with different sets of arithmetic facts for each treatment condition. Thus, we designed the practice sheets were designed such that mastery of the facts on the problems presented during the first condition would not help the student complete the problems more fluently during the alternating condition, which contained different math facts. A number of manipulations were used to enhance the saliency of the two treatment conditions and to enhance student discrimination between the two
treatment conditions. First, each treatment had specific instructions that highlighted the differences in contingencies. Second, students were asked to repeat instructions and contingencies each time they were given a practice assignment. Finally, presenting subjects with different colored papers with different labels and pictures for each condition was expected to reduce the likelihood of multiple treatment interference influencing the results. The sequence of the treatment conditions was counterbalanced (e.g., ABBAAB) to control for sequence effects.

In-class and homework treatment. This second alternating treatment phase was implemented if a student's fluency performance did not improve or trended downwards during either of the two homework treatment conditions. The In-Class and Homework Treatments phase was implemented to determine if students were able to increase fluency rates when the treatment designed to meet the child's hypothesized deficit area was implemented with 100% integrity. Hence, students whose Brief Assessment indicated a skill deficit continued to practice under the Contingent Reward Homework Treatment while alternating practice with the Instruction In-Class Treatment condition. In contrast, students whose Brief Assessment indicated a performance deficit continued to practice under the Instruction Homework Treatment while alternating practice with the Contingent Reward In-Class Treatment condition. Given that there was an accelerating trend during the Alternating Homework Treatment phase for instruction, and given that the Brief Assessment has revealed these to be students with skill deficits, the instructional treatment potential effectiveness was enhanced by controlling the integrity with which it was implemented. Although each student in this phase completed their practice assignment at school each day, the treatment implementation procedures for the opposing hypothesis
remained unchanged to verify that fluency measures would remain the same as predicted if the practice assignments were completed at home.

This phase continued if fluency scores increased during the In-Class Treatment, with little overlap with performance during the homework treatment condition until the student obtained a fluency mastery criterion at 40 digits correct per minute. After the student responded at or above the fluency mastery criterion, then the Student Managed Package phase was introduced to evaluate the use of peers for treatment implementation. However, if fluency scores were low and stable or heading downward, then the treatment protocol was considered to be ineffective for that individual. This pattern of results suggested that these students might benefit from an instructional intervention that included strategies that targeted fluency growth. If the student performance did not improve due to an ineffective homework treatment protocol, then these students fell into the second cohort that investigated the effects of a Fluency Training Treatment Package.

**Student Managed Implementation.** If students obtained the fluency mastery criterion at or above 40 digits per minute during the In-Class Treatment condition, then a pair of students was trained to follow the treatment steps on a second skill. During this phase students implemented the Student Managed Package that mimicked the procedures used by the teacher during the In-Class Treatment condition. This phase continued to be implemented until students performed at or above the mastery criterion.

**Cohort Two: Assessing Fluency Training Packages**

As shown in Figure 1, when fluency performance did not improve under conditions of 100% integrity then the homework protocol was judged to be ineffective.
In this study, the homework protocol was ineffective for four students (i.e., Jake, Diane, Taylor, and Matt). Given the inadequacy of accuracy-based treatments (Cooper, 1989; Olympia, Sheridan, & Jenkins, 1993), it was not expected that all students would be able to equally enhance fluency performance gains. For these students, the use of programmed instructional or motivational variables that are designed to promote fluent responding may be needed to promote fluency responses to a mastery level. The purpose of this second cohort of students was to further investigate alternative treatments that would effectively obtain fluency mastery levels. The effect of a Fluency Training Package was compared to a homework treatment that combined Instruction and Contingent Reward Homework Treatment procedures. The Fluency Training Package was designed to provide instruction and fluency practice opportunities to promote skill fluency. Students practiced how to do the skill quickly during brief practice sessions with timed practice to increase both accuracy and speed resulting in a high number of responses in short period of time. If student performance failed to consistently increase, then a motivational component was added to the Fluency Training Package.

Several conditions previously described in Cohort One were initially in effect at the beginning this study. Similar to study one, Baseline, Brief Assessment, Homework Treatment, and In-Class and Homework Treatment phases were initially implemented. Each phase was implemented depending on performance obtained under the various conditions and the performance criterion described during in Cohort One. That is, each student’s fluency performance failed to improve under any treatment condition that had been implemented during the Homework Treatment phase or during the In-Class and Homework Treatment phase. These experimental conditions were identical to
those used in Cohort One. Once it was decided that the homework treatment protocol did not improve fluency performance for an individual, the following phases were implemented.

**Fluency training and homework treatment.** Following the implementation of an In-Class and Homework Treatments phase, the Fluency Training and Homework Treatments phase was introduced if the In-Class condition did not lead to improved fluency performance across time. During this phase, two treatments, Fluency Training Package condition and the Instruction with Contingent Reward Homework Treatment condition, were compared. Students continued to practice the skill at home in order to compare its effect on fluency progress with a Fluency Training Package incorporating proven fluency building activities. The fluency building strategies included flashcard practice with a procedure for fading prompts followed by a written practice on a timed probe consisting of a portion of the skill to be learned on the daily math probe (Miller, Hall, & Heward 1995; Johnson & Layng, 1994). However, students were provided with the strongest homework treatment, Instruction with Contingent Reward Homework Treatment, that combined both the procedures used during the Instruction and Contingent Reward Homework Conditions. The combined homework treatment was compared to the fluency-based program because students were returning more homework with the Contingent Reward condition yet three of the four subjects were exhibiting a skill deficit in the brief assessment. Hence, student data during the homework conditions suggested that a treatment that may better address the skill deficit would more likely be used more if it included the choice of a preferred reward for performance gains.
The second treatment, Fluency Training Package was alternately implemented with the Instruction and Contingent Reward Homework Treatment in the classroom with the teacher. This phase continued to be implemented until the student obtained the mastery criterion fluency score. After obtaining the criterion, the Student Managed Fluency Package was introduced with the homework practice sheets.

Fluency training with reward and homework treatment. For students who failed to adequately increase fluency rates following implementation of the Fluency Training Package condition, an incentive program was added to the Fluency Training Package sessions in order to determine if a student's performance would better meet a mastery level with the added motivation tactic. However, interventions that include numerous practiced timings may become dull and boring across time and motivational problems may arise. Performance patterns indicating lack of motivation include deterioration in the rate or variable up and down performance patterns. If these patterns were observed, the Fluency Training Package was supplemented with an incentive program. During this phase, the effect of the Fluency Training with Reward Package was compared to the effects of the homework treatment on fluency by alternating treatments across sessions. This phase continued to be implemented until the student obtained the mastery criterion fluency score. After obtaining the criterion, the Student Managed Fluency Package was introduced with the homework practice sheets.

Student Managed Fluency Implementation. If a student obtained the mastery criterion at or above 40 digits per minute during the Fluency Training Package or during the Fluency Training Package with Reward condition, then a pair of students was trained to follow the treatment steps on a second skill. All students in Cohort Two had obtained mastery during the Fluency Package with Reward condition. During this
phase students implemented the Student Managed Fluency Package that mimicked the procedures used by the teacher during the Fluency Package with Reward condition. Briefly, students took turns presenting flashcards to their partners for several minutes. The student would provide the answer to their partner if their partner failed to answer the question correctly after three seconds. Next, students administered the Sliced Probes to their partner for one minute after writing their previous best score on top of the paper. After grading their partner's practice sheet, they then administered the daily probe. The student would write their partner's best score on the daily probe and set the timer for one minute. The student would then immediately grade the probe and the students would report to their teacher for a reward if a student(s) had exceeded their best score. This phase continued to be implemented until students performed at or above the mastery criterion.

Cohort Three: Assessing Ordering Effect

This phase was designed to replicate the Fluency Training Package results and to ensure that results were not due to carry over effects from previous sessions. Three subjects who had also failed to increase fluency rates during the presentation of either the instructional, contingent reward or combined homework treatments were selected to participate in the third cohort. In this study, the subjects participated in the following conditions in the following sequence: Baseline, Brief Assessment, Homework Treatments, Fluency with Reward and Homework Treatments, and Student Managed Fluency Implementation. These phases were conducted following the same procedures that were described for Cohort One and Cohort Two.
Procedure

As indicated in Figure 1, subjects were placed into three different cohorts depending on specific results found after practice assignments were given at home. All subjects were given a homework treatment program after participating in a brief experimental analysis that was conducted to form a hypothesis that suggested the type of treatment needed to remediate the problem. Specifically, students were assessed to identify if poor performance was most likely due to a skill deficit or a performance deficit. An instructional treatment addressed the needs of students exhibiting a skill deficit. In contrast, a treatment including reward contingent upon academic performance addressed the needs of a student exhibiting a performance deficit. In this study, both treatments were presented to students to determine if the Brief Assessment results corresponded with the treatment that yielded greater increases in fluency performance (i.e., DCPM) as compared to the opposing treatment. The two treatments associated with the skill and performance deficits were used in an alternating treatments phase to test differential effects of the two treatments on fluency performance.

Although the Brief Assessment was expected to predict a homework intervention that would yield greater fluency performance, this was not the case for the population of students participating in this experiment. However, given that past research suggests that homework is often ineffective for this population, further phases were implemented to investigate why practice assignments completed at home were not effective by creating more controlled conditions at school to evaluate treatment effectiveness. Additional phases that were progressively more intense were
introduced to determine if homework was ineffective due to lack of treatment integrity or lack of effective treatment components.

Given that a lack of academic performance improvements may be due to incorrect implementation of practice sessions at home or other factors that were not controlled in the home environment, the first question was to determine whether the prescribed homework treatment would be effective if implemented with 100% integrity under the teacher's supervision. For students whose performance increased under conditions of 100% integrity, the treatment was continued until the student obtained the fluency master criterion. After mastering the skill, the feasibility of peer implementation was examined on a second skill. During this phase, four of eight students’ performance rates increased and reached the mastery criteria level when the homework treatment was implemented under 100% conditions. As shown in Figure 1, these four students are grouped and labeled as Cohort One in this study.

As noted in the experimental flowchart in Figure 1, an alternative treatment was implemented for students whose performance was not enhanced under 100% treatment integrity conditions. In this study, four students met these criteria and comprised Cohort Two. These results would indicate that the prescribed homework treatment was ineffective and that additional intervention components would be necessary to positively impact student performance. For students who failed to respond positively to either treatment, a more intense treatment package was introduced and evaluated. When data indicated that a student's fluency performance stabilized or was trending downward before reaching the mastery criteria, an additional phase was implemented to compare the effectiveness of a Fluency Training Package on fluency rates to the original homework treatment which utilized a more traditional
accuracy-based treatment. Although accuracy-based interventions are popular with teachers, there are many reported advantages to emphasizing fluency over merely accuracy (Binder, 1996; Howell & Lorson-Howell, 1995). Although the effect of the homework treatment was evaluated for subjects Jake, Diane, Taylor and Matt, these students failed to progress with the standard homework package, matched to either a skill or performance deficit, or under 100% treatment integrity conditions. Once the treatment protocol was considered to be ineffective for that individual, an additional phase comparing the effects of a Fluency Training Package with a homework treatment on fluency rates was introduced. A Fluency Training Package with and without reward was evaluated in this study.

Finally, the third cohort was designed specifically to evaluate possible ordering effects of treatments implemented in the classroom. Although students in Cohort Two obtained mastery criteria with the Fluency Training Package with Reward, performance gains may have been influenced by the practice opportunities that occurred during the previous experimental conditions. To determine whether or not the previous phases are necessary for their performance gains, the Fluency Training Package with Reward was immediately implemented after three students failed to show adequate fluency gains when alternating the Instructional and Contingent Reward Homework Treatments. These students were immediately presented with the Fluency Training with Reward treatment in their classrooms to examine the possibility that this treatment was effective only when it followed Instruction Homework Treatment, Contingent Reward treatment or the Fluency Training Package.
Reinforcer Assessment

Prior to student academic skills and performance assessment, a reinforcer survey was presented to all the students participating in the study to identify preferred stimuli for each participant. Initially, students were told that they were to earn a chance to choose a reward or activity each time they exceeded a daily goal on practice math worksheets. Similar to procedures previously used by Witt, Noell, LaFleur, & Mortenson (1997), students were then asked to mark items or activities on a list of potential reinforcers that they would be willing to earn for exceeding the math goals (See Appendix 8). After each student was given a list of reinforcers, the teacher read each reinforcer aloud as students marked the reinforcers they would be willing to work for. The preferred reinforcers were purchased and activities were written on a coupon and placed in a decorated box labeled as the “Treasure Chest” (See Appendix 9).

Observer Training and Reliability for Procedures and Observation

Interobserver training and agreement for treatment integrity. Throughout various conditions in the study, the teacher or student was responsible for implementation of the interventions. Separate checklists were developed for each experimental condition (See Appendices 14, 17 through 24) Integrity checks were performed during math sessions to measure the accuracy with which the teacher and students performed the treatment steps. Psychology graduate students were trained to observe and record treatment steps after they occurred during the math class sessions. Observers recorded whether a teacher or student completed the steps listed on the checklist that corresponded to the treatment being used. On the checklist, the observer marked a “✓” next to a required treatment step after the teacher or student performed the step. In order to ensure that treatments were implemented at 100%
integrity level whenever peers implemented treatments during this study, observers prompted students to conduct any missed steps during the session. After the sessions, the integrity of experimental procedures was computed by dividing the number of steps the consultant explained by the total number of procedural steps listed and then multiplied by 100.

Observers were initially trained in a series of progressive steps. First a verbal explanation of the observation form and method was followed by a demonstration of the appropriate recording procedures. Next, an experimenter served as a role model for the treatment steps while the observers practiced recording observed treatment steps. Finally, observers were considered trained when the observers on task percentage scores are within 80% agreement with an experimenter’s percentage score.

The accuracy of the delivery of the treatment sessions that were assessed was 100% for all eleven students and teachers. Moreover, for all treatment phases, indices of overall agreements averaged 100% for all students and teachers.

Interobserver training and agreement for accuracy and fluency measures. Psychology graduate students were trained to calculate and record the accuracy percentage on the practice assignments. Recorders first were shown how to grade the practice assignment by writing an “X” next to any answer that had an incorrect answer. The recorders were then shown how to count the number of problems correct and divide by the total number of problems on the sheet. Finally, the recorders were shown how to write the percentage on the paper. In the same manner, these recorders were shown how to count the number of digits correct on a daily math
probe. Recorders were considered trained when the recorders were in 100% agreement with an experimenter's percentage score.

To obtain interobserver agreement, two independent observers each calculated the accuracy for a minimum of 30% of the completed math practice assignments. Agreement was calculated by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100%. The agreement checks of the permanent product data recording yielded an agreement of 100% for all eleven students.

**Teacher Training**

Teachers were trained prior to the implementation of the Instruction Homework Treatment, Contingent Reward Homework Treatment, Instruction In-Class Treatment, Contingent Reward In-Class Treatment, Fluency Training Package or Fluency Training Package with Reward. For each treatment, teachers were first given a classroom coach. This coach was a one-page step-by-step description of the teacher's procedures that was intended to serve as a reminder for the teacher to use when carrying out the treatment procedures (See Appendices 10, 11, 12, 13, 15, and 16). Second, the experimenter provided verbal instructions explaining each of the steps described in the classroom coach and answered any questions. Third, the experimenter modeled the correct application of each intervention step. Finally, the teacher performed each of the steps to demonstrate knowledge of the procedures. Treatment implementation was considered successful when the teacher executed the defined steps correctly resulting in 100% integrity.
Student Training

Similar procedures were followed when training students as those used during teacher training. Each step was first explained to the students and then the steps were modeled for them. Next, students performed each step to demonstrate their ability to carry out each treatment step. To ensure high treatment integrity levels, the teacher or experimenter monitored students as they implemented each step during a math session. If a student failed to complete a step, then the teacher or observer would prompt students to use the missed step correctly before the end of the math session.
Chapter Four

Results

In this study, differences between Baseline and the treatment phases were assessed using three approaches: a) visual inspection of time-series data b) comparison of mean fluency scores on the daily math probe and c) examination of the percentages of the non-overlapping data points between treatment conditions for fluency rates. In this study, the degree to which a student’s fluency rate increased was the primary dependent measure. A secondary dependent measure, homework accuracy, was also monitored. Results will be discussed separately for fluency and accuracy.

Fluency

Throughout this study, both accuracy and fluency scores were monitored. However, phase change decisions were determined by fluency performance during conditions. Hence, fluency performance for Cohort One, Cohort Two and Cohort Three during the Baseline, Homework Treatments, In-Class and Homework Treatments, Fluency Training And Homework Treatments, Fluency Training with Reward and Homework Treatments, Student Managed Implementation or Student Managed Fluency Implementation experimental phases will be presented in this first section.

Results for Students in Cohort One: Homework Treatment Group

Figure 2 shows the fluency rate (i.e., DCPM) for each of the four students in Cohort One across sessions during Baseline, Homework Treatments, In-Class and Homework Treatments and Student Managed Implementation experimental phases. Table 2 shows the average fluency performance (i.e., DCPM) on the daily math probe for students in Cohort One during the same four phases. Overall, students’ fluency performance improved and skill reached the fluency mastery criterion level when
Figure 2: Digits correct per minute (i.e., FLUENCY) for four students in COHORT ONE across Baseline, Brief Assessment (BA), Homework Treatments (HW Txs), In-Class and Homework Treatments (In-Class HW Txs), and Student Managed (SM) Implementation conditions.
The diagram illustrates the performance of four individuals (Alicia, Martha, Tanya, and Kyle) over several sessions on a daily math probe. The x-axis represents the sessions, while the y-axis shows the number of digits correct per minute. The graph includes data points for Baseline BA (Baseline Behavior Analysis), HW TxS (Homework Tasks), In-Class SM (Systematic Monitoring), and SM Implementation. The skill deficit is contingent on instruction and contingent reward for each individual. The graph shows improvements in performance after the implementation of different instructional and reward strategies.
students with skill deficits completed their practice during the Instruction In-Class Treatment condition as well as during the Student Managed Package condition.

Table 2: Average Fluency Performance (i.e., DCPM) on the Daily Math Probe for Students in Cohort One.

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline</th>
<th>Homework Treatments</th>
<th>In-Class Treatments</th>
<th>Student Managed Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alicia</td>
<td>8</td>
<td>14</td>
<td>18</td>
<td>29</td>
</tr>
<tr>
<td>Martha</td>
<td>8</td>
<td>12</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>Tanya</td>
<td>4</td>
<td>11</td>
<td>19</td>
<td>36</td>
</tr>
<tr>
<td>Kyle</td>
<td>8</td>
<td>9</td>
<td>14</td>
<td>36</td>
</tr>
</tbody>
</table>

**Baseline.** During Baseline, student average fluency performance was 8 for Alicia, Martha, and Kyle, while Tanya average fluency performance was 4 digits correct per minute. Tanya and Kyle initially increased their fluency performance during the first few sessions, however, the fluency gains were not maintained.

**Brief assessment.** Table 3 displays the results obtained from the Brief Assessment that followed baseline. The table shows the maximum fluency score for each child during Baseline and the score obtained when given the opportunity to earn a reward for achieving a score above their maximum Baseline score. During the Brief Assessment, all four students were unable to increase their score by more than 25% when provided with previously chosen preferred items. Based on these results, it was hypothesized that these students were exhibiting a skill deficit and would benefit most from the Instruction Homework Treatment.

**Homework treatments.** During this condition, the Instruction Homework Treatment and the CR Homework Treatment were implemented. As shown in Table 2, the average fluency performance increased over Baseline during both Instruction and
Table 3: Student Results from the Brief Assessment for Cohort One.

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline maximum DCPM</th>
<th>Brief Assessment DCPM</th>
<th>Percent Growth</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alicia</td>
<td>10</td>
<td>9</td>
<td>-10%</td>
<td>Skill Deficit</td>
</tr>
<tr>
<td>Martha</td>
<td>10</td>
<td>12</td>
<td>20%</td>
<td>Skill Deficit</td>
</tr>
<tr>
<td>Tanya</td>
<td>6</td>
<td>7</td>
<td>13%</td>
<td>Skill Deficit</td>
</tr>
<tr>
<td>Kyle</td>
<td>12</td>
<td>14</td>
<td>14%</td>
<td>Skill Deficit</td>
</tr>
</tbody>
</table>

CR homework treatment conditions for all students. Moreover, the average fluency performance for all students was slightly higher during the Instructional Homework Treatment condition than the Contingent Reward Homework Treatment condition thereby supporting the brief assessment results. Specifically, Alicia, Martha, Tanya and Kyle, respectively averaged 14, 12, 11, and 9 DCPM during the CR Homework Treatment condition and averaged 18, 16, 19, and 14 during the Instructional Homework Treatment condition. However, these differences have little practical significance since there was no clear differentiation between the instructional and contingent reward homework conditions for all four students. Table 4 presents the percentages of non-overlapping data points between treatment conditions for all four subjects. There was a considerable amount of overlap in the fluency performance between Instructional and CR Homework conditions such that the non-overlapping percentage was lower than 70% for all four students. Moreover, daily fluency scores did not increase markedly for any of the students during either homework treatment condition.

Table 4: Percentages of Non-overlapping Data Points Between Treatments within a Phase for Cohort One.

<table>
<thead>
<tr>
<th>Student</th>
<th>Homework Treatments</th>
<th>In-Class and Homework Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alicia</td>
<td>43</td>
<td>100</td>
</tr>
<tr>
<td>Martha</td>
<td>57</td>
<td>100</td>
</tr>
<tr>
<td>Tanya</td>
<td>67</td>
<td>100</td>
</tr>
<tr>
<td>Kyle</td>
<td>67</td>
<td>92</td>
</tr>
</tbody>
</table>

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In-Class and homework treatments. Given the general lack of effectiveness of either the indicated or the contraindicated treatment during the homework condition, the next step was to test the possibility that lack of effectiveness was attributable to treatment integrity. Hence, during this phase, the indicated treatment, Instruction Treatment, was delivered at school under conditions of 100% integrity insuring that all students in Cohort One were exhibiting a skill deficit during the Brief Assessment. Thus, the Instructional In-Class Treatment was implemented at school while the CR Homework Treatment continued to be implemented at home for all four students. The CR Homework Treatment condition was retained during this alternating treatment phase as a control against which to evaluate changes in fluency scores for the indicated treatment. In addition, continued use of the contraindicated treatment, for a brief period of time, helped control various threats to internal validity by showing that some other unmeasured factor did not suddenly start to produce growth in all children.

When the students practiced the skill independently in the classroom with treatment implemented at 100% integrity, the effectiveness of the Instruction In-Class Homework Treatment condition was apparent for all students. Fluency performance increased at a greater rate during the Instruction In-Class Treatment than during the CR Homework Treatment condition. There was clear differentiation between the two conditions with a percentage of non-overlapping data points greater than 92% for all four students. More specifically, the average fluency performance during the Instructional In-Class Treatment condition was greater than 30 DCMP while DCMP average scores were no greater than 20 during the Contingent Reward Homework Treatment condition. All four fluency performance rates steadily increased to mastery criterion level of 40 digits correct per minute.
Student managed implementation. For all students in Cohort One, student progress was maintained, if not enhanced, when students working in pairs, implemented the intervention steps during the Student Managed Implementation condition. All students were performing at the preset mastery criterion level after an average of seven sessions.

Results for Students in Cohort Two: Assessing Fluency Training Packages

Figure 3 reveals the fluency performance (i.e., DCPM) for the four students in Cohort Two across the following seven conditions: Baseline, Brief Assessment of Academic Performance, Homework Treatments, In-Class and Homework Treatments, Fluency Training and Homework Treatments, Fluency Training with Reward and Homework Treatments, and Student Managed Fluency Implementation. Table 5 shows the average fluency performance for each of the four students in Cohort Two across the same seven conditions. In general, all four students obtained the fluency mastery criterion during the Fluency Training Package with Reward condition as well as the Student Managed Fluency Package.

Baseline. During baseline, Jake, Diane, Taylor, and Matt, respectively obtained an average fluency performance of 4, 13, 2, and 7. Jake and Diane initially increased fluency levels during the first few sessions, however, the fluency gains were not maintained.

Brief assessment. Following Baseline, the Brief Assessment results suggested that Jake, Diane and Taylor were exhibiting a skill deficit given that the percentage increase from non-reinforced to reinforced trials was less than 25% (see Table 6). For Matt, however, the percentage increase was 75% and he was above the frustrational...
Figure 3: Digits correct per minute on daily math probe (i.e., FLUENCY) for four students in COHORT TWO across Baseline, Brief Assessment (BA), Homework Treatments (HW Txs), In-Class and Homework Treatments (In-Class Hw Txs), Fluency Training and Homework Treatments (FT & HW Txs), Fluency Training with Reward and Homework Treatments (FT+R & HW Txs) and Student Managed (SM) Fluency Implementation conditions.
range (i.e., 0 to 10 digits per minute) suggesting that he was exhibiting a performance deficit.

Table 5: Average Fluency Performance (i.e., DCMP) on the Daily Math Probe for Students in Cohort Two.

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline</th>
<th>CR Homework</th>
<th>Instruction Homework</th>
<th>CR In-Class</th>
<th>Instruction In-Class</th>
<th>I + CR Homework</th>
<th>Fluency Training Package</th>
<th>Fluency Training Package</th>
<th>Student managed Fluency Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jake</td>
<td>4</td>
<td>9</td>
<td>15</td>
<td>14</td>
<td>22</td>
<td>14</td>
<td>21</td>
<td>20</td>
<td>37</td>
</tr>
<tr>
<td>Diane</td>
<td>13</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>19</td>
<td>22</td>
<td>21</td>
<td>22</td>
<td>31</td>
</tr>
<tr>
<td>Taylor</td>
<td>2</td>
<td>11</td>
<td>6</td>
<td>20</td>
<td>27</td>
<td>21</td>
<td>29</td>
<td>21</td>
<td>39</td>
</tr>
<tr>
<td>Matt Perform</td>
<td>7</td>
<td>20</td>
<td>13</td>
<td>24</td>
<td>18</td>
<td>18</td>
<td>32</td>
<td>21</td>
<td>47</td>
</tr>
</tbody>
</table>

Brief assessment. Following Baseline, the Brief Assessment results suggested that Jake, Diane and Taylor were exhibiting a skill deficit given that the percentage increase from non-reinforced to reinforced trials was less than 25% (see Table 6). For Matt, however, the percentage increase was 75% and he was above the frustrational range (i.e., 0 to 10 digits per minute) suggesting that he was exhibiting a performance deficit.

Table 6: Student Results from the Brief Assessment for Cohort Two

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline maximum DCPM</th>
<th>Brief Assessment DCPM</th>
<th>Percent Growth</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jake</td>
<td>8</td>
<td>5</td>
<td>-38%</td>
<td>Skill Deficit</td>
</tr>
<tr>
<td>Diane</td>
<td>15</td>
<td>16</td>
<td>-10%</td>
<td>Skill Deficit</td>
</tr>
<tr>
<td>Taylor</td>
<td>3</td>
<td>0</td>
<td>-100%</td>
<td>Skill Deficit</td>
</tr>
<tr>
<td>Matt</td>
<td>8</td>
<td>14</td>
<td>75%</td>
<td>Performance Deficit</td>
</tr>
</tbody>
</table>

Homework treatments. When the Instructional and Contingent Reward Homework treatments were alternately presented, Jake, Diane, and Taylor, who were
exhibiting a skill deficit during the Brief Assessment, showed gains over Baseline during both of the homework treatments. For Diane and Taylor, however, there was no clear differentiation between the two homework conditions showing a 0% in non-overlapping data points. Moreover, while their fluency levels initially slightly increased over Baseline during both conditions, increases in fluency scores did not continue to increase after several sessions for either student. As shown in Table 5, the average fluency performance during the Instructional Homework Treatment condition and CR Homework Treatment condition was respectively 18 and 17 for Diane and was 6 and 11 for Taylor. Taylor was one of the few subjects who failed to return homework during either the Instruction or Contingent Reward Homework Treatment condition. After the implementation of I+CR Homework Treatment, Taylor returned 60% of the homework assignments but fluency average performance remained less than 11. For Jake, however, the fluency scores were slightly greater during the Instructional Homework Treatment condition than during the CR Homework Treatment condition with an 86% of non-overlapping data points (See Table 7). The average fluency performance was also higher during the instructional condition at 15 DCMP relative to the CR condition at 9 DCMP.

Table 7: Percentages of Non-overlapping Data Points Between Treatments Within a Phase for Cohort Two.

<table>
<thead>
<tr>
<th>Student</th>
<th>Homework treatments</th>
<th>In-Class and Homework Treatments</th>
<th>Fluency training and Homework Treatments</th>
<th>Fluency training with reward and Homework Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jake</td>
<td>86</td>
<td>100</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>Diane</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>67</td>
</tr>
<tr>
<td>Taylor</td>
<td>0</td>
<td>88</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Matt</td>
<td>83</td>
<td>67</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Matt, a student exhibiting a performance deficit, generally obtained higher fluency scores during the CR Homework Treatment condition with 83% of non-
overlapping data points. His average DCMP increased to 20 DCMP during the CR Homework Treatment condition and 13 DCMP during the Instruction Homework Treatment as compared to a 7 DCMP average score during Baseline. However, scores stabilized and trended downwards after 12 sessions during the Contingent Reward Homework condition.

In-Class and homework treatments. During this condition, the indicated treatment was implemented under 100% integrity conditions to test the possibility that the lack of its effectiveness was attributable to treatment integrity. With the introduction of the Instruction In-Class Treatment, fluency performance varied between the three subjects, Jake, Diane, and Taylor, who had exhibited a skill deficit during the Brief Assessment. For Jake, the Instruction In-Class Treatment fluency scores were greater than the Contingent Reward Homework Treatment condition such that there was a non-overlapping percentage at 100%. Jake’s average fluency performance was greater during the In-Class Treatment at 22 DCPM than during the CR Homework Treatment condition at 14 DCPM. However, fluency scores stalled during the last four sessions. For Diane, the second skill deficit student, there was no difference in fluency performance between the Instructional In-Class Treatment condition and the Contingent Reward Homework Treatment condition. Diane’s average fluency performance was 19 for both conditions and the non-overlapping percentage was at 0%. The third skill deficit student, Taylor, initially showed some gains in DCMP scores when practicing in class with instruction, but his fluency rates stabilized followed by a downward trend after 5 sessions. His average performance was 27 DCPM during the Instruction In-Class Treatment and was 20 DCPM during the CR Homework Treatment and the non-overlapping percentage was at 88%.

The Contingent Reward procedures were implemented in class for Matt, the student exhibiting a performance deficit. For Matt, there was little difference in fluency performance between the CR In-Class Treatment condition and the Instructional
Homework Treatment condition. Matt’s average fluency performance was 18 during the Instructional Homework Treatment and 24 DCPM during the CR In-Class Treatment. Matt’s non-overlapping percentage was at 67%.

**Fluency training and homework treatment.** With a fluency-based package, fluency performance did not steadily improve above the scores obtained during the previous phase for Jake, Diane and Taylor. The non-overlapping percentage for Jake, Diane and Taylor was respectively, 75%, 0%, and 100%. Matt’s score differentiated initially, but his fluency performance steadily decreased after three sessions. The average fluency performance for Jake, Diane, Taylor, and Matt were respectively 21, 21, 29, 32 during the FTP condition and 14, 22, 21, and 18 during the I+CR Homework Treatment condition.

**Fluency training with reward and homework treatment.** Given the lack of marked improvement in fluency scores during the previous phase, a decision was made to add a reward component to the fluency building package. This decision was derived from the decision making protocol offered by Wolery, Bailey and Sugai (1988) who report that motivational problem commonly occur with interventions that include numerous practiced timings. Deterioration of performance or erratic up and down performance is commonly indicative of motivation problems (Wolery, Bailey, & Sugai, 1988). If this type of performance is observed, then contingent reinforcement often promotes continuous increases in fluency scores.

With the introduction of the Fluency Training Package with Reward (FTP+R) condition, the fluency mastery criterion was obtained for all four students. Fluency performance was clearly greater during the FTP+R condition than during the Instructional with Contingent Reward Homework Treatment condition for all four students although Diane showed clear results after 9 sessions. Jake, Taylor, and Matt had non-overlapping percentages at 100% whereas Diane was at 67%. For all four students, the average fluency performance was greater than 31 during the FTP+R
whereas the average was less than 21 during the Instruction and Contingent Reward Homework Treatment condition.

**Student managed fluency implementation.** When the students implemented the FTP+R package, all students obtained the fluency mastery criterion within seven sessions. The average fluency performance for Jake, Diane, Taylor, and Matt was respectively, 36, 35, 35, and 37 DCPM.

**Results for Students in Cohort Three: Assessing Ordering Effect**

Figure 4 shows the fluency performance for three students in Cohort Three on the daily math probe across the Baseline, Homework Treatments, Fluency Training with Reward and Homework Treatments, and Student Managed Fluency Implementation conditions for all three students. Table 8 shows the average fluency performance on the daily math probe during the same previous four conditions. Overall, all three students' fluency performance improved and reached the fluency mastery criterion level during the Fluency Training Package with Reward condition that had been implemented after the Homework Treatment phase. Moreover, all three students also obtained the mastery criterion level during the Student Managed Fluency Implementation condition on the second skill.

**Table 8: Average Fluency Rates (i.e., DCPM) on the Daily Math Probe for Students in Cohort Three.**

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline</th>
<th>Homework CR Treatment</th>
<th>Instruction Homework</th>
<th>Fluency with Treat I+CR Treatment</th>
<th>Training Reward with Reward</th>
<th>Student managed Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Todd</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>12</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Shandra</td>
<td>9</td>
<td>14</td>
<td>13</td>
<td>14</td>
<td>27</td>
<td>30</td>
</tr>
<tr>
<td>David</td>
<td>2</td>
<td>21</td>
<td>16</td>
<td>31</td>
<td>37</td>
<td>46</td>
</tr>
</tbody>
</table>

**Baseline.** During Baseline, student average fluency performance for Todd, Shandra, and David was respectively 8, 9, and 2. Todd and David showed little change.
Figure 4: Digits correct per minute on daily math probe (i.e., FLUENCY) for four students in COHORT THREE across Baseline, Brief Assessment (BA), Homework Treatments (HW Txs), Fluency Training with Reward and Homework Treatments (FT+R & HW Txs) and Student Managed (SM) Fluency Implementation conditions.
in fluency performance while Shandra initially increased fluency levels but the fluency
gains were not maintained.

**Brief assessment.** Table 9 displays the results obtained from the Brief
Assessment that followed Baseline. During the Brief Assessment of Academic
Performance, all three students were unable to increase their score by more than 25%
and above frustrational range (i.e., 0 to 10 digits per minute) when provided with
reinforcing items. David had increased his score by 200%, yet he still scored within
frustrational range. Based on these results, we hypothesized that these students were
exhibiting a skill deficit and would benefit most from the Instructional Homework
Treatment.

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline maximum DCPM</th>
<th>Brief Assessment DCPM</th>
<th>Percent Growth</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Todd</td>
<td>10</td>
<td>11</td>
<td>10%</td>
<td>Skill Deficit</td>
</tr>
<tr>
<td>Shandra</td>
<td>11</td>
<td>12</td>
<td>10%</td>
<td>Skill Deficit</td>
</tr>
<tr>
<td>David</td>
<td>3</td>
<td>9</td>
<td>200%</td>
<td>Skill Deficit</td>
</tr>
</tbody>
</table>

**Homework treatments.** With the introduction of the Instruction and CR
Homework Treatments, there was no clear differentiation of fluency rates between
either of the homework treatments for any of the three students. Shandra and Todd’s
average fluency performance across both treatments were approximately equal and
showed little improvement across sessions (See Table 8). Shandra averaged fluency
performance was 13 DCPM during the Instruction Homework Treatment condition and
14 DCPM during CR Homework Treatment condition while Todd average 9 DCPM
during both conditions. The average fluency performance was somewhat higher for
David during the CR Homework Treatment condition (i.e., 21 DCPM) than during the
Instruction Homework Treatment condition (i.e., 16 DCPM). However, there was a
considerable amount of overlap of data points between the two homework conditions. In fact, the percentage of non-overlapping data points between treatments fell below 30% for all three students (See Table 10).

Table 10: Percentages of Non-overlapping Data Points Between Treatments Within a Phase for Cohort Three.

<table>
<thead>
<tr>
<th></th>
<th>Homework Treatments</th>
<th>Fluency Training with Reward and Homework Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Todd</td>
<td>0</td>
<td>91.67</td>
</tr>
<tr>
<td>Shandra</td>
<td>28.57</td>
<td>100</td>
</tr>
<tr>
<td>David</td>
<td>11.11</td>
<td>71.43</td>
</tr>
</tbody>
</table>

**Fluency training with reward and homework treatment.** With the introduction of the Fluency Training Package with Reward condition along with the Instructional with Contingent Reward (I+CR) Homework Treatment condition, all three students had fluency scores greater during the FTP+R condition than during the (I+CR) Homework Treatment condition. Todd and Shandra showed clear differentiation between the FTP+R condition and the I+CR after several sessions with a non-overlap percentage respectively at 92% and 100%. Specifically, the average fluency performance was greater than 27 for Todd and Shandra during the FTP+R condition while the average fluency performance was less than 14 DCPM during the Instructional with Reward Homework Treatment condition. For David there was clear differentiation after six sessions with fluency scores greater during the FTP+R treatment condition than during the I+CR homework treatment condition. David's overall non-overlapping percentage was at 71%. The average fluency performance for David increased to 37 DCPM during FTP+R condition while scores increased to 31 DCPM during the I+CR Homework Treatment condition.

**Student managed fluency implementation.** With the introduction of the student-managed fluency package, all three students obtained the fluency mastery.
criterion on the second skill with peer assistance. David reached mastery level after four sessions while Todd and Shandra reached mastery level within 10 sessions. The average fluency performance for Todd, Shandra, and David, were respectively, 30, 30, and 46 DCPM.

Accuracy

Although fluency was the primary dependent variable for phase changes, accuracy was also monitored. Typically, student academic progress has been evaluated with accuracy measures in homework studies, however, the literature is not consistently supportive of solely relying on this measure for various reasons (Binder, 1996; Howell, Fox, & Morehead, 1993; Johnson & Lanyg, 1992). Although accuracy suggests that a skill has been acquired within a student’s behavioral repertoire, high accuracy does not ensure that the student can perform the skill with the speed necessary to make it useful. An accuracy measure indicates only the correctness of the response while a frequency measure determines if the student can perform the skill easily and automatically without errors across time and context. Moreover, a fluency measure is quick, can be done often, and it is 10 to 100 more times more sensitive to changes in student learning than accuracy measures (Lindsey, 1990). Accuracy results are presented here because it has practical relevance to teachers when evaluating homework practice and in order to show that high accuracy results does not necessary reflect the level of skill fluency.

Figures 5, 6, and 7 show the percent correct on the practice sheets for the Cohort One, Cohort Two, and Cohort Three during the relevant implemented experimental phases such as Baseline, Homework Treatments, In-Class and Homework Treatments, Fluency Training and Homework Treatment, Fluency Training and
Homework Treatment, Student Managed Implementation, or Student Managed Fluency Implementation. Table 11, 12, and 13 respectively reveals the average percent correct on the practice assignments on the daily math probe during the relevant experimental phases for Cohort One, Cohort Two and Cohort Three.

### Table 11: Percentage Correct on Practice Sheets for students in Cohort One.

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline</th>
<th>Homework Treatments</th>
<th>In-Class and Homework Treatments</th>
<th>Student Managed Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CR Homework</td>
<td>Instruction Homework</td>
<td>CR Homework</td>
<td>Instruction In-class</td>
</tr>
<tr>
<td>Alicia</td>
<td>14%</td>
<td>69%</td>
<td>21%</td>
<td>100%</td>
</tr>
<tr>
<td>Martha</td>
<td>0</td>
<td>88%</td>
<td>71%</td>
<td>78%</td>
</tr>
<tr>
<td>Tanya</td>
<td>0</td>
<td>100%</td>
<td>67%</td>
<td>100%</td>
</tr>
<tr>
<td>Kyle</td>
<td>0</td>
<td>100%</td>
<td>99%</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Table 12: Percentage Correct on Practice Sheets for Students in Cohort Two.

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline</th>
<th>Homework Treatments</th>
<th>In-Class and Homework Treatments</th>
<th>Fluency Training and Homework Treatments</th>
<th>Fluency Training and Homework Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CR Homework</td>
<td>Instruction Homework</td>
<td>CR Homework</td>
<td>Instruction In-class</td>
<td>I + CR Homework</td>
</tr>
<tr>
<td>Jake</td>
<td>0%</td>
<td>71%</td>
<td>73%</td>
<td>66%</td>
<td>100%</td>
</tr>
<tr>
<td>Diane</td>
<td>0%</td>
<td>97%</td>
<td>71%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Taylor</td>
<td>0%</td>
<td>31%</td>
<td>26%</td>
<td>14%</td>
<td>100%</td>
</tr>
<tr>
<td>Matt Performance</td>
<td>0%</td>
<td>75%</td>
<td>13%</td>
<td>100%</td>
<td>0%</td>
</tr>
</tbody>
</table>

### Table 13: Student Percentage Correct Practice Sheets for Cohort Three.

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline</th>
<th>Homework Treatment</th>
<th>Fluency Training With Reward and Homework</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CR Homework</td>
<td>Instruction Homework</td>
<td></td>
</tr>
<tr>
<td>Todd</td>
<td>0%</td>
<td>79%</td>
<td>50%</td>
</tr>
<tr>
<td>Shandra</td>
<td>33%</td>
<td>71%</td>
<td>43%</td>
</tr>
<tr>
<td>David</td>
<td>0%</td>
<td>50%</td>
<td>24%</td>
</tr>
</tbody>
</table>
Figure 5: Percent Correct on practice assignment (i.e., ACCURACY) for four students in COHORT ONE across Baseline, Homework Treatments (HW Txs), In-Class and Homework Treatments (In-Class HW Txs), and Student Managed (SM) Implementation conditions.
Baseline HWTxs

InClass & HWTxs SM Implementation

<table>
<thead>
<tr>
<th>ALICIA</th>
<th>Skill deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARTHA</td>
<td>Skill deficit</td>
</tr>
<tr>
<td>TANYA</td>
<td>Skill deficit</td>
</tr>
<tr>
<td>KYLE</td>
<td>Skill deficit</td>
</tr>
</tbody>
</table>

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Figure 6: Percent Correct on practice assignment (i.e., ACCURACY) for four students in COHORT TWO across Baseline, Homework Treatments (HW Txs), In-Class and Homework Treatments (In-class HW Txs), Fluency Training and Homework Treatments (FT & HW Txs), Fluency Training with Reward and Homework Treatments (FT+R & HW TXS), and Student Managed (SM)Fluency Implementation conditions.
Figure 7: Percent Correct on practice assignment (i.e., ACCURACY) for four students in COHORT THREE across Baseline, Brief Assessment (BA), Homework Treatments (HW Txs), Fluency Training with Reward and Homework Treatments (FT+R & HW Txs), and Student Managed (SM) Fluency Implementation conditions.
One general trend was consistent throughout the entire study. In general, students obtained an accuracy score of 100% correct whenever homework was returned. Due to this ceiling effect in accuracy scores, the accuracy data are difficult to interpret because the average difference across sessions more markedly reflects that the intervention effectively increased the number of times that a homework assignment was returned rather than an increase in the ability to do the work accurately. Two exceptions, Jake and Matt, steadily increased accuracy scores during the CR Homework Treatment condition until they consistently obtained 100% accuracy whenever homework was completed. When comparing these results with fluency gains, it appears that all students were able to do the skill with high accuracy, however, they were not performing the skill quickly after practicing the skill at home.

More specifically, 80% of the students in this study returned 0% of the homework assignments presented during Baseline thereby receiving an average 0% accuracy score. The remaining subjects, Alicia and Shandra, respectively returned 14% and 33% of the homework assignments presented and obtained 100% correct on any homework returned. With the introduction of the Homework Treatments phase, homework accuracy scores increased over Baseline for all students during both homework conditions due to an increase in the amount of homework assignments returned. Although there was no clear differentiation between the Contingent Reward and Instructional Homework Treatment conditions, more homework was returned during the CR Homework Treatment condition than during the Instructional Homework Treatment condition for 91% of the subjects. Consequently, 91% of the students obtained a higher average accuracy performance score during the CR Homework Treatment condition than during the Instruction Homework Treatment condition since
more homework assignments were returned with reward. One student, Kyle, returned all homework assignments in both homework conditions during the Homework Treatment phase.

The In-Class and Homework Treatment phase was introduced for students in Cohort One and Cohort Two. During the In-Class and Homework Treatment phase, homework completion gains were maintained for six of the eight students. Specifically, all four students in Cohort One continued to return more than 75% of the homework presented during the CR Homework Treatment condition. In Cohort Two, Jake and Diane returned 100% of the homework presented during the Homework Treatment condition, whereas Taylor returned 14% and Matt returned 0% percent. When homework was returned, all students obtained a score of 100% correct. Finally, all students in Cohort One and Cohort Two obtained an average accuracy score of 100% when completing work during the In-class condition.

Seven students in Cohort Two and Cohort Three continued to have homework on one skill when the teacher was implementing the Fluency Training Package Treatment or Fluency Training Package with Reward Treatment on a second skill. When work was taken home, all students in Cohort Two and Cohort Three were presented with the I+CR Homework Treatment during the homework condition. In general, four of the six students who were returning homework during the CR and Instruction Homework Treatment conditions continued to return homework fairly consistently with 100% accuracy. The two exceptions, David and Matt, returned considerable less homework during the I+CR Homework Treatment phase although they were able to score 100% correct when homework was returned. Matt, in Cohort Two, respectively returned 25% of the homework during the Fluency Training and
Homework Treatment phase and 67% of the homework during the Fluency Training with Reward and Homework Treatment phase. David, in Cohort Three, returned 33% during the Fluency Training with Reward phase and the Homework Treatment phase.

The seventh student, Taylor, consistently returned less than 40% throughout the entire study. Specifically, he returned 0% during the Fluency Training and Homework Treatment or Fluency Training with Reward and Homework Treatment phases.
Chapter Five

Discussion

This study examined the effects of homework interventions on the academic performance of eleven students who were experiencing problems in homework performance and were at risk for failure in math class. Our overall goal was to examine whether or not homework is a viable option for increasing response opportunities for at risk children in an inner city school. In cases where homework was not effective over time, this study further investigated whether or not the lack of homework efficacy was due to either a lack of adequate treatment implementation at home or lack of an effective treatment protocol. In addition, this study investigated whether classroom based opportunities to respond could be an effective alternative to homework and whether the use of peers would make in-class practice an efficient alternative for the teacher.

Similar to past studies, mixed findings between subjects were shown for the effect of homework on academic achievement for elementary students (Cooper, 1989; Harris & Sherman 1974; Olympia, Jenson, Sheridan, & Andrews, 1994; Rosenberg, 1989). However, past homework studies commonly applied a global homework intervention equally to all students regardless of the homework problem. As a result, these studies sometimes failed to enhance performance across all students, perhaps because specific student may not have benefited from a “one size fits all” approach to intervention design. Research on homework interventions has generally demonstrated the extent that a classroom-wide homework program affects students without further examining why individual students were not performing as expected. There are a number of reasons why students perform academic work poorly (Daly, Witt, Martens...
& Dool, 1999). For example, the student may not be able to perform the skill or the student may not be motivated to respond to instructional demands. If a single treatment was given to all students regardless of the different types of problems each individual has, then obtaining mixed results between students was not surprising. This present study included a direct assessment of academic performance that would determine whether a student was exhibiting a skill or performance deficit for homework problems. Further, results from the brief assessment would suggest the effective use of one of two fundamentally different interventions that would either include instructional components to teach the skill (i.e., skill deficit) or reinforcing components to motivate students to do the work (i.e., performance deficit).

This study attempted to further expand the body of evidence establishing the utility of brief test conditions for guiding effective intervention design (McComas, Wacker, Cooper, Asmus, Richman, & Stoner, 1996; Daly, Martens, Hamler, Dool, & Eckert, 1999; Eckert, Ardoin, Daisey, & Scaroloa, 2000; Noell, Freeland, Witt, & Gansle, in press; and Noell, Gansle, Witt, Whitmarsh, Freeland, LaFleur, Gilbertson, & Northup, 1998). We have used these brief assessments in an attempt to design effective interventions to remediate homework problems in at-risk students. Results from past studies generally have been able to identify one or more interventions that effectively increased fluency in the classroom. However, these studies generally did not examine intervention effectiveness over time nor did they continue the intervention until a mastery criterion was obtained for all students. The results from this study suggest that brief testing conditions that are interpreted idiomatically show promise for determining if individual differences are due to different types of homework problems. When treatment implementation was validated at school for eight students, 50% of
these students increased fluency performance to a mastery criterion level with the indicated treatment. This finding suggests that the testing conditions may need further refinement and that continued progress over time cannot be assumed since the intervention's effects on gains in fluency over time (i.e., celeration) were not equally durable for all students. However, the brief assessment may have been more efficient and effective with the addition of a brief test condition for the Fluency Training Package and for the Fluency Training Package with Reward. The Fluency Training Package with Reward consisted of several components that targeted fluency gains rather than accuracy gains, which are normally the focus in homework-based interventions. Given that the Fluency Training Package with Reward consisted of several components, the relative influence of each element on an individual’s behavior is difficult to determine. A more complete component analysis, perhaps with the use of brief testing conditions, may be necessary to determine those components that are required to produce the same positive effect on academic performance.

In this study, we further investigated whether or not additional intervention modifications that incorporated fluency building strategies would enhance fluency rates when homework with instruction or homework with contingent reward proved to be insufficient. Students who failed to increase fluency performance using the accuracy-based homework treatment were able to increase fluency rates after a fluency building intervention with reward was implemented. Although an increase in response opportunities has repeatedly found to be associated with increases in fluency, results from this study further support research indicating that it is not just the provision of practice opportunities that is critical but how the practice is conducted (Binder, 1996; Johnson & Layng, 1994; Skinner, Fletcher, Henington, 1996; Van Houten, Hill, &
Parsons 1975). For some students, optimal performance was dependent both on the amount of material presented and how fast the responses were emitted during practice sessions. In this study, procedures such as brief practice sessions with time limits, practicing small segments of a larger skill, and goal setting increased not only the number of response opportunities but also the rates of accurate responding.

This study further extends studies that demonstrate that academic performance gains can be achieved when treatments are implemented with peer assistance (Olympia, Jenson, Sheridan, & Andrews, 1994; O'Melia & Rosenberg, 1994). Once an effective intervention is identified for each individual, this study along with others have shown that students are capable of learning and implementing a wide number of interventions with integrity (Greenwood, Carta, & Hall, 1988; Olympia, Jenson, Sheridan, & Andrews, 1994). Moreover, interventions employing peer tutoring have the advantage of decreasing the amount of teacher time and effort needed to achieve academic progress.

Traditionally, the effectiveness of homework is judged on accuracy performance. The present results extend these findings of the previous investigations by examining the effects of homework interventions on both the development of fluency and accuracy. Similar to previous studies, accuracy results in this study showed that accuracy and homework compliance (e.g. the number of homework assignments returned) are generally enhanced with the addition of an incentive program with homework assignments for most students (Harris & Sherman, 1974; Miller & Kelly, 1994; Rosenberg, 1989). However, broad conclusions based on these results may be limited for five of the eleven students whose performance scores failed to differentiate between the instructional and reinforcement treatments. Although these five students
were assessed as having a skill deficit, they consistently returned homework during both treatment conditions with high accuracy. There are several possible explanations for these findings. First, the instructions given during the Instruction Homework Treatment may have also helped the student complete the work during the Contingent Reward condition. Alternatively, the instructions may have assisted the student in completing homework with little effort during the Instructional Homework Treatment condition while the Contingent Reward Homework Treatment condition provided incentives that made the effort worthwhile. Second, an uncontrolled variable, such as adult attention or effort, may have confounded these results. However, we find this unlikely due to the simple fact that the amount of adult attention was generally consistent across all phases of the study (baseline through treatment). Finally, students may have failed to discriminate between the two conditions. The latter appears to be unlikely since students frequently asked for the pink homework sheets (which they subsequently would be reinforced for completing) when given a white-colored assignment (unreinforced) during the Instructional Homework Treatment condition because they indicated that they wanted to get a reward the next school day (personal observation).

The results of this study have several implications for classroom practice and future research. First, the results of the present study support the importance of monitoring the effect of homework on a fluency measure as well as an accuracy measure. Although student academic progress has typically been evaluated with accuracy measures, research has shown a number of critical benefits of targeting fluency progress (Fuchs & Fuchs, 1986; Howell, & Lorson-Howell, 1995; Shinn, 1989). An accuracy measure indicates only the correctness of the response while a frequency
measure determines if the student can perform the skill easily and automatically without errors. When homework assignments are completed, it is difficult to measure how long the child worked on the paper, and what type of assistance was given without relying on self-report. In this study, the classroom one minute probe given under specific conditions served to further assess the effect of homework practice on fluency performance. This study suggests that ongoing monitoring of fluency progress (a) assisted in determining whether intervention is needed to enhance skill mastery, (b) demonstrated that a homework plan that effectively increased homework accuracy, failed to optimally enhance fluency for some students, and (c) identified those students that needed additional intervention support to impact fluency performance over time.

Second, this study suggests that brief practice sessions at school with supervision may be more effective than homework for many students who were failing math. The number of past homework studies for elementary students that only equivocally support homework practice for students verifies that other alternatives are needed for at-risk students. This is an important consideration given the fact that homework is becoming more prevalent in elementary schools while, at the same time, complaints of homework problems reported by parents and teachers continue to escalate (Cooper, 1989; Jayanthi, Sawyer, Nelson, Bursuck, & Epstein, 1995; Miller & Kelly, 1991). The results of the present study suggest that practice completed at home may not be sufficient to enhance mastery of basic skills for some at-risk students. Our findings further support past group studies suggesting that elementary students that complete work with supervision at school typically perform better than students working at home (Cooper, 1989). The idiographic progress monitoring
approach used in this study identified individual students that benefited from supervised study from those who needed more intensive intervention modifications. Until an effective homework plan is in effect, the use of alternative strategies such as those used in this study may prevent students from falling further behind due to lack of available learning time.

Third, these findings support the use of peer tutoring in academic interventions. Interestingly, peer tutoring was also ranked by teachers in a survey as the preferred alternative for homework (Epstein, Munk, Bursuck, Polloway, & Jayanthi, 1999). When parents are either difficult to contact, do not have time to be trained, or have the desire to assist their child with homework, this study presents a feasible and practical alternative for enhancing academic progress. The peer tutoring interventions for the classroom setting in this study proved reliable since peer tutors were able to effectively implement the intervention steps. Interventions employing peer tutoring have the advantage of decreasing both the amount of teacher time and behaviors needed to achieve academic progress and the reliance on parent support. The practice sessions that were effective were also reasonably efficient. That is, students were able to implement the procedures reliably in approximately ten minutes. All interventions in this study remained effective when implemented by a peer.

Several limitations of the present study provide direction for future research. One potential limitation of the current investigation is the failure to identify and control factors that were related to the practice occurring in the home environment that resulted in a lack of progress. A more complete and systematic analysis is needed in order to isolate and compare the effects of variables that may have contributed to the lack of performance in the home setting. However, this may not be an easily
accomplished goal. Parents of the students participating in the study were unresponsive to repeated requests to come to the school for training and assistance. This was partially attributable to a lack of direct means for communication since families lacked phones, failed to respond to home notes and/or attend scheduled meetings. Research using more direct observation methods in the home environment is needed for this population of students to determine what factors need to be altered in the home environment to produce optimal academic growth rates.

A second potential limitation of this study is the failure to examine whether or not the fluency package with reward could be equally effective if practice was completed at home. Due to the extensive number of sessions during this investigation, the approach of the end of the school year limited our inclusion of a phase that examined the implementation of the validated fluency program at home. Since parent assistance would have been needed to implement this phase, further research needs to be conducted to determine the effectiveness of the fluency-based treatment at home as well as strategies that would obtain parent assistance for at-risk students with limited modes of communication (i.e. no phone, limited reading ability).

A third limitation is the lack of the counterbalancing during the In-Class and Homework Treatments, Fluency Training and Homework Treatments, Fluency Training with Reward and Homework Treatments phases. During these three phases, one treatment condition was applied at home after school while a second treatment condition was applied in the classroom during the school day. Hence, it was possible to complete both conditions on a daily basis. As a result, treatment effects were ascertained sooner. Despite this benefit, the potential importance of sequence effects is unknown during these phases. During the Student Managed Implementation phase,
however, the attainment of the fluency mastery criterion on a second skill when the treatment was administered without the homework condition further supports that the results were due to the treatment alone.

Despite these considerations, the analysis of data collected in this study confirmed that achievement gains in accuracy performance can be obtained when more homework is returned with incentives. However, incentives alone had limited impact on fluency performance for all students in this study. Factors that are contributing to poor fluency performance may potentially be identified in the brief format used during the Brief Assessment Phase in this study. The brief assessment is a quick, practical and easy procedure that guides professionals towards an intervention that will enhance fluency performance for some students. Moreover, this study demonstrated that continued progress monitoring with a daily probe quickly detected the lack of homework gains for individual students. These equivocal results suggested that while practice was vital for skill mastery, the type of practice differentially influenced fluency performance over time for individual students. Some students obtained the fluency mastery criterion with instruction before practicing the skill independently in class. This type of practice proved to be ineffective for other students. For some students, a number of additional treatment components were required in order to obtain the mastery level. Generally, for these students mastery criterion was obtained with the more intensive Fluency Training Package with Reward treatment.

Clearly, these findings indicate that different levels of effort are required from professionals for all students to reach established academic goals. The strategies needed to improve performance in those students who are not achieving academic standards may take a variety of forms, both inside and outside the classroom. Ideally,
each student would have access to all the services in school and home settings to ensure academic progress. But for many students this is not the case, particularly in the home setting where parents play a critical role. However, if parents are unable, unwilling or unavailable to receive intervention training, this study suggests that the implementation of brief practice sessions at school with peer assistance may be an efficient and effective option along with homework assignments to enable even academically at-risk students to master skills at the expected time.

In summary, results of this present study are consistent with previous research that has produced equivocal results for homework with individual elementary students. While other studies report improvements for some students in homework performance, procedures used in the present study did not ignore those students who did not show immediate improvement with the treatment package. The idiographic protocol used here made it possible to identify deficiencies and design interventions that worked for every student who had homework problems. While the number and type of individual treatment components differed among students, all students in this study obtained the mastery fluency criterion as defined in this study. Thus, with the correct individualized treatment, all students, even those determined to be “at-risk” can benefit from programs designed to improve academic performance.
References


Appendix 1: Example of a Practice Assignment

Find the missing number in the addition equation.

\[
\begin{align*}
8 + \square &= 12 & 6 + \square &= 12 & 7 + \square &= 11 \\
4 + \square &= 12 & 6 + \square &= 11 & 2 + \square &= 11 \\
8 + \square &= 11 & 9 + \square &= 11 & 8 + \square &= 12 \\
2 + \square &= 11 & 9 + \square &= 11 & 7 + \square &= 11 \\
3 + \square &= 12 & 8 + \square &= 11 & 4 + \square &= 11 \\
8 + \square &= 11 & 3 + \square &= 11 & 5 + \square &= 11 \\
5 + \square &= 11 & 7 + \square &= 11 & 2 + \square &= 11 \\
6 + \square &= 11 & 5 + \square &= 11 & 4 + \square &= 11 \\
3 + \square &= 12 & 6 + \square &= 12 & 5 + \square &= 11 \\
6 + \square &= 11 & 7 + \square &= 12 & 8 + \square &= 11
\end{align*}
\]
**Appendix 2: Example of a Reinforcement Practice Assignment**

Name: ___________________________  Date: ___________________________

**TREASURE CHEST** OR **FUN ACTIVITY**

**YOU WILL EARN A REWARD IF YOU BEAT THIS GOAL:**

<p>| | | |</p>
<table>
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<tbody>
<tr>
<td>6 +</td>
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<td>15</td>
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<td>7 +</td>
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<td>14</td>
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<td>6 +</td>
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<td>13</td>
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### Appendix 3: Example of a Daily Math Probe

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<thead>
<tr>
<th>Name:</th>
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<tbody>
<tr>
<td>8 + □ = 12</td>
<td>4 + □ = 11</td>
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<td>4 + □ = 11</td>
<td>6 + □ = 12</td>
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<td>5 + □ = 12</td>
<td>3 + □ = 11</td>
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<td>2 + □ = 11</td>
<td>9 + □ = 12</td>
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<td>6 + □ = 12</td>
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<td>3 + □ = 11</td>
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<td>8 + □ = 12</td>
<td>9 + □ = 11</td>
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ANSWERS to Daily Math Probe

8 + □ 4 = 12  7 + □ 5 = 12  4 + □ 8 = 12

6 + □ 5 = 11  6 + □ 6 = 12  2 + □ 9 = 11

7 + □ 5 = 12  4 + □ 8 = 12  8 + □ 3 = 11

2 + □ 9 = 11  4 + □ 8 = 12  4 + □ 7 = 11

8 + □ 4 = 12  8 + □ 4 = 12  9 + □ 3 = 12

7 + □ 4 = 11  3 + □ 8 = 11  4 + □ 7 = 11

5 + □ 6 = 11  7 + □ 5 = 12  7 + □ 4 = 11

8 + □ 4 = 12  3 + □ 9 = 12  6 + □ 5 = 11

5 + □ 7 = 12  4 + □ 8 = 12  7 + □ 4 = 11

9 + □ 2 = 11  7 + □ 5 = 12  8 + □ 3 = 11

125
Appendix 4: Example of a Fact Sheet

\[
\begin{array}{ll}
6 + 5 & = 11 \\
7 + 4 & = 11 \\
8 + 3 & = 11 \\
9 + 2 & = 11 \\
\hline
6 + 6 & = 12 \\
7 + 5 & = 12 \\
8 + 4 & = 12 \\
9 + 3 & = 12 \\
\end{array}
\]
Appendix 5: Example of a Sliced Probe

The first probe (i.e., sliced probe) consists of a smaller segment of the problems on the second probe (i.e., daily math probe)

| 6,7,8 for 12 |  |
| Find the missing number in the addition equation. |
| 6 + □ = 12 | 5 + □ = 12 | 5 + □ = 12 |
| 6 + □ = 12 | 8 + □ = 12 | 8 + □ = 12 |
| 6 + □ = 12 | 7 + □ = 12 | 5 + □ = 12 |
| 4 + □ = 12 | 6 + □ = 12 | 7 + □ = 12 |

Find the missing number in the addition equation.

| 8 + □ = 11 | 4 + □ = 11 | 5 + □ = 12 |
| 3 + □ = 12 | 5 + □ = 12 | 2 + □ = 11 |
| 5 + □ = 11 | 7 + □ = 11 | 8 + □ = 12 |
| 2 + □ = 11 | 8 + □ = 11 | 7 + □ = 11 |
Appendix 6: Example of a Progress Chart

<table>
<thead>
<tr>
<th>Date</th>
<th>Practice Score</th>
<th>TEST SCORE</th>
<th>Put a star by the best score</th>
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Appendix 7: Reward Survey

THINGS I WOULD LIKE TO EARN

TREASURE CHEST:

_____ 1. Candy
_____ 2. Fruit punch
_____ 3. Pencils
_____ 4. Erasers
_____ 5. Pens
_____ 6. Stickers
_____ 7. Awards
_____ 8. Ribbons
_____ 9. A small toy
_____ 10. Hair deco's
_____ 11. Stickers
_____ 12. Books
_____ 13. Sport cards
_____ 14. Folder

FUN ACTIVITY:

_____ 1. Fun Reading Time
_____ 2. Jump Rope time
_____ 3. Playing Board Games
_____ 4. Puzzle Time
_____ 5. Art Time
_____ 6. Coloring
_____ 7. Tutor other students
_____ 8. Play table games
_____ 9. Listen to Music
_____ 10. Grade papers
_____ 11. Phone mom to say hello.
_____ 12. Five minute nap
_____ 13. Write in journal
_____ 14. Be in charge of the teacher's timer
_____ 15. Post good work in class
_____ 16. Hug from the teacher
_____ 17. Teacher will give a great job phone call to parent
_____ 18. Wear a Good job ribbon for a day
_____ 19. Show work to teacher or principal

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<table>
<thead>
<tr>
<th>Reading Time</th>
<th>Color</th>
<th>A nap</th>
<th>Send home an award</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>![Color Icon]</td>
<td>![Nap Icon]</td>
<td>![Award Icon]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Jump rope time</th>
<th>Phone home</th>
<th>Write in journal</th>
<th>Teacher will call home to say “GOOD JOB”</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Jump Rope Icon]</td>
<td>![Phone Icon]</td>
<td>![Journal Icon]</td>
<td>![Teacher Call Icon]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Play a game or puzzle</th>
<th>Post good work</th>
<th>In charge of timer</th>
<th>Wear a Good Work Ribbon for a day</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Game Icon]</td>
<td>![Good Work Icon]</td>
<td>![Timer Icon]</td>
<td>![Ribbon Icon]</td>
</tr>
</tbody>
</table>
Appendix 9: Integrity for Brief Assessment of Academic Performance

TAKE the child to a quiet place such as the school library, cafeteria, or counselor's office.

PLACE the blank worksheet in front of the student. The worksheet should be similar to the worksheet completed during the in class assessment. The student will be required to do the same types of problems and skill.

SAY “In class you completed _____ digits correct on this math skill. You will be given a chance to complete as many problems as you can in two minutes. But this time you will earn a reward if you can beat this score. You can earn something from my treasure chest or play a game for five minutes with me. Do you have any questions?”

ALLOW the student a chance to examine the treasure chest to see what they will be able to earn.

SAY “When I say “Start”, begin working the math problems at the top of this page. Be sure to do your very best work. Are there any Questions?”

SET the timer to TWO minutes, begin the timer and say “START!”

SAY “STOP” when the timer buzzes after TWO minutes.

SCORE the worksheet for the number of digits correct.

TELL student the Score and GIVE a reward if the student exceeded their goal or PRAISE the student for trying their best if they did not exceed their goal.
For white instruction sheet:

**PRESENTING HOMEWORK**

**Tell** student what they need to do to complete a problem correctly.

**Model** how to do a problem.

**Guide** student as he or she practiced.

**Provide fact sheet** if needed.

**Give homework** with fact sheet

**COLLECTING HOMEWORK**

**Collect** homework

**Grade** the homework

**Tell** student the grade and reviewed mistakes

**Praise** student for effort and correct answers

**Write** score on chart
Appendix 11: Teacher Coach for Contingent Reward Homework Treatment Procedures

For Pink Contingent Reward Homework:

**COLLECTING HOMEWORK**

- Collect homework
- Grade the homework
- Tell the student the homework performance score.
- Give a reward if the student exceeded or met their goal.

**PRESENTING HOMEWORK**

- Write the student’s best previous score on the Homework sheet.
- Tell the student that they will need to exceed the goal or meet 100% goal in order to earn a reward.
- Have the student repeat the directions.
MINUTE TEST

_____ GRADE yesterday's worksheet and show student their grade.

_____ Give student Daily math probe.

_____ Write BEST SCORE on paper.

_____ SET the timer for 1 minute and say "GO!".

_____ Student works on the worksheet for 1 minute.

_____ GRADE the daily math probe.

_____ CHART the test score.

PRACTICE

_____ Take out a Practice Worksheet

_____ Modeled three problems.

_____ Guide student as he or she practice by telling student to "Try this one again" if an answer was wrong on the first three problems and gave them the right answer if missed again.

_____ Give student time to complete the worksheet.

_____ Put worksheet in folder.
Appendix 13: Teacher Coach for Contingent Reward In-Class Treatment

MINUTE TEST

GRADE yesterday’s paper and show student their grade.

Give student Daily math probe.

Write BEST SCORE on paper.

SET the timer for 1 minute and say “GO!”.

Student works on the worksheet for 1 minute.

GRADE the daily math probe.

CHART the test score.

PRACTICE

Take out a Practice Worksheet

Write the best previous score on the practice worksheet

Tell student that they needed to exceed the goal or meet the 100% goal in order to earn a reward.

Ask student to repeat the directions.

Give student time to complete the WORKSHEET.

Put the practice assignment in the folder.
Appendix 14 : Student Integrity for Student Managed Package Data

Checklist

Date:_______ Student:________ Observer:________

MINUTE TEST

____ _____ ______ GRADE your partner’s paper from yesterday.

____ _____ ______ Show your partner their grade.

____ _____ ______ Both students take out a WORKSHEET.

____ _____ ______ TELL the teacher to set timer for 1 minute.

____ _____ ______ DO the worksheet for 1 minute.

____ _____ ______ GRADE your partner’s test with marker.

____ _____ ______ CHART the test score.

PRACTICE

____ _____ ______ Take out one a another WORKSHEET AND ANSWER sheet

____ _____ ______ Partner 2 showed Partner one how to DO THE FIRST THREE problems using the answer sheet.

____ _____ ______ Partner 1 worked on one WORKSHEET.

____ _____ ______ Partner 2 said “Try this one again” if an answer was wrong on the first three problems and gave them the right answer if missed again.

____ _____ ______ SWITCH. Partner 2 will do the Practice sheet while Partner 1 tells when problem is incorrect.
PRACTICE FLASH CARDS

- Get **MATERIALS:** flashcard, timer, worksheets.
- Set **TIMER** for 2 minutes
- Practice **FLASHCARDS** for 2 minutes
- When student says a wrong answer, **TELL THE ANSWER** after 3 seconds.

PRACTICE ONE

- Take out **WORKSHEET PACKET.**
- **WRITE BEST SCORE** on worksheet.
- Set **TIMER** for 1 minute and say "GO!".
- Student works for one minute on **FIRST WORKSHEET.**
- **GRADE**
- **WRITE** the score on the chart.

PRACTICE TWO

- Go to **SECOND WORKSHEET.**
- **WRITE BEST SCORE** on worksheet.
- Set **TIMER** for 1 minute and say "GO!".
- Partner 2 works for one minute on **SECOND WORKSHEET.**
- **GRADE**
- **WRITE** the score on the chart.
PRACTICE FLASH CARDS

_____ Get MATERIALS: flashcard, timer, worksheets.
_____ Set TIMER for 2 minutes
_____ Practice FLASHCARDS for 2 minutes
_____ When student says a wrong answer, TELL THE ANSWER after 3 seconds.

PRACTICE ONE

_____ Take out WORKSHEET PACKET.
_____ WRITE BEST SCORE on worksheet.
_____ Set TIMER for 1 minute and say "GO!".
_____ Student works for one minute on FIRST WORKSHEET.
_____ GRADE
_____ WRITE the score on the chart.

PRACTICE TWO

_____ Go to SECOND WORKSHEET.
_____ WRITE BEST SCORE on worksheet.
_____ Set TIMER for 1 minute and say "GO!".
_____ Partner 2 works for one minute on SECOND WORKSHEET.
_____ GRADE
_____ WRITE the score on the chart.
_____ Give student a REWARD if they exceeded their goal.
Appendix 17: Student Integrity for Student Managed Fluency Package Data Checklist

DATE DATE DATE DATE DATE

PRACTICE FLASH CARDS

Get FOLDER
Partner 1 sets TIMER for 2 minutes
Practice FLASHCARDS for 2 minutes
When your partner says a wrong answer, TELL THE ANSWER after 3 seconds.

PRACTICE ONE

Take out WORKSHEET PACKET.
WRITE BEST SCORE on worksheet.
Partner 1 sets TIMER for 1 minute and says “GO!”.
Partner 2 works for one minute on FIRST WORKSHEET.
GRADE by coloring the space next to the problem with marker.
WRITE the score on the chart.

PRACTICE TWO

Go to SECOND WORKSHEET.
WRITE BEST SCORE on worksheet.
Partner 1 sets TIMER for 1 minute and says “GO!”.
Partner 2 works for one minute on Second Worksheet.
GRADE by coloring the space next to the problem with marker.
WRITE the score on the chart.
Student will choose a REWARD if they exceeded their goal.

<table>
<thead>
<tr>
<th>Steps completed</th>
<th>Steps possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps completed</td>
<td>Percent of steps completed</td>
</tr>
</tbody>
</table>
Appendix 18: Baseline Integrity Data Checklist

Date:_________ Teacher:___________ Observer:___________

DATE DATE DATE DATE DATE

______ ______ ______ ______ Passed out homework assignments.

______ ______ ______ Gave homework directions and told students to return it the next day.

______ ______ ______ Collected homework assignment

______ ______ ______ Graded homework assignment after collecting them.

______ ______ ______ Gave students their graded assignments.

______ ______ ______ Administered a one minute probe.

______ ______ ______ Graded one minute probe.

______ ______ ______ Told students their score.

________________________________________________________________________

______ ______ ______ ______ Steps completed/Steps possible

______ ______ ______ ______ Percent of steps completed.
Appendix 19: Teacher Integrity for Instructional Homework Treatment Data Checklist

OBSERVER: ___________________ DATE:______ TEACHER: ______________

**COLLECTING HOMEWORK**

<table>
<thead>
<tr>
<th>Child</th>
<th>Graded the homework</th>
<th>Told student the grade and reviewed mistakes</th>
<th>Praised student for effort and correct answers</th>
<th>Steps completed/Steps possible</th>
<th>Percent of steps completed</th>
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**PRESENTING HOMEWORK**

<table>
<thead>
<tr>
<th>Child</th>
<th>Told student what they need to do to complete a problem correctly.</th>
<th>Modeled how to do a problem.</th>
<th>Guided student as he or she practiced.</th>
<th>Provided visual prompt if needed.</th>
<th>Steps completed/Steps possible</th>
<th>Percent of steps completed</th>
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Appendix 20: Teacher Integrity for Reinforcement Homework Treatment

Data Checklist

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<td>Child</td>
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Appendix 21: Teacher Integrity for Instruction In-Class Treatment Data Checklist

Student:________ Teacher:_________ Observer:________

DATE DATE DATE DATE

MINUTE TEST

_____ _____ _____ GRADE yesterday's worksheet and show student their grade.

_____ _____ _____ Give student Daily math probe.

_____ _____ _____ Write BEST SCORE on paper.

_____ _____ _____ SET the timer for 1 minute and say “GO!”.

_____ _____ _____ Student works on the worksheet for 1 minute.

_____ _____ _____ GRADE the daily math probe.

_____ _____ _____ CHART the test score.

PRACTICE

_____ _____ _____ Take out a Practice Worksheet

_____ _____ _____ Modeled three problems.

_____ _____ _____ Guide student as he or she practice by telling student to “Try this one again” if an answer was wrong on the first three problems and gave them the right answer if missed again.

_____ _____ _____ Give student time to complete the worksheet.

_____ _____ _____ Put worksheet in folder.

____ ___ ___ ___ Steps completed/Steps possible

____ ___ ___ ___ Percent of steps completed.
**Appendix 22: Teacher Integrity for Contingent Reward In-Class Treatment Data Checklist**

Teacher: __________  Student: _________  Observer: _________

**MINUTE TEST**

<table>
<thead>
<tr>
<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>GRADE yesterday's paper and show student their grade.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Give student Daily math probe.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Write BEST SCORE on paper.</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>SET the timer for 1 minute and say “GO!”.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Student works on the worksheet for 1 minute.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>GRADE the daily math probe.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CHART the test score.</td>
</tr>
</tbody>
</table>

**PRACTICE**

<table>
<thead>
<tr>
<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>Take out a Practice Worksheet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Write the best previous score on the practice worksheet</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>Tell student that they needed to exceed the goal or meet the 100% goal in order to earn a reward.</td>
</tr>
<tr>
<td></td>
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<td>Ask student to repeat the directions.</td>
</tr>
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<td></td>
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<td></td>
<td>Give student time to complete the worksheet.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Put the practice assignment in the folder.</td>
</tr>
</tbody>
</table>

---

Steps completed/Steps possible

Percent of steps completed.
Appendix 23 : Teacher Integrity for Fluency Training Package Data Checklist

Teacher: _______________ Student: ______ Observer:_________

DATE DATE DATE DATE DATE DATE

PRACTICE FLASH CARDS

_______ _______ _____ Get MATERIALS: flashcard, timer, worksheets.
_______ _______ _____ Set TIMER for 2 minutes
_______ _______ _____ Practice FLASHCARDS for 2 minutes
_______ _______ _____ When student says a wrong answer, TELL THE
_______ _______ _____ ANSWER after 3 seconds.

PRACTICE ONE

_______ _______ _____ Take out WORKSHEET PACKET.
_______ _______ _____ WRITE BEST SCORE on worksheet.
_______ _______ _____ Set TIMER for 1 minute and say "GO!".
_______ _______ _____ Student works for one minute on FIRST
_______ _______ _____ WORKSHEET.
_______ _______ _____ GRADE
_______ _______ _____ WRITE the score on the chart.

PRACTICE TWO

_______ _______ _____ Go to SECOND WORKSHEET.
_______ _______ _____ WRITE BEST SCORE on worksheet.
_______ _______ _____ Set TIMER for 1 minute and say "GO!".
_______ _______ _____ Partner 2 works for one minute on SECOND
_______ _______ _____ WORKSHEET.
_______ _______ _____ GRADE
_______ _______ _____ WRITE the score on the chart.

_______ _______ _____ Steps completed/Steps possible
_______ _______ _____ Percent of steps completed.

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Appendix 24: Teacher Integrity for Fluency Training Package with Reward Data Checklist

Student:_________ Teacher:_____________ Observer:_________

DATE DATE DATE DATE DATE

PRACTICE FLASH CARDS

Get MATERIALS: flashcard, timer, worksheets.
Set TIMER for 2 minutes
Practice FLASHCARDS for 2 minutes
When student says a wrong answer, TELL THE ANSWER after 3 seconds.

PRACTICE ONE

Take out WORKSHEET PACKET.
WRITE BEST SCORE on worksheet.
Set TIMER for 1 minute and say "GO!".
Student works for one minute on FIRST WORKSHEET.
GRADE
WRITE the score on the chart.

PRACTICE TWO

Go to SECOND WORKSHEET.
WRITE BEST SCORE on worksheet.
Set TIMER for 1 minute and say "GO!".
Partner 2 works for one minute on Second Worksheet.
GRADE
WRITE the score on the chart.
Give REWARD if student exceeded the goal.

Steps completed/Steps possible
Percent of steps completed.
Appendix 25: Consent Form

HOMEWORK PROGRAM FOR MATH AT POLK ELEMENTARY SCHOOL

Dear Parents, March 2, 1999

We are starting a new homework program with Louisiana State University School Psychology Department to help motivate students to complete their homework. We feel that your child will benefit from this new program and so we are glad to offer you this unique opportunity to help your child!

We are writing to request permission to include your child in the homework program for math skills. Your child would be working with graduate students from the School Psychology Program at LSU for approximately 15 minutes a day to practice and learn basic math skills. Your child will then be given work to complete as homework.

The results of the math homework program may be included in research reports. If your child’s results are included in any research reports, his or her name will not be included in the report. If, at any time, you feel the program is not beneficial you may withdraw your child from the program.

We are able to make this offer to only a limited number of students at this time. You won’t want to miss this opportunity to receive this free service for your child.

If you have any questions, please contact Donna Gilbertson at your earliest convenience at 388-8784.

Sincerely,

_____________________________  ______________________________
Donna Gilbertson                  Teacher
LSU graduate student

_____________________________  ______________________________
I give permission for my child to participate in the homework program for math skills.

_____________________________  ______________________________
No, I prefer that my child not participate in the homework program for math skills.

Telephone number: ________________________________
The best time to call is ____________________

_____________________________  ______________________________
Parent or Guardian                  Student
Vita

Donna Gilbertson currently holds a bachelor’s degree in chemistry and earth science and a master’s degree in school psychology. Prior to graduate school, she had seven years of educational experience in both regular and special education classrooms, provided numerous workshops and coordinated a Hands-On Science Program in two school districts.

During graduate school in the psychology department at LSU, Ms. Gilbertson has been involved in variety of programs. First, she has worked with LSU Behavior Intervention team which provides direct service to schools and children in Louisiana. Second, she assisted with the training program for teachers in elementary schools with Project T.R.U.E.: Transdisciplinary Residential Urban Education. Third, she participated in Project RASE which incorporated Direct Instruction and Precision Teaching methods in math class at an inner city school. Finally, she participated in the development of a functional behavioral assessment strategy for special education referrals.

During her internship experience, Ms. Gilbertson attended the Louisiana School Psychology Internship Consortium as a school psychologist with supervision. Her primary focus throughout her graduate school experience has been in the area of research investigating strategies that promotes teacher usage of interventions in the regular and special education classrooms for both behavioral and academic problems. She plans on pursuing her primary research interests are in identifying strategies that increase academic performance for basic skills for students who are at risk for failure while decreasing common behavior problems in the classroom. She will receive the degree of Doctor of Philosophy at the December commencement in 2000.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Donna Gilbertson

Major Field: Psychology

Title of Dissertation: The Effect of Antecedent and Consequent Strategies on Increasing Student Homework Compliance and Academic Achievement

Approved:

[Signature]

Major Professor and Chairman

[Signature]

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination: 20 October 2000