Homework: The Effects of Differentiated Homework on Homework Completion Rates and Assessment Scores

Heather Allen
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MS in Mathematics, Science, and Technology Education

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Homework: Uses, Effectiveness and Motivation

Public attitudes and opinions about homework have varied over the past several decades. Homework has been seen as a way to extend students’ educational opportunities and conversely as a symptom of the needless pressure placed upon students. It has been seen as a way to compete with foreign nations but also as a hindrance to students’ extracurricular activities. In the current educational setting of higher standards and increased rigor for student learning, homework has once again been accepted as a beneficial pedagogical strategy.

The research tends to favor the attitudes surrounding homework at the time the research was conducted. Research on homework is difficult from which to draw conclusions due to the nature of homework itself. Homework can be influenced by a multitude of factors. Because homework is meant to be done at home, students have a choice in whether, when and how to complete it. Their home environment may hinder or help homework completion, and there may be other activities that put restrictions on their time (Cooper & Valentine, 2001).

This study investigated the attitudes and uses of homework by the teaching staff at a large suburban middle school. It also attempted to determine the effectiveness of differentiated homework as a means of increasing student homework completion rates by comparison to baseline data taken on a previous unit. The amount of homework completed was compared to assessment scores to ascertain whether increased homework had a positive affect.
Homework has been defined as “any task assigned by schoolteachers intended for students to carry out during nonschool hours” (Cooper, Robinson & Patall, 2006, p. 1). This definition allows for time that students may spend completing homework during study hall, subsequent classes or at home. There are several purposes that teachers wish to accomplish through homework. First, it can be used as practice to review and reinforce concepts covered in class. It can also be used as preparation for an upcoming lesson. Furthermore, homework can be used to provide an extension to determine if students can apply the skills and strategies they have learned to new situations.

Punishment has previously been given as a purpose for homework; however, most teachers condemn this practice as it reinforces a negative connotation of school work. Homework can also be useful as a means of parent-teacher communication, it allows parents to see what topics are being covered in their child’s class and, depending on the assignment, may call for the parent’s direct interaction (Gajria & Salend, 1995; Cooper, Robinson & Patall, 2003; Strother, 1984; Cornu & Xu, 2004; Van Voorhis, 2004).

Homework, from the student perspective shares a similar viewpoint to teachers in that homework is assigned to “develop a sense of responsibility, learn to work independently, learn study skills, and reinforce school learning.” (Xu, 2005, p. 50)

Conversely, students also see homework as a way to seek approval from teachers and parents. This approval can be in the form of positive verbal praise, a grade, or a physical reward.
There are many ways that homework can be varied to best meet the needs of both teachers and students. Homework can be differentiated based on its “amount, skill area, purpose, degree of choice for the student, completion deadline, degree of individualization and social context” (Harris, Robinson, & Patall, 2006, p. 1). Many students learn differently and have varying academic needs; modifying homework can assist a child in being successful. For example, some students may need their work broken down into different pieces for homework each night. When writing an essay, some students may write an introductory paragraph one night, body paragraph the next, etc. while others might outline, draft and then write a final copy. Homework can be assigned to be completed in one evening or over the course of a week. Certain assignments may be made mandatory while others can be optional. For example, students might be required to practice the Pythagorean Theorem for homework but extensions using the theorem might be optional for more advanced students. Van Voorhis (2004) suggested considering the amount of time low-, average-, and high-ability students should spend on homework and whether or not the homework provided allows them appropriate practice. Homework should be created to address the needs of all students.

In this section, the literature concerning homework is reviewed. Both the positive and negative outcomes of homework are discussed with an emphasis on the effectiveness of homework as a pedagogical strategy to increase student achievement. Varying recommendations for the appropriate amount of assigned homework are presented. Several strategies for increasing completion and effectiveness of homework such as the interspersal technique, student planners, and family involvement are also included.
Positive and Negative Effects of Homework

The effects of homework cover a broad base of areas, from positive to negative, from academic to nonacademic. Homework has an immediate effect on the retention and understanding of the material it covers (Cooper & Valentine, 2001). Homework can allow all students to work individually and demonstrate their understanding of a topic. Some students prefer to be more vocal in class which shows their level of understanding, but other students prefer to remain quiet in class and may appear to have limited comprehension of the subject. Thus, through the completion of homework, teachers are able to assess the understanding of all of their students (Van Voorhis, 2004).

Homework can also improve students' study habits and time management skills. It can foster positive character traits such as responsibility and independence for those completing the work successfully and on time. However, there also exists the possibility of homework leading to undesirable character traits by promoting cheating, either through directly copying someone else's homework or from receiving help which moves beyond tutoring to someone completing the students homework for them (Van Voorhis, 2004; Cooper & Valentine, 2001; Cooper, 2001). Many parents and educators argue that homework may cause students to be overwhelmed with a topic and thereby lose interest. It is also argued that homework interferes with students' ability to participate in extra curricular activities which diminishes the social learning that occurs there (Cooper, 1989).

Keith's (1982) research attempted to control background variables. His study took into account the race, family background, ability, field of study, time spent on homework, and grades so far in high school. The strongest effect on grades was found to
be made by intellectual ability. However, time spent on homework was found to have the second strongest effect on student achievement. The effect of homework was stronger than both race and family background (socioeconomic status). Based on the inclusion of background variables, Keith’s study was also able to show the compensatory effects of homework. Low ability students who completed homework were able to achieve grades that were equal to average ability students who did not complete homework.

The effects of homework also vary from subject area to subject area. Brookhart (1997) found that homework assignment and completion had a direct effect on student achievement in mathematics. “The importance of homework variables to mathematics achievement is probably best explained by learning theory and the importance of practice to mastery” (Brookhart, 1997, p. 328). For mathematics specifically, time spent on homework provides students with the additional opportunities needed to practice and reinforce skills.

In Cooper, Robinson and Patall’s (2006) meta-analysis of homework research, 20 studies were found which compared results of students receiving homework to those receiving no homework. Of those studies, 14 found that homework was an effective strategy for increasing student achievement, six showed support for the no homework group. Fifty studies were found that compared the amount of time students spent on homework with measures of achievement. Of those studies, 43 showed that students who completed more homework have increased achievement, while only seven resulted in a negative outcome.
Time on Homework

Research has shown that the effects of homework vary based on grade level. In Cooper, Robinson, and Patall’s (2006) synthesis of research it was concluded that the average high school student in a class doing homework outperformed 69% of students in a no-homework class, based on grades or standardized testing. The effect of homework in the middle grades was half this size and in the elementary level homework did not result in gains in achievement. The question then becomes what is the correct amount of homework to assign and how often. The research on this point provides varied answers.

Although homework has not been shown to have an effect on the achievement of elementary students, there exists an argument for the assignment of homework to this age group of students. Cooper (1989) wrote the following,

First, I recommend that elementary students be given homework even though it should not be expected to improve test scores. Instead, homework for young children should help them develop good study habits, foster positive attitudes toward school, and communicate to students the idea that learning takes work at home as well as at school. (p. 90)

Homework for elementary students should therefore be short and provide students with opportunities to be successful with homework experiences. Teachers need to ensure that the homework they assign is at the proper developmental level for their students and requires an appropriate amount of time for a child at that age. Homework for elementary students can also be more beneficial if it includes lessons on how to study, as this is an area which will benefit them in later grades (Cooper, Lindsay, Nye & Greathouse, 1998).
It was previously reported that homework time varied from 2.3 hours per week for fifth and sixth graders to 5.9 hours per week for seventh and eighth graders. Leone and Richards (1989) conducted a study to confirm these estimates of time spent on homework. The findings of their study were consistent with the previous estimates for seventh and eighth graders; students reported spending 6.5 hours per week completing homework. Their study also found that more time spent on homework was associated with increased academic achievement (Leone & Richards, 1989). Based on their finding it is recommended that students in middle school/junior high school should spend 50 minutes on homework daily (Marzano, Pickering, & Pollock, 2001).

Keith (1982) found that with 1-3 hours of homework per week, low ability students were able to achieve similar grades to average ability students who did no homework. This study also showed that although there is an ethical limit to the amount of homework assigned, the more homework students complete the better their achievement. An increase of about thirty minutes per night of homework increased students’ overall grade point average about half a point.

Although the research provides a varied recommendation for the amount of homework a student should receive, a combined analysis of the data supports the Ten Minute Rule, or 10 minutes multiplied by the students’ grade level per night. Therefore, an eighth grade student should expect an hour and 20 minutes of homework each night (Cooper, 2001). As this recommendation is for all homework combined, teachers need to communicate with each other to ensure that students are not receiving too little or too much homework.
An interest in the amount of homework to assign must lead teachers to analyze the amount of time it takes students to complete an assignment. Bryan and Burstein (2004) had teachers estimate the time it would take students to complete an assignment and then had students indicate the amount of time it actually took. Students reported spending much more time on assignments than teachers had expected. However, student calculations of homework time may be biased based on the difference between total time and active time. A student who reports spending large amounts of time on homework may in fact reflect problems of motivation and concentration (Trautwein, Lüdtke, Snyder & Niggli, 2006). These problems could include an inappropriate homework space, such as a busy living room, TV, music, etc.

Increasing Homework Completion

Research devoted to the time students spend on homework indicated that a small number of students spend more than two hours on homework each night. In a sample of 9, 13 and 17 year olds, 5%, 8% and 12% respectively reported spending more than two hours on homework each night. Perhaps more importantly, 53%, 37%, and 26% respectively report spending less than one hour per night on homework. Approximately a third of students reported doing no homework at all citing that no homework was assigned or they chose not to complete it (Gill & Schlossman, 2003; Van Voorhis, 2004). Many students find the task of completing homework challenging: Polloway, Foley and Epstein (1992) found that 28% of average achieving students and 56% of students with learning disabilities have difficulties in completing their homework. This brings back the point of differentiating homework for individual student learners.
It is evident that homework benefits the individual, however, homework can also contribute to the success of the class as a whole. If the majority of the class completes the homework, then the class can work collaboratively from it (Cornu & Zu, 2004). Conversely, if homework is not completed time may be lost reviewing content or practicing problems. For all the benefits that homework can bring, teachers must find ways to increase the homework completion rates of their students.

Directions and feedback.

In a study completed by Salend and Schliff (1989), 85% of the teachers who responded stated they had issues with getting students to complete homework. This concern may have stemmed from the teachers' failure to provide adequate feedback on assignments, to include homework as part of a students' grade, or to incorporate parent involvement. 43% of respondents reported they do not often review or discuss homework after it is assigned, 42% did not consistently grade homework assignments, and 42% did not include homework performance when calculating grades. It was recommended that teachers provide immediate, specific feedback, review homework during class time, grade homework, and actually include these grades in determining final averages.

Some research suggested that collecting, correcting and returning student work may actually have a negative effect on student achievement. It may be that students in this study perceived the assessment of their homework as judgment as opposed to information for improvement. This finding was contradictory to what one would expect and warrants further study (Brookhart, 1997). Marzano, Pickering and Pollock (2001)
suggested varying the ways in which feedback is provided. It may be difficult for teachers to grade and comment on every assignment, therefore, teachers need to determine the importance of the assignment and the type of feedback they provide. For example, teachers may occasionally choose to have students grade their own work and provide feedback for themselves. Teachers may also decide to conference with students weekly regarding their work. The goal is to provide as much informative feedback as possible.

Homework completion rates may also be increased by providing students with clear and precise directions. Teachers should inform students of the purpose of the assignment and include directions for completion, date due and format of expected responses. Students should also be made aware of any resources they may need or can use to assist them. Such resources should include the amount and type of assistance they can receive from others; for example if they are able to complete the assignment working with a parent or friend. Students should also be encouraged to ask questions pertaining to the homework assignment and class time should be provided to do so. To ensure instructions were understood, teachers may select students to re-explain the directions to the class to ensure that they were understood. Lastly, teachers should allow some class time to begin assignments to clear up any confusion before the assignment is taken home where the teacher is no longer available for consultation (Salend & Schliff, 1989).

Family involvement.

It has been theorized that there are three reasons that parents do or do not become involved with school related activities. First, parents must believe that their role includes
involvement. Also, parents must have observed parent involvement by either their own parents or other adults to ensure success. Second, parents become involved if they experience feelings of being effective in helping their children. These feelings can be lessened if parents believe they lack the skills and knowledge necessary to help. Third, parents become involved if their assistance is requested by school personnel or their own children (Hoover-Dempsey & Sandler, 1995).

Research concerning family involvement has shown the positive effects that it can have with regard to student success. The trepidation comes in the way that parents are involved. There are many different roles that parents may play in homework involvement. They may act as a tutor, helping students with concepts they find difficult; a facilitator, setting up a homework time and location; or a reinforcer of independent behavior (Roderique, Polloway, Cumblad, Epstein, & Bursuck, 1994). The attitudes of students can be shaped by the attitudes and beliefs held by their parents. Cooper et. al. (1998) stated:

The lack of positive effect of homework for some students may be due, in part, to attitudes toward homework held by parents that impede, or at least do not support, their children’s full participation, persistence, or commitment to completing assignments. (p. 82)

Xu (2005) concluded that teacher attitudes regarding homework were more positive than parent attitudes which were more positive than student attitudes. However, parent attitudes were a predictor of student attitudes while teacher attitudes were not. Negative parent attitudes can, therefore, have a negative effect on students’ perceptions of homework, which in turn may lessen the effectiveness of homework for those students.
A study completed by Leone and Richards (1989), showed that students were most attentive to their homework when it was completed with a parent as opposed to with a peer or on their own. This response occurred across socioeconomic level, age and gender, thereby reinforcing the importance of parent involvement.

District policies concerning homework tend to recommend parents assume a supportive role concerning homework rather than assuming the role of a tutor or instructor (Roderique, et.al., 1994). In fact, studies have shown that parents can have a somewhat negative effect on student achievement when their problem solving strategy differs from what was demonstrated during class instruction (Marzano, et. al, 2001). Often parents are unaware of how best to facilitate homework for their child. For example, parents can lie between two extremes, where they do not help at all or where they go so far as to complete the homework themselves. Students benefit from parent supervision when it clarifies teacher expectations, demonstrates and promotes effective work habits and responds swiftly when the child needs help (Cornu & Zu, 2004).

Unfortunately, parents are often not informed of the ways in which they can help students with homework. Bryan and Burstein (2004) found that about 35% of districts have an established homework policy that is communicated to parents. In general, homework decisions tend to be made by individual teachers’ beliefs. From a survey of 560 elementary and middle school parents, Reetz (1991) found that more than half were concerned about how to establish effective study habits, about a third of the parents were concerned with the actual academic content. Parents also cited difficulty establishing routines as family schedules often interfered.
Hoover-Dempsey and Sandler (1995) claimed that parents become involved when their involvement is requested. Balli, Demo and Wedman (1997 & 1998) investigated a homework intervention designed to increase parent involvement. The study consisted of the use of three groups: one where no prompts were used to involve a family member, one where students were prompted to involve family members, and one where both students and family members were prompted to involve family members. The study found that there were substantially higher levels of involvement in the two prompt groups as compared to the no prompt group. Regrettably, in this study higher levels of family involvement were not correlated with higher achievement results. However, parents who were involved became more aware of the curriculum their children were learning in school. In this way, parent involvement serves as a means of parent-teacher communication.

In a study of at-risk students by Callahan, Rademacher and Hildreth (1998), parents were asked to facilitate self-management strategies at home. Students recorded start and end times, amount of time spent on homework, if homework was completed at the proper time and location with proper materials, and amount of questions correct. Parents then matched the student's answers to their own responses and points were earned. Parents could also award bonus points based on how the student completed various homework tasks. The points were used by students to purchase rewards from an individualized reinforcement menu. This study showed that parent-facilitated self-management strategies improved homework completion rates and accuracy on assignments for at-risk students.
Interactive homework, which requires students to involve others at home, is rarely used. However, there are many types of interactive homework assignments, one of which is Teachers Involve Parents in Schoolwork (TIPS). TIPS assignments are written to encourage conversation with others. For example, a middle school TIPS math assignment may concern the computation of averages. Students may be expected to interview family members to obtain data from which to find the average and then share the results with the family. In TIPS assignments the members interviewed are not expected to teach the skill associated, only to provide data. Due to the nature of TIPS with involvement of another necessary for completion, teachers need to consider the time required. Whereas an individual assignment can be expected to be collected the following class day, TIPS assignments require more time to deal with family schedules. The use of TIPS assignments has been shown to increase parent involvement and to positively influence report card grades. In order for TIPS homework to be effective there needs to be an increased home-school communication as well. There are four required components to TIPS homework assignments. First, TIPS assignments must include a letter to the family that provides the objective of the assignment. Second, specific directions are necessary for both student and family. Third, a section needs to be included for home to school communication. Lastly, TIPS assignments have a two-page limit (Van Voorhis, 2004).

Reinforcement and real-life homework.

A study was conducted to determine the results of using reinforcement and real-life assignments on the effects of homework completion. For three weeks students were
rewarded at the end of the week if all of their homework was completed. For the purpose of the study, all teachers involved agreed upon one reward, namely an extra 20 minutes of recess on Friday afternoons. During the next three weeks, the rewards were stopped and teachers focused on creating real-life homework assignments that related to the in-class area of study. For the final three weeks, both reinforcement and real-life assignments were used. Comparison to baseline data taken showed that both strategies were effective in increasing the homework completion rates of students. These results were seen most significantly in mathematics homework. The prescriptions used in this study were meant to be delivered to the entire class. Some students who had never before completed assignments became actively engaged in the real-life assignments. There were others, however, that remained unresponsive to all efforts. Perhaps, individualization of rewards and assignments would benefit these students (Bryan & Sullivan-Burstein, 1998).

Homework planners.

Homework planners or agendas are used by many school districts in attempts to help students with organization, which would in turn help with the completion of homework assignments. However, simply handing the planner to students and expecting them to use them properly is an ill-advised idea. Teachers and students need to be instructed on their uses. To be most effective, the planners should be used by all teachers on a consistent basis. In one study, teachers were trained on how to use the planners; parents were informed of how the planners would be used and were encouraged to sign their child’s homework. Parents were also encouraged to use the planners to send
messages to their child's teacher. This study found that average achieving students with homework problems showed significant gains in homework completion when using the planners. The planners were especially helpful for students with learning disabilities (Bryan & Sullivan-Burstein, 1998).

*Interspersal technique.*

The interspersal technique is a homework method designed to increase the completion rates of students. In a particular assignment, target questions are interspersed with less challenging questions. The completion of easier interspersed problems can act as a reinforcing event. Students are able to experience success on the easier problems and are then motivated to continue the assignment. The interspersal technique has an affect on students' perceptions of the difficulty, effort, and time required in completing an assignment.

The effects of the interspersal technique have been researched multiple times using similar methodologies. Each reiteration of the experiment produced comparable results. In one such reiteration, students were exposed to two pairs of mathematics assignments, an experimental and a control. The control assignment consisted of 15 three-digit by two-digit multiplication problems. The experimental assignment consisted of 18 similar problems. It also included 6 one-digit by one-digit problems interspersed after every third target problem. In this experiment, students rated the control assignment as being more difficult, requiring more time, and more effort to complete even though it contained less difficult problems than the experimental assignment. More students also chose the experimental assignment as homework, although the difference was not

The interspersal technique can be helpful in improving students' perceptions of assignments and may result in their choice to complete more work. Implementing this strategy in a classroom may be difficult, depending on topic and length of assignment.

Summary

Although the research on homework has produced varying results, homework as an acceptable strategy for improving student achievement has considerable support. There are many reasons given by both teachers and students for assigning and completing homework. Homework can have compensatory effects for students of lower ability. Teachers need to find ways to improve the effectiveness and completion of homework in their classrooms by using a variety of strategies. As teachers can attest, one strategy for all is rarely effective. There are many suggestions given throughout the research including precise directions, feedback, family involvement, reinforcement, real-life assignments and homework planners. Research on homework can be difficult due to the number of variables that can affect student achievement. Due in part to this, there are many areas of homework research that are lacking and require further investigation so that teachers’ decisions can be informed by sound research-based ideas.
Methodology

The purpose of this study was two-part. The first was to determine the attitudes and uses of homework of staff members in the building. The second was to investigate the effectiveness of differentiated homework on improving homework completion rates and assessment scores.

Participants

This study took place at a large, suburban middle school in Western New York State. The school was comprised of grades six through eight and had an enrollment of 852 students. Of these students, 46% qualified for free or reduced lunch. The ethnic representation of the school was 1% Native American or Alaskan Native, 9% African-American, 5% Hispanic or Latino, 2% Asian or Pacific Islander and 82% White. The school employed 78 teachers.

All teachers were invited to participate in the survey about attitudes and uses of homework. The participants for the student-based portion of the study were selected for participation based on their placement in the researcher’s classes. Students were distributed between four classes, of which two were taught with a consultant model with a special education teacher present for all class activities. There were a total of 62 students, of which 27 were females and 35 were males; of those, seven students were classified as receiving special education services. Additionally, eight students have Section 504 plans and five students qualify for ESOL (English speakers of other languages) services.
Instruments and Materials

A survey (see Appendix A) was conducted of all teaching staff to determine the climate of homework in the building where the research was being completed. The survey questioned ideas that were raised by the research. For example, if homework was assigned, was it included as a portion of students’ final grades? Also, were there differences in the opinions and variations of homework across different subject areas?

For the student-based portion, prior to implementation of the unit, a pre-assessment (See Appendix B) and post-assessment (See Appendix E) were developed. A rubric (see Appendix C) was developed to accompany the pre-assessment which arranged the questions from the pre-assessment by the topics that would be taught throughout the unit. Homework (See Appendix D) was differentiated into three levels: red, yellow and green. Red corresponded to a low level of difficulty, yellow to the medium, and green to the high. The use of color to name assignment levels was done in an attempt to remove the negative connotation of receiving a “low” level assignment. The context of homework questions was the same for all three assignment levels. Questions were modified by type: multiple choice questions on the red assignment would have the choices removed for yellow or green. Questions were also modified by changing the numbers involved to increase or decrease the level of difficulty. Most assignments were the same length or within one question of each other to ensure that students did not feel that there was inequity in the assignments.

Data Collection

Surveys were distributed to all staff by placing them in faculty mailboxes. They were returned in the researcher’s mailbox or were turned in personally. The surveys were
immediately placed in a large envelope to help ensure confidentiality. The data from the survey was input into an Excel spreadsheet. The data was sorted by both grade level and subject area.

Homework data was recorded on a paper spreadsheet and then transferred to Microsoft Excel for analysis. Students' homework was coded as a 0, 1, or 2. Students received a 2 if their homework was complete, a 1 if it was partially completed and a 0 if it was not completed. Students’ pre-assessment data was recorded on a rubric and the total score was recorded on the Excel spreadsheet.

**Procedures**

Baseline data for homework completion rates was taken on the unit prior to the research unit. Homework was coded and recorded in the same manner. On the first day of the unit, students were given the pre-assessment to determine the level of difficulty they would be assigned for each homework assignment. Students were given the rubric which displayed the level of homework that they were expected to complete for each topic. The topics included percent representations and percent of a number, application of percents, proportions, map scale and measurement, and unit price and unit rate. There were a few topics which students had no prior experience with and were not included on the pre-assessment. These topics included simple interest, temperature conversion and finding the percent of increase or decrease.

On the top section of the rubric students were leveled low, medium and high so that they would see and understand which topics they struggled with and which ones they excelled at. Students were able to earn five points on the pre-assessment on the topic of percent representation and percent of a number. Students were leveled low if they scored
zero to two points, medium if they scored three to four points and high if they scored five points. Application of percents was scored out of four points. Students were leveled low if they received zero to one point, medium if they received two points and high if they received three to four points. Proportions consisted of three points. Students were leveled low if they scored zero to one point, medium if they scored two points and high if they scored three points. Map scale and measurement, and unit price and unit rate both consisted of five points like percent representation and percent of a number. All three topics were leveled in the same way.

The levels earned on the top section of the rubric were transferred to color assignments for the corresponding homework assignments. For the topics which were not included on the pre-assessment, students’ were leveled based on their overall performance. Students were assigned the color they received most frequently or an average of the colors they received.

As there was not enough time on the first day to complete an analysis of students’ levels, all students were given the same homework. This was not seen as an issue as the assignment was meant to diagnose students’ fluency with rounding, a skill that was required throughout the unit. At the conclusion of each subsequent lesson, students were given the homework assignment that corresponded to their level on that skill. The teacher used a spreadsheet (See Appendix F) which listed all students’ levels on each assignment for ease of distribution. Students were given the option of selecting the next higher degree of difficulty if they felt that they were capable of completing the assignment and were often encouraged by the teacher to do so.
At the beginning of the next class, students’ homework was scored for completion while students worked on their warm-up assignment. Homework keys were posted for each difficulty level and similarities and differences were discussed. Students were expected to self-assess their work, ask for clarification and make corrections accordingly. This process continued throughout the completion of the unit. On the last day, the post-assessment was given.
Results

Survey

In reference to the survey for teaching staff, 30 of 78 teachers responded. Of the respondents, 19 stated that they assigned homework; seven stated that they occasionally or rarely assigned homework; and four stated that they did not assign any homework. The six mathematics teachers who responded all stated that homework was assigned every class and that homework accounted for 20% of the students’ final grade. The five social studies teachers who responded assigned homework once per week and counted homework as 10% of the students’ final grade. The four science teachers stated that they assigned homework three to four times per week and that it accounted for 10% of students’ final grade. Of the four English language arts (ELA) teachers who responded, two stated that they assigned homework three to four times per week. One stated she occasionally assigned homework and the fourth stated that she rarely assigned homework. With the exception of the fourth ELA teacher, homework was included as 10% of the final grade. Of the special area teachers (art, music and physical education) who responded, only physical education stated that homework was assigned. Homework was minimal, one to two times per semester; however, it was included as 10% of students’ final grades.

Teachers approximated the time required to complete homework assignments fell within a range of 10 to 30 minutes. The reasons for assigning homework as well as not assigning homework varied from teacher to teacher. Reasons for assigning homework included: reinforcing and reviewing concepts; completion of activities started in class; launching or expanding on a current lesson; and exploration of curriculum that will not be
covered in class. Other reasons included teaching independent learning skills (reading and vocabulary); and involving parents and guardians in their child's education. Reasons for not assigning homework included: teachers' perceptions of student completion rates (i.e. only the smartest student do their homework; students copy or cheat to complete homework; students do not do homework); teacher wants to monitor progress on long term assignments in class; content area does not lend itself to assigning homework; understanding that time is a limited resource, teacher would rather spend time planning quality lessons or working with small groups of students rather than grading homework; and not assigning homework allows kids to be kids outside the school day.

**Effects of Homework**

All statistical analyses were calculated with an Alpha risk level of 0.05. A paired samples t-test was conducted between the percentage of homework completed during the baseline unit and the percentage of homework completed during the research unit. Since the t critical value is 1.67, the test showed that there was a highly significant difference between the homework percentages, $t(61) = -2.27$, $p < 0.05$. The mean score of homework percentage during baseline unit ($M = 46.08$, $SD = 30.27$) was lower than the mean homework percentage during the research unit ($M = 52.78$, $SD = 28.55$). The null hypothesis that the two units would have the same homework percentages is rejected in favor of the hypothesis that students completed more homework during the research unit.

Students were then sorted into three groups based on the amount of homework they completed. Group one was defined as students who completed little to no homework based on having a homework average, $\bar{x}$ such that $0\% \leq \bar{x} \leq 3\%$. Group
Effectiveness of Homework 29

two was defined as students who completed some homework based on having a homework average, $\bar{x}$ such that $33\frac{1}{3}\% < \bar{x} \leq 66\frac{2}{3}\%$. Group three was defined as students who completed most of the homework based on having a homework average, $\bar{x}$ such that $66\frac{2}{3}\% < \bar{x} \leq 100\%$. Groups one and two both contained 21 students. Group three contained 20 students. A one-way ANOVA (see Table 1) was conducted to determine if there was a difference among the means of the post-assessment scores of the three groups, $f(2,59) = 6.11, p < 0.05$. Since the $f$ critical value is 3.15 the ANOVA reveals that there is a statistically significant difference between at least one of the groups.

The ANOVA shows that there is a statistically significant difference between at least one of the groups, however, it does not show between which two groups this significance exists. The Tukey Test is a post hoc test designed to perform a pair wise comparison of the means which will determine where the significant difference exists. A Tukey test of 95% simultaneous confidence intervals was then conducted to determine between which groups the difference was present. The Tukey test revealed that there was a statistically significant difference between the group that completed little to no homework and the group that completed most of the homework. There was no statistically significant difference between any of the other pairs of groups.
Table 1

ANOVA Summary Table

Summary Table for Analysis of Homework Completion and Assessment Scores

<table>
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<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
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<td>Factor</td>
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<td>7554</td>
<td>3777</td>
<td>6.11</td>
<td>0.004</td>
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<td>36488</td>
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<td>Total</td>
<td>61</td>
<td>44042</td>
<td></td>
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</table>

\[ S = 24.87 \quad R\text{-}Sq = 17.15\% \quad R\text{-}Sq (adj) = 14.34\% \]

Note. ANOVA = analysis of variance.
Discussion and Conclusion

The present studies were designed to investigate the climate of homework created by teachers in the building where the research was conducted and to examine the effectiveness of differentiated homework on increasing homework completion rates and student achievement. In this section, each aspect is summarized and interpreted. Implications and suggestions for future research are discussed.

Survey

The purpose of the survey was to determine the attitudes and uses of homework of staff members in the building. Unfortunately, it is not believed that the survey provided an accurate representation of the climate of homework in the school. Due to the questions in the survey, which focused more on those who assigned homework, teachers who did not assign homework were less likely to respond. However, the survey did provide insights into those who did assign homework and their motivation for doing so.

Trends were seen in frequency and time length of homework assignments within curriculum groups. From the group who responded, mathematics teachers assigned homework most frequently with most stating that homework was assigned on a daily basis. Science teachers were next in terms of frequency of homework assigned. Of the core area subjects, social studies and English language arts teachers assigned homework the least frequently. It is possible that social studies and ELA teachers had not seen significant improvement of student achievement through the completion of homework. This difference may also be due to the nature of math and science content which provides more opportunities for repetition and practice. This is supported by Brookhart’s (1997)
findings that homework assignment and completion had a direct influence on student success in mathematics.

Salend and Schliff (1989) recommended the inclusion of homework as a portion of final grades as one way to communicate to students the importance of its completion. Of the teachers who assigned homework, all but one included homework as a portion of the students' final grades. In fact each curricular area had the same percentage dedicated to homework; mathematics, 20%, physical education, 15% and science, social studies and English language arts, 10%. These similarities across curricular area are a result of grading discussions that occurred as part of staff development the previous school year. Administration required that curricular departments align their grading policies and practices.

Grouping the data across grade level as opposed to curricular area allowed for comparison of the amount of homework assigned to students based on the teachers' approximation of time required to complete assignments. An increase can be seen in the amount of homework assigned as the grade level of students increases. Sixth grade teachers estimate a range of 10 to 20 minutes per assignment whereas eighth grade teachers estimate a range of 20 to 30 minutes per assignment. This is consistent with research findings that state that homework should increase as students' age increases. Cooper, Robinson, and Patall's (2006) synthesis of research supported the finding that the impact of homework is larger in higher grade levels as compared to the lower grades and thus is a necessary part of students' education at those grade levels. It is difficult to determine if the Ten Minute Rule, which is supported by Cooper (2001), is being
followed based on the survey data. This determination is difficult because the school uses block scheduling which does not allow for students to have each core class daily.

Although there are a number of ways in which homework could be differentiated, most respondents who did differentiate homework did so by changing the length of assignments. One teacher responded that they assigned easier reading passages to lower functioning students. Two teachers differentiated in the manner in which students were assessed. The lack of use of differentiation amongst the respondents validated the investigation of the use of differentiated homework by ability.

Upon further examination of the survey used, it could have been designed to elicit more detailed responses in reference to the use of differentiation. Also, the survey was lacking in that it did not question what teachers did with the homework once it was assigned. There was research to suggest that the type of feedback and the manner of assessing homework had an impact on its effectiveness (Brookhart, 1997; Marzano, Pickering & Pollock, 2001)

Effects of Differentiated Homework

The decision to code homework assignments by color was done in an attempt to remove the stigma of being labeled low, medium and high level. However, most students were able to determine which color corresponded to which level. Although it would be more difficult for the teacher to remember, this could be remedied by changing the color code from day to day.

Students were given the option of challenging themselves by taking a higher level homework assignment. Students who exhibited a higher level of understanding at the
completion of a lesson were encouraged to do this by the teacher, however, it was often questioned whether they would receive extra credit. When the response was no, students very rarely attempted the higher assignment. They were a few students who, without teacher prompting, requested a higher assignment because they felt more confident after the lesson was completed.

The paired samples t-test revealed a statistically significant difference in the amount of homework completed in the research unit as compared to the baseline unit. However, there is some doubt as to whether the treatment applied was the reason for the increase. The research unit was on proportional reasoning which is more real-world applicable and understandable to students as compared to the baseline unit which was on monomials and polynomials, a very abstract topic which has little relationship to the students’ real-world. On the other hand, it cannot be discounted that the increase did occur because of the differentiated homework assignments. Findings discussed by Polloway, Foley, and Epstein (1992) stated that students felt the level of difficulty of homework assignments was beyond their ability to complete them. This was supported by the researcher’s observations that some students were more likely to attempt the homework based on their perception that it matched their ability level and therefore, successful completion was attainable. Based on this, the use of differentiated homework may in fact increase homework completion. Since the results of this study are not sufficient to conclude that differentiated homework was the cause of the increase, further study in this area is warranted. One possibility for future research would be to compare completion rates within one unit, where one class would receive differentiated homework and the other would receive non-differentiated homework.
The results of the ANOVA and the Tukey test showed that students who did most of the homework scored significantly higher on the post-assessment than students who did little to no homework. Although, this could have been influenced by other factors such as intellectual ability, it tends to support the claim that increased homework completion has a positive effect on achievement scores. This claim was also supported by a number of other studies (Keith, 1982; Leone and Richards, 1989; Brookhart, 1997; Cooper, Robinson and Patall, 2006).

Improving the achievement of their students should be the goal of all teachers and this study shows that homework is a valid tool in accomplishing this goal. The results of this study support the use of homework as a means of improving students’ assessment scores. The use of differentiated homework as a pedagogical strategy was successful in increasing the homework completion rates of students. However, there was some doubt as to whether the increase in homework completion was due to the differentiated homework or to the difference in the units from which the homework data was collected. Future research is necessary to further validate the findings of this study. One suggestion would be to implement differentiated versus non-differentiated homework within one unit, i.e. having one group assigned differentiated homework and another group assigned non-differentiated homework. Educators should continue to focus on ways to improve the uses and effectiveness of homework within their classrooms to best meet the needs of all students.
References


Appendix A

Teacher Survey

As part of my Masters’ program at St. John Fisher College, I am completing my action research on the uses and effectiveness of homework. I would greatly appreciate your help in some data collection. If you could, please take a few minutes to fill out the following survey and return it to me at your earliest convenience. Any feedback will be kept anonymous and used solely for my thesis.

Thank you in advance,

Heather Allen

1. What subject do you teach?

2. What grade level do you teach?

3. Do you assign homework and why or why not?

4. If yes, how often?

5. On average, how long should your homework assignments take to complete?

6. Do you differentiate your homework assignments? If so, how?

7. What percent of a student’s grade depends on homework?
Appendix B

Pre-assessment

Proportional Reasoning
Pre-Assessment

Name ___________________________

Color ________

Part 1 - Multiple Choice - NO CALCULATOR

1. What is 15% of 40?
   A 25
   B 600
   C 6
   D 4

2. The circle graph below shows the favorite radio stations of the students in Julie's school.

   RADIO STATION SURVEY

   Julie's teacher asks her to estimate what percent of the students chose WXPR. Which best represents the percent of students who chose WXPR?
   A 10%
   B 25%
   C 30%
   D 45%

3. A drawing of the Greensburg Airport uses a scale of 1 centimeter = 300 meters. Runway A is drawn 12 centimeters long. How many meters is the actual length of the runway?
   A 300
   B 360
   C 3,000
   D 3,600
4. A 20-ounce bag of popcorn costs $2.80. If the unit price stays the same, how much does a 35-ounce bag of popcorn cost?

A $3.60  
B $4.00  
C $4.50  
D $4.90

5. To make 3 dozen cookies, a recipe calls for 4 eggs and ½ cup of chocolate chips. Ben wants to make 12 dozen cookies for a class picnic. How many eggs and how many cups of chocolate chips does he need?

A 4 eggs, 1 cup chocolate chips  
B 4 eggs, 2 cups chocolate chips  
C 16 eggs, 1 cup chocolate chips  
D 16 eggs, 2 cups chocolate chips

6. Anneke and her parents had dinner at their favorite restaurant. The dinner bill was $50.00, and her parents tipped their server 20% of the bill. How much money did Anneke's parents leave as a tip?

A $1.00  
B $10.00  
C $20.00  
D $25.00

7. The students in a math class measured and recorded their heights on a chart in the classroom. Keith's height was 1.62 meters. Which is another way to show Keith's height?

A 0.162 cm  
B 16.20 cm  
C 162 cm  
D 1,620 cm
8. Felicia is making a design with shaded and unshaded sections, as shown below.

What fraction of the design is shaded?

*Answer* _______________

On the lines below, explain how you determined your answer.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
9. Chelsea needs 16 ounces of milk for a recipe. She only has a \( \frac{1}{4} \) cup measuring cup. How many times does she need to fill the \( \frac{1}{4} \) cup measuring cup to measure the 16 ounces of milk?

1 cup = 8 fluid ounces

*Show your work.*

Answer \___________\ times

10. The table below shows the prices of three different-sized packages containing the same type of candy.

| CANDY |
|---|---|---|
| Package | Weight (in ounces) | Package Price |
| A | 8 | $1.60 |
| B | 10 | $1.80 |
| C | 12 | $2.04 |

Complete the table to determine which package has the lowest candy price, per ounce.

*Show your work.*

Answer \___________\
11. **Part A** In Randi's school, 5 out of every 7 students ride the bus to school. What percent of students ride the bus? Round your answer to the nearest tenth.

*Show your work.*

*Answer _______%*

**Part B** If there are 350 students in Randi's school, approximately how many students ride the bus?

*Show your work.*

*Answer ___________ students*

12. Ben wants to buy a guitar. The regular price of the guitar is $325. The sale price of the guitar is 25% off of the regular price.

**Part A** What is the sale price of the guitar?

*Show your work.*

*Answer $_________

**Part B** Ben must pay 7.25% sales tax in addition to the sale price of the guitar. What is the total amount Ben must pay for the guitar?

*Show your work.*

*Answer $_________
13.

What value of $x$ would make the two triangles shown below similar?

[not to scale]

>Show your work.
14. Ben is hiking from Mt. Pleasant to Yorkville. He is following the trail shown on the map below.

![Map of Ben's hike from Mt. Pleasant to Yorkville]

The darker section of trail shows how far Ben has hiked, a distance of approximately 4 miles. ESTIMATE how many more miles Ben has to hike to get to Yorkville.

*Estimate* ___________ miles

On the lines below, describe the process you used to determine your estimate.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Appendix C

Pre-assessment rubric

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<tr>
<td></td>
<td>2</td>
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<tr>
<td></td>
<td>8</td>
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<td></td>
<td>11</td>
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<td></td>
<td>7</td>
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<td>Simple Interest, Celsius/Fahrenheit, &amp; Percent of Increase/Decrease</td>
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Appendix D

Differentiated Homework Assignments

Diagnostic Rounding Activity

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<td>Round to the nearest whole</td>
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<td>Round to the nearest hundredth</td>
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Homework - Red

% Representation & % of a Number

Solve the following percent problems. Read carefully!

1. .7 = _____
   a) 7%
   b) 7
   c) 70%
   d) 700%

2. 340% = _____
   a) 34,000
   b) 34
   c) 3.4
   d) 0.34

3. \( \frac{1}{5} \)% = _____
   a) 0.2
   b) 0.02
   c) 0.002
   d) 0.0002

4. \( \frac{1}{3} \) = _____
   a) 33
   b) 0.33
   c) 0.3
   d) \( \frac{33}{3} \)%

5. 24 is what percent of 50?

6. What is 15% of 300?

7. 27 is what percent of 90?

8. What is 8% of 150?
Solve the following percent problems. Read carefully!

1. 0.4% = ______
   a) 0.004
   b) 0.04
   c) 0.4
   d) 4

2. 340% = ______
   a) 34,000
   b) 34
   c) 3.4
   d) 0.34

3. \(\frac{1}{5}\) % = ______
   a) 0.2
   b) 0.02
   c) 0.002
   d) 0.0002

4. \(\frac{1}{200}\) = ______
   a) \(\frac{1}{2}\) %
   b) \(\frac{1}{20}\) %
   c) 0.2%
   d) 0.02%

5. 24 is what percent of 50?
   a) 48
   b) 4%
   c) 0.48
   d) 0.048

6. What is 15% of 300?
   a) 45
   b) 15
   c) 0.15
   d) 0.015

7. 27 is what percent of 90?
   a) 30
   b) 3%
   c) 0.3
   d) 0.03

8. What is 8% of 155?
   a) 12.4
   b) 12.4%
   c) 0.124
   d) 0.0124
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Homework - Green

% Representation & % of a Number

Solve the following percent problems. Read carefully!

1. $0.4\% = \_\_\_
   
   a) 0.004  
   b) 0.04  
   c) 0.4  
   d) 4

2. $\frac{1}{5}\% = \_\_\_
   
   a) 0.2  
   b) 0.02  
   c) 0.002  
   d) 0.0002

3. $4500\% = \_\_\_
   
   a) 45,000  
   b) 4,500  
   c) 450  
   d) 45

4. $\frac{5}{8}\% = \_\_\_
   
   a) 0.00625  
   b) 0.0625  
   c) 0.625  
   d) 62.5

5. $\frac{1}{200} = \_\_\_
   
   a) \frac{1}{2}\%  
   b) \frac{1}{20}\%  
   c) 0.2\%  
   d) 0.02\%

6. 24 is what percent of 50?

7. What is 15\% of 300?

8. 27 is what percent of 81?

9. What is 8\% of 15.50?
1. A television has a regular price of $210. It goes on sale at a 20% discount. What is the amount of the discount?

2. Sylvia hiked a 30-mile trail in 3 days. The first day, she hiked 50% of the total distance. The second day she hiked 10% of the distance that remained. How many miles did she hike the third day?

3. Ms. Praban adds 15% to her dinner bill as a tip. About how much tip would she leave on a $58.34 check?
   - a. $3
   - b. $6
   - c. $9
   - d. $12

4. Michael’s mother wrote a mystery book for a publisher. She receives a 2% commission on gross sales of her book. If gross sales last year were $125,000, how much money did Michael’s mother receive in commission?
1. A television has a regular price of $215. It goes on sale at a 20% discount. What is the amount of the discount?

2. Sylvia hiked a 30-mile trail in 3 days. The first day, she hiked 50% of the total distance. The second day she hiked 20% of the distance that remained. How many miles did she hike the third day?

3. Ms. Praban adds 15% to her dinner bill as a tip. About how much tip would she leave on a $58.34 check?
   a. $3     c. $9
   b. $6     d. $12

4. Michael's mother wrote a mystery book for a publisher. She receives a 2 1/2% commission on gross sales of her book. If gross sales last year were $125,000, how much money did Michael's mother receive in commission?
Homework - Green

Application of Percents

1. A television has a regular price of $215. It goes on sale at a 25% discount. What is the amount of the discount?

2. Sylvia hiked a 30-mile trail in 3 days. The first day, she hiked 50% of the total distance. The second day she hiked 25% of the distance that remained. How many miles did she hike the third day?

3. Ms. Praban adds 15% to her dinner bill as a tip. About how much tip would she leave on a $58.34 check?

4. Michael's mother wrote a mystery book for a publisher. She receives a 2 1/4% commission on gross sales of her book. If gross sales last year were $125,000, how much money did Michael's mother receive in commission?
1. Sam typed 420 words in 10 minutes. If he continues to type at this rate, how many words will he have typed in 3 hours?
   A 756
   B 1,260
   C 2,520
   D 7,560

2. An odometer shows the distance a car has been driven. The odometer does not work correctly on Peter's car, and it registers only 2 miles for every 3 miles it has been driven. If his odometer shows 48 miles, how many miles has the car actually been driven?
   F 16
   G 24
   H 32
   J 72

3. Jenny's Gift Shop sells candles in a variety of packages. The cost per candle is the same in every package. A package of 8 candles costs $14.00. Write a proportion that can be used to determine the cost of a package of 3 candles.

   Solve your proportion to determine the cost of a package of 3 candles. Show your work.

   Answer $ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_
1. Sam typed 420 words in 10 minutes. If he continues to type at this rate, how many words will he have typed in 3 hours?

2. An odometer shows the distance a car has been driven. The odometer does not work correctly on Peter's car, and it registers only 2 miles for every 3 miles it has been driven. If his odometer shows 48 miles, how many miles has the car actually been driven?
   - F 16
   - G 24
   - H 32
   - J 72

3. Jenny's Gift Shop sells candles in a variety of packages. The cost per candle is the same in every package. A package of 8 candles costs $12.96. Write a proportion that can be used to determine the cost of a package of 3 candles.

Solve your proportion to determine the cost of a package of 3 candles.
*Show your work.*

*Answer* $___________
1. Sam typed 420 words in 10 minutes. If he continues to type at this rate, how many words will he have typed in 3 and $\frac{1}{2}$ hours?

2. An odometer shows the distance a car has been driven. The odometer does not work correctly on Peter's car, and it registers only 2 miles for every 3 miles it has been driven. If his odometer shows 48 miles, how many miles has the car actually been driven?

3. Jenny's Gift Shop sells candles in a variety of packages. The cost per candle is the same in every package. A package of 8 candles costs $12.96. Write a proportion that can be used to determine the cost of a package of 3 candles.

Solve your proportion to determine the cost of a package of 3 candles. *Show your work.*

*Answer $\_\_\_\_$*
Homework - Red
Map Scale and Measurement Conversion

1. A drawing of a suspension bridge uses a scale of 1 cm = 200 m. In the scale drawing, one span of the bridge is 6 cm long. What is the actual length of that span of the bridge in meters?

2. Use your ruler to help you solve this problem.

This map shows several locations inside Silver Lake Camp.

a. What is the actual distance from the mess hall to the swimming pool?

b. What is the actual distance from the pool to the lodge?

c. A volleyball court will be built 200 meters from the lodge. How far would the volleyball court be from the lodge on the map?

3. 60 inches = ________ feet

4. 3 miles = ________ feet

5. 124 cm = ______ mm

6. 12 g = ______ mg
1. A drawing of a suspension bridge uses a scale of 1 cm = 200 m. In the scale drawing, one span of the bridge is 6.5 cm long. What is the actual length of that span of the bridge in meters?

2. Use your ruler to help you solve this problem.

This map shows several locations inside Silver Lake Camp.

a. What is the actual distance from the mess hall to the swimming pool?

b. What is the actual distance from the pool to the lodge?

c. A volleyball court will be built 150 meters from the lodge. How far would the volleyball court be from the lodge on the map?

3. 66 inches = __________ feet

4. 3.5 miles = __________ feet

5. 124 cm = _______ mm

6. 12 g = _______ Kg
1. A drawing of a suspension bridge uses a scale of 1 cm = 200 m. In the scale drawing, one span of the bridge is 6.25 cm long. What is the actual length of that span of the bridge in meters?

2. Use your ruler to help you solve this problem.

   This map shows several locations inside Silver Lake Camp.

   a. What is the actual distance from the mess hall to the swimming pool?

   b. What is the actual distance from the pool to the lodge?

   c. A volleyball court will be built 175 meters from the lodge. How far would the volleyball court be from the lodge on the map?

3. 66 inches = _______ feet

4. 3.25 miles = _______ feet

5. 124 cm = _______ m

6. 12 g = _______ Kg
1. Find the better buy based on unit price.
   
   a. A 35-ounce can of Best Brand Plum Tomatoes for $0.69 or a 64-ounce can of Sun Ripe Tomatoes for $1.88.

   b. A can of favorite Dog Food holds 14 oz. Each can is $0.42. The price of a can of Delight Beef Dog Food, containing 12 oz. is $0.58.

2. Tubes of oil paint can be bought in sets of 5 for $13.75 or bought separately for the unit price. What would be the price of 2 tubes of this oil paint?
SHOW ALL WORK!!!!

1. Find the better buy based on unit price.
   
a. A 35-ounce can of Best Brand Plum Tomatoes for $0.69 or a 4-lb. can of Sun Ripe Tomatoes for $1.88.

   b. A can of favorite Dog Food holds 14 oz. Each can is $0.42. The price of a can of Delight Beef Dog Food, containing 12 oz. is $0.58.

2. Tubes of oil paint can be bought in sets of 5 for $13.75 or bought separately for the unit price. What would be the price of 2 tubes of this oil paint?
SHOW ALL WORK!!!

1. Find the better buy based on unit price.

   a. A 35-ounce can of Best Brand Plum Tomatoes for $0.69 or a 4-lb. can of Sun Ripe Tomatoes for $1.88.

   b. A can of favorite Dog Food holds 14 oz. Four cans are $1.00. The price of three cans of Delight Beef Dog Food, each containing 12 oz. is $0.58.

2. Tubes of oil paint can be bought in sets of 5 for $13.75 or bought separately for the unit price. What would be the price of 2 tubes of this oil paint?
1. Find the simple interest earned if $8000 is deposited for 3 years at 5% per year?

2. If Bjorn invests $220 at 3% yearly simple interest for 2 years, how much money will he have after the two years are completed?

3. Jacob is borrowing money to buy a new car. If he borrows $9500 at a 7.5% interest rate for 3 years, how much money will he need to repay at the end of the loan?
1. Find the simple interest earned if $8000 is deposited for 3 years at 5.5% per year?

2. If Bjorn invests $220 at 3% yearly simple interest for 2 years, how much money will he have after the two years are completed?

3. Jacob is borrowing money to buy a new car. If he borrows $9500 at a 7.5% interest rate for 3 and a half years, how much money will he need to repay at the end of the loan?
1. Find the simple interest earned if $8000 is deposited for 3 years at 5.5% per year?

2. If Bjorn invests $220 at 3% yearly simple interest for 3 months, how much money will he have after the two years are completed?

3. Jacob is borrowing money to buy a new car. If he borrows $9500 at a 7.25% interest rate for 3 and a half years, how much money will he need to repay at the end of the loan?
1. John put money into a savings account. He initially deposited $400. After 20 years he had $900 in the bank. What was the percent of increase in his savings?

2. Suppose the average price of a quart of milk at the beginning of the year was $1.50. If the average price decreased by $.12 a quart after 6 months, find the percent of decrease since the beginning of the year.

3. A cell biologist was growing bacteria in a dish. At Hour 1 there were 200 bacteria in the dish, and at Hour 2 there were 500 bacteria. What percent increase occurred between Hour 1 and Hour 2?

4. The population of Buffalo was 300,000 in 1990. In 2000, the population was 320,000. What was the percent of increase in the population?
1. John put money into a savings account. He initially deposited $400. After 20 years he had $900 in the bank. What was the percent of increase in his savings?

2. Suppose the average price of a quart of milk at the beginning of the year was $1.50. If the average price decreased to $1.38 a quart after 6 months, find the percent of decrease since the beginning of the year.

3. A cell biologist was growing bacteria in a dish. At Hour 1 there were 200 bacteria in the dish, and at Hour 2 there were 500 bacteria. What percent increase occurred between Hour 1 and Hour 2?

4. The population of Buffalo was 320,000 in 1990. In 2000, the population was 300,000. What was the percent of decrease in the population?
1. John put money into a savings account. He initially deposited $400. After 20 years he had $900 in the bank. What was the percent of increase in his savings?

2. Suppose the average price of a quart of milk at the beginning of the year was $1.50. If the average price decreased to $1.38 a quart after 6 months, find the percent of decrease since the beginning of the year.

3. A cell biologist was growing bacteria in a dish. At Hour 1 there were 175 bacteria in the dish, and at Hour 2 there were 500 bacteria. What percent increase occurred between Hour 1 and Hour 2 to the nearest percent?

4. The population of Buffalo was 320,000 in 1990. In 2000, the population was 300,000. What was the percent of decrease in the population?
Appendix E

Unit Test and Rubric

Proportional Reasoning
Unit Test

Name______________________________
Color____________________________

Multiple Choice - Write your choice on the line.
NO CALCULATORS ALLOWED.

1. The scale of a map is $\frac{1}{4}$ inch = 12 miles. The distance between two cities on the map is $3\frac{1}{4}$ inches. What is the actual distance, in miles, between the two cities?
   - A 37
   - B 39
   - C 144
   - D 156

2. If the outside temperature is 50 degrees Fahrenheit, what is the outside temperature in degrees Celsius?
   
   \[ C = \frac{5}{9} (F - 32) \]
   
   - F 2
   - G 5
   - H 9
   - J 10
3. Mr. Frank wants to mix yellow paint and blue paint to get 15 ounces of green paint. The shade of green he wants requires 2 parts yellow paint and 3 parts blue paint. How many ounces of yellow paint does he need for his mix?

A 2
B 6
C 9
D 10

4. The students in a math class measured and recorded their heights on a chart in the classroom. Keith’s height was 1.62 meters. Which is another way to show Keith’s height?

F 0.162 cm
G 16.20 cm
H 162 cm
J 1,620 cm

5. Anneke and her parents had dinner at their favorite restaurant. The dinner bill was $50.00, and her parents tipped their server 15% of the bill. How much money did Anneke’s parents leave as a tip?

A $1.00
B $5.00
C $7.50
D $15.00

6. A pair of sandals is on sale for 20% off the original price. If the original price is $16.00, what is the sale price?

F $3.20
G $12.00
H $12.80
J $19.20
7. Joy is taking a trip to Japan. She wants to convert $960 USD into Japanese yen. If $1 USD is equal to 108.199 yen, how much money will Joy have rounded to the nearest whole yen?

Answer _____________ yen

8. Amy is a contestant on the Biggest Loser. Her weight last week was 250 pounds. Her weight this week is 240 pounds. Calculate her percent of weight loss (percent of decrease).

Answer ________________%
9. Bart won $2000 when he was ten years old. Marge made him deposit the money in a savings account which earns 3.5% simple annual interest. He is not allowed to take it out until his 18th birthday. How much total money will be in the account on his 18th birthday?

\[ I = Prt \]

Answer $_____________________

10. Tai went to a shopping mall. He spent $25.75 on a shirt, $15.49 on a hat, and $9.95 on a poster, before tax. Tax was 8.25% on all purchases. What was the total cost of Tai's purchases, including tax?

Answer $_____________________

35. Eliana and her sister are comparing the prices of two brands of cereal. Toasty Oats costs $2.25 for a 15-ounce box. Crunchy Oaties costs $3.90 for a 30-ounce bag.

12. Mary selected some students in her school at random and asked how they got to school each morning. Her results are shown in the table below.

<table>
<thead>
<tr>
<th>Way to School</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride in car</td>
<td>23</td>
</tr>
<tr>
<td>Ride the bus</td>
<td>51</td>
</tr>
<tr>
<td>Walk</td>
<td>18</td>
</tr>
</tbody>
</table>

**Part A**

What percent of the students in the table above ride in a car to school each morning?

*Show your work.*

**Part B**

There are 440 students in Mary’s school. The proportion of students who ride in a car to Mary’s school is equal to the proportion in the table shown above. How many students in Mary’s school ride in a car to school?

*Show your work.*
Proportional Reasoning
Post Assessment

Multiple Choice

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Question</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.M.1 Calculate distance using a map scale</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.M.1 Solve equations/proportions to convert to equivalent measurements within metric and customary measurement systems.</td>
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<td></td>
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<tr>
<td>6.A.5 Solve simple proportions within context</td>
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<td></td>
</tr>
<tr>
<td>8.M.1 Solve equations/proportions to convert to equivalent measurements within metric and customary measurement systems.</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.N.4 Apply percents to: Tax, percent, increase/decrease, simple interest, sale price, commission, interest rates, and gratuities</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.N.4 Apply percents to: Tax, percent, increase/decrease, simple interest, sale price, commission, interest rates, and gratuities</td>
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Extended Response

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<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.M.7 Convert money between different currencies with the use of an exchange rate table and a calculator</td>
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<tr>
<td>8.N.4 Apply percents to: Tax, percent, increase/decrease, simple interest, sale price, commission, interest rates, and gratuities</td>
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<td>8.N.4 Apply percents to: Tax, percent, increase/decrease, simple interest, sale price, commission, interest rates, and gratuities</td>
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<td></td>
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<tr>
<td>8.N.4 Apply percents to: Tax, percent, increase/decrease, simple interest, sale price, commission, interest rates, and gratuities</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.M.5 Calculate unit price using proportions</td>
<td>11</td>
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<tr>
<td>7.M.6 Compare unit prices</td>
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<td></td>
<td></td>
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<tr>
<td>8.N.3 Read, write, and identify percents less than 1% and greater than 100%</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.N.4 Apply percents to: Tax, percent, increase/decrease, simple interest, sale price, commission, interest rates, and gratuities</td>
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</table>

Total: ______ out of 20


Effectiveness of Homework 77

Appendix F

Class Summary Spreadsheet

<table>
<thead>
<tr>
<th>Math 8 Red Class</th>
<th>Percent Representations/Percent of a Number</th>
<th>Application of Percents</th>
<th>Proportion</th>
<th>Map Scale/Measurement</th>
<th>Unit Price</th>
<th>Simple Interest/Temperature Conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student A</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
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<tr>
<td>Student B</td>
<td>Y</td>
<td>G</td>
<td>R</td>
<td>G</td>
<td>Y</td>
<td>G</td>
</tr>
<tr>
<td>Student C</td>
<td>Y</td>
<td>G</td>
<td>R</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Student D</td>
<td>R</td>
<td>R</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>Y</td>
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<tr>
<td>Student E</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>Y</td>
<td>R</td>
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<tr>
<td>Student F</td>
<td>Y</td>
<td>Y</td>
<td>G</td>
<td>R</td>
<td>Y</td>
<td>Y</td>
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<td>Student G</td>
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<td>R</td>
<td>R</td>
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<td>Y</td>
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<td>Student H</td>
<td>R</td>
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<td>R</td>
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</tr>
<tr>
<td>Student I</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>G</td>
<td>Y</td>
<td>R</td>
</tr>
</tbody>
</table>