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Effects of TIPS Homework on Student Learning

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EFFECTS OF TIPS HOMEWORK ON STUDENT LEARNING

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Abstract

Homework is a teaching tool used to facilitate student learning outside of the classroom. The purpose of this study was to observe if parental homework involvement increased homework effectiveness. By soliciting parental involvement using Teachers Involve Parents in Schoolwork (TIPS) assignments, the study implemented an experimental quantitative design with pre and posttests to measure differences in student learning. Convenience sampling was used to select two random class periods, each with 28 students. One period acted as the control group; whereas, the other served as the intervention group. The intervention group received TIPS homework; whereas, the control group received non-TIPS homework. Data was gathered across a three week study. Independent and paired samples t-tests were conducted to determine if there were statistically significant differences between the means of both groups. Both groups showed an increase in average quiz scores from pretest to posttest; however, the control group had greater and statistically significant growth which rejects the hypothesis that using TIPS homework improved students' comprehension above and beyond their normal instruction. Such findings go against much of the available research. As a result, further research is recommended. Possible factors negatively impacting results include: small sample size and difficulty in soliciting homework completion and turn in.

Keywords: homework, TIPS (Teachers Involve Parents in Schoolwork), quantitative

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Investigating the Effects of TIPS Homework on Student Learning and Skills Acquisition

Literature Review

Homework is a teacher provided task designed to be completed after school (Keith, Diamond-Hallam, & Fine, 2004). Although there are many common uses for homework, teachers most often assign homework for instructional purposes, using assignments as a means of reviewing and reinforcing concepts learned in the classroom (Corno, 1996; Voorhis 2004). Homework can also be used as a form of home communication, helping to involve and inform family members of students' learning and progress. Less encouraged is the use of homework to fulfill political agendas such as to satisfy school policy, meet public expectations of rigor, and/or serve as a form of punishment for misbehaving students (Voorhis, 2004). Any combination of such motives may be why some teachers feel homework is a vital educational tool.

Attitudes about homework. Today, homework seems to be a staple of the American educational system; however, the usefulness of homework has long been a topic of debate. In early 1900s, homework was valued as an effective learning tool; however, between 1900-1950, Americans experienced a shift in homework sentiment (Cooper, 1989). Some teachers, parents, and experts called into question the effectiveness of homework in furthering learning (Cooper, 1989). They characterized homework as a stress inducing detriment to children, imparting little educational gains as reflected in standardize test scores and/or grade point averages (Cooper, 1989; Gill & Schlossman, 2004). Later in the 1980s, homework regained public favor upon the implementation of new state content standards and achievement testing (Cooper, 1989). Currently, doubts about homework still linger inspiring researchers to investigate the factors that may contribute to effective and ineffective homework implementation.

Homework prevalence. A 2007 survey of teachers from 1000 public schools found 81% - 91% of parents and teachers believed homework was important and helpful towards learning; however, 23% of students, 19% of parents, and 16% of teachers believed homework was unimportant (Markow, Kim, & Liebman, 2007). In a similar study, 26% of students, 24% of teachers, and 40% of parents reported having felt that, at least some homework, was busywork and therefore held little educational merit (Voorhis, 2011). Nonetheless, as of 2011, according to the National Center for Educational Statistics, United States high school students spent an average of 6.3-18.3 hours a week completing homework assignments. Students are being held accountable for more homework than previous generations (Voorhis, 2004); however, it is still unknown if homework is effective and, if it is, what types of homework leads to greater success.

Homework effectiveness. In a study examining the transcript grades and achievement test scores of high school math and science students, researchers discovered that the amount of time spent doing homework positively correlated with higher standardized test scores; however, had little impact on transcript grades (Maltese, Tai, & Fan, 2012). In other words, homework resulted in better performance on achievement tests but had no influence on classroom performance suggesting homework does not guarantee success in all academic measures. In addition, researchers discovered that spending more than two hours completing nightly homework led to lower grades; equal to students who did not complete homework (Maltese et al., 2012). These results reaffirmed Cooper's (1989) synthesis of existing studies on the effects of homework on student learning. After analyzing fifty classroom studies, Cooper found 43 positive correlations between homework and student performance (1989). He discovered that between one and two hours of nightly homework at the middle and high school levels resulted in higher grade point averages (GPAs); however, homework at the elementary level had little to no effect (Cooper, 1989). This suggests that older students can benefit more from moderate levels of homework.

Considering student age and homework quantity are factors in homework effectiveness, researchers sought to determine how the at-home aspect of homework might influence student success differently than work done in the classroom. Specifically, researchers investigated if differences between the home and school setting contributed to differences in student learning outcomes. First, a longitudinal study of high school students by Keith and colleagues (2004), showed that students doing work at-home had better grades than students doing the same work in school. This suggests that the home may have an impact on student performance. Researchers hypothesized that homework, if done at home, allowed students to benefit from the guidance, support, and supervision of their family members (Keith et al., 2004). In addition, the quality, quantity, and type of homework, combined with family support, can influence student learning (Gonida & Cortina, 2014). Finally, the psychological influence of the home environment impacts homework effectiveness (Paschal, Weinstein, & Walberg, 1984) and parental guidance during homework can positively affect academic achievement (Epstein, 1992). In other words, family participation can be seen as a tool to increase the learning potential behind homework assignments.

A style of parental homework involvement, known as autonomy support, showed the greatest impact on student grades (Gonida & Cortina, 2014; O’Sullivan, Chen, & Fish, 2014). Autonomy support is defined as tasks that allow students to take ownership and control of their work, where family members are present as an audience but are not expected to possess content expertise (Epstein, 1992). For example, a student’s homework may be to describe to family members what they learned in school. The family's job will be to listen and ask attentive questions. Researchers, upon surveying 282 elementary and middle school students, found that children who had parental autonomy support homework had a greater improvement in class grades than those who did not (Gonida & Cortina, 2014). In a separate study done by Fehrmann, Keith, and Reimers (1987), 58,728 high schoolers were sampled and surveyed for family background, gender, ability, homework, TV time, and grades. An analysis of the data showed students who experienced parental autonomy support also had better grades (Fehrmann et al., 1987). The study further reinforces the idea that family involvement is a resource for student learning. Although there are different approaches to involving parents in school assignments, one approach is called TIPS.

Teachers Involve Parents in Schoolwork. Teachers Involve Parents in Schoolwork (TIPS) interactive homework may be an effective and novel approach to homework. This approach uses interactive assignments designed to meld at-home collaboration with school learning. TIPS homework solicits parent involvement (Epstein, 1992) and has been linked to increases in students' content memory and retention (Epstein & Dauber, 1989). According to Epstein (1992), TIPS are brief assignments requiring parental participation to complete; and, they can facilitate the strengthening of the school-home partnership, often resulting in an improvement in student academic outcomes (Trahan & Lawler-Prince, 1999). As a result, TIPS implementation may be a useful tool in unlocking student learning potential.

In a study by Voorhis (2011), researchers found upon administering TIPS and non-TIPS homework to sixth and eighth grades science students that TIPS homework participants reported higher report card grades and frequency of homework completion than non-TIPS students. Consequently, the most effective types of TIPS interactive homework assignments are short and easy to implement activities that require little content or background knowledge from the parent

(Balli, Demo, & Wedman, 1998; O'Sullivan et al., 2014). In other words, the student takes charge of the task and the parent is present as a helper. For example, an effective TIPS activity may require a child paraphrase their classwork to a family member. That is to say, the student becomes the speaker while the parent acts as a listener. This dynamic requires the student to think, synthesize, and share their learning with others and enables the parent to gain a better understanding of their child's educational development without fearing a lack of content knowledge (Epstein, 1992).

In addition to brevity and supportive parental expectations, effective TIPS homework often contains parent response components. In a study by Balli and colleagues (1998), researchers found that explicit family prompts incorporated into TIPS homework assignments lead to increases in parent involvement regardless of parents' academic and socioeconomic background. Family prompts are TIPS homework questions that solicit parent feedback and signatures as proof of parent participation. Researchers observed middle school math students given TIPS with pretest and posttest assessments and found that students given homework with family prompts scored the highest on achievement tests compared to TIPS students without family prompts. Further, both types of TIPS groups score higher than non-TIPS students. Despite the differences in pre- and post-tests scores, researchers deemed the results to be inconclusive because the differences were slight due to the small sample size. Further investigations were recommended; however, a synthesis of other related studies supported the notion that brevity and family involvement were the greatest predictors of academic success (Balli et al., 1998; Cooper, 1989). In other words, TIPS homework worked best when the tasks were short and parents and students were explicitly addressed within the homework assignment.

The purpose of this study was to determine if parent-assisted homework (i.e., when homework requires both parent and student collaboration to complete) could be a useful learning tool. This study sought to evaluate the influence of TIPS parent autonomy support homework on chemistry students' mathematical skills development in an attempt to shed light on how such student-parent homework might impact students' test scores. Since it could not be assumed that all students have parental support at home, the study allowed students to substitute parents for an alternate TIPS Partner, which included third party individuals such as other adults, friends, and/or fellow classmates (Epstein, 1992). Although there is a lack of research regarding the effects of TIPS parental substitution on student performance, it can be assumed that TIPS encourages a collaborative learning experience. The substitution maintains a partner learning environment where the child continues to play the role of teacher; whereas, the TIPS Partner will play the role of student. The child's task remains unchanged and he/she will be asked to disclose parental substitutions for later analysis.

Methods

Research Question

Does using TIPS homework assignments influence high school students' chemistry competency as assessed by weekly quizzes?

Hypothesis

TIPS homework would result in an increase in students' competency as assessed by weekly content and skills based quiz scores (Balli et al., 1998; Epstein, 1992; Voorhis, 2003).

Research Design

The study was an experimental quantitative design that included pretest and posttest assessments. There were two groups, a treatment and a control group, assessed using the same measures. Additionally, the treatment group received the TIPS intervention, while the control group completed non-TIPS homework (Voorhis, 2003).

Independent variable. The independent variable was the presence/absence of TIPS homework assignments. One treatment group of students was asked to submit homework completed with the help of a TIPS Partner (e.g., parents, classmates, friends, or family). A second group of students acted as the control and completed non-TIPS homework (Voorhis, 2003).

Dependent variable. Students' performance on weekly multiple choice quizzes served as the dependent variable. Pretest and Posttest questions were derived from the textbook, *Glencoe Chemistry: Matter and Change, 2nd edition* (2005) and textbook aligned student notebook. Students were assessed on their conceptual and algebraic comprehension of scientific notation in the presence/absence of TIPS homework assignments. Tests were scored using a textbook provided answer key (Dingrado et al., 2005).

Setting & Participants

The study took place in a Title I high school located in an agricultural community in Central California. The city itself had a population of about 160,000 residents, 75% of whom were of Hispanic descent. Median income was just under $60,000 per year. Approximately 20.5% of families lived in poverty and an estimated 12.5% were undocumented immigrants. The school district consisted of four high schools, each with an estimated 2,500 students ("Population Estimates," 2015)

In the focus school, 66% of students were Hispanic, 49.3% were considered economically disadvantaged and 15.9% were classified English Language Learners (ELLs). Average science classroom size ranged between 23-32 students. After four years, 51% of ELLs did not complete the necessary coursework to graduate. This was above the California state average of 49% (School Accountability Report, 2015).

Sample. Convenience sampling was used to select two college preparatory chemistry classes for the experimental study. The researcher selected classes containing students with similar academic profiles. One class was randomly chosen to serve as a control group; whereas, the other served as a treatment group (Voorhis, 2003). The total participants were 53 high school chemistry students.

Treatment group. The treatment group consisted of 28 students, 57% female and 43% male. Students differed in grade levels: 87.5% were sophomores, 11.5% were juniors. The classroom was 23% Caucasian and 77% Hispanic. There were no ELLs or students with 504 plans. There was one student with an Individualized Educational Program (IEP). The student was diagnosed with Aspergers Syndrome and required preferential seating and extended testing time.

Control group. The control group consisted of 28 Students, 62% female and 38% male. This class had students of different grade levels: 59.2% sophomore, 33.3% junior, and 7.4% senior. Ethnicity was collected for this group as well: 11.5% were Caucasian and 88.5% Hispanic. There were no ELLs, students with special accommodations (504), or IEPs.

Measures

There were three tests used to measure student learning that spanned one chemistry unit. There was a pretest and posttest to assess student learning before, during, and after TIPS homework implementation. The two tests (see Appendix A) were the same and came directly from the Chapter 2 Assessment and Standardized Test Practice section of the textbook (Glencoe, 2005). The unit assessed students' understanding of scientific notation. For example, students were asked to convert 3500 to scientific notation, $3.5x10^3$ and vice versa. The tests consisted of 16 free answer questions, each worth 1 point with a total 16 points possible per test, and graded using a textbook provided answer key. Each question had only one correct answer and no partial credit was given. Homework and sample questions were derived from chapter practice problems and assessments. Students were given 15 minutes for each assessment.

Validity. To ensure validity was established, textbook derived pretest and posttests were used to measure student learning (Voorhis, 2003). These were valid California state approved measures designed by experts to meet state standards and textbook content objectives.

Reliability. To establish reliability, 12 (22%) of each of pretest and posttests were graded by the primary researcher and another teacher to ensure Inter-Rater Reliability. Using a textbook provided answer key, the study looked for 80% agreement for 20% of the tests. Due to the free response format of the tests, no partial credit was awarded (see Appendix B).

Intervention

There were two groups, intervention and control in the study. Each were provided with identical homework assignments created using Esptein's School, Family, and Community Partnerships Handbook for Action (Epstein, 1992); however, the intervention homework possessed a parent accountability component (see Appendix C). All homework assignments included multiple practice problems; however, the TIPS homework asked students to share and describe chemistry concepts to a TIPS Partner. TIPS Partners were later asked to share their reactions and comments (see Appendix C) about the material and provide a signature verifying collaboration (Balli et al., 1998).

Procedures

The following procedure has been adapted from the TIPS curriculum (Balli et al., 1998; Burgess, 2001; Epstein, 1992; Voorhis, 2003). First, both the control and intervention groups were given a pretest to assess their existing level of knowledge and performance on a Monday before intervention. On the same day, following the administration of the pretest, a letter was sent home informing TIPS students and their TIPS Partners of their respective roles (see Appendix D).

Then a TIPS homework assignment (see Appendix C) was assigned to the intervention group on the subsequent Monday and collected on Wednesday of the same week. Each TIPS homework assignment started by asking students to explain a pre-done example problem to their self-chosen TIPS Partner. Guiding questions and statements were provided to help students through the process. Afterwards, students were asked to solve sample problems with their TIPS Partner, asking them to comment on the activity and provide a signature as proof of participation. The TIPS homework was designed so that the TIPS Partner needed only minimal content knowledge to participate in the assignment. Once returned to the teacher, the TIPS homework was evaluated for completion. Another TIPS homework was assigned the next Monday followed by collection and a posttest. The assessments (pretest and posttest) was administered using pencil and paper. Students were allowed 15 minutes to complete each assessment.

The control group was given the exact same homework and testing schedule (see Appendix E). The control group homework contained the same example and sample problems used in the intervention; however, students were not asked to solicit the help and cooperation of a TIPS Partner. Control group students were neither encouraged nor discouraged from collaborating with outsiders; however, as a reliability measure, students were asked to disclose whether they received help. TIPS and non-TIPS homework were assigned no more than two times a week in congruity with current classroom homework routines.

Data collection. Data were collected in the form of completed homework assignments and weekly textbook based assessments (pretest and posttest) and took place across a three week period. The homework assignments were graded on a complete/incomplete basis. The quizzes were free answer and graded on an sixteen point scale with each correct answer worth one point (Balli et al., 1998). Using pretest scores as a baseline, the data were analyzed to determine the correlation between TIPS and non-TIPS homework on students' posttest scores.

Fidelity. Fidelity was established through a variety of ways. First, a letter was sent home prior to experimentation to inform families of their roles (Voorhis, 2003). As a result, families were made aware of their responsibilities and were better able to cooperate and participate in TIPS assignments. Next, the TIPS Partners were asked to sign each homework assignment to ensure TIPS collaboration had indeed taken place (Balli et al, 1998). Third, homework was assigned once or twice a week in congruity with current classroom routines. Maintaining class protocol by adhering to the existing homework schedule allowed students and their TIPS Partners to better acclimate to the TIPS style of homework. Changing the homework frequency would likely create discourse in the learning environment and introduce extraneous elements into the study. Homework assignments were graded for completion and parent involvement. The focus was not centered on homework correctness. Since homework was given as an exercise, mistakes were considered part of the learning process. Students were not named and retained complete anonymity. Both groups received the same pretests, posttests, and homework problems; however, the control group lacked a parent contribution component (Balli et al., 1998). The control group was also asked to disclose if they received help from another individual to complete their non-TIPS assignment. This was to ensure that assessment data were properly categorized to their respective homework types.

Ethical Considerations

Student names were not used and all data was confidential. This maintained the safety and privacy of those involved. No students, parents, or teachers were harmed.

Validity threats. There was no researcher bias. There was no presumption on the effectiveness of TIPS or non-TIPS homework assignments on student performance. Although both students and parents were informed of TIPS assignments, they were not made aware of the experiment itself. This protected against the Hawthorne effect where participant behaviors may be altered due to the awareness of being studied (Adair, 1984).

Other threats to validity included dishonesty from TIPS Partners and/or students. Both parties may have falsely claimed to have participated fully in the TIPS homework. Students may also have failed to complete and submit their homework assignments. To protect against this, TIPS Partners were asked to comment and sign student's TIPS homework. In addition, homework participation points were given to on time submissions of completed assignments as a means to encourage timely homework turn in.

Data Analyses

All data were entered into the Statistical Package for the Social Sciences ® (SPPS®) for Windows, version 24.0.0 (SPSS, 2016). No names or identifying information were included in the data analysis. Before analyses were conducted all data were cleaned to ensure no outliers were present (Dimitrov, 2012). After cleaning the data, the final sample size was 28 participants for the treatment group and 28 participants for the control group. Initially, a one-way ANOVA was conducted to determine if there were statistically significant differences between the two groups across the three time points: pre, mid, and post assessment. However, the study did not have enough power to conduct such an analysis and therefore t-tests were conducted on the pre and post assessments. Therefore, Independent (control and treatment groups) and paired (pre test and post test) sample t-tests were conducted to determine the significant difference in scores on chapter tests derived from the textbook, Glencoe Chemistry: Matter and Change, 2nd edition (2005) and associated student notebook. Further, before interpreting the analytical output, Levene's Homogeneity of Variance was examined to see if the assumption of equivalence had been violated (Levene, 1960). Levene’s Homogeneity of Variance was violated, therefore, the variances were not equal across groups and the corrected output was used for interpretation.

Results

Two independent samples t-tests were conducted on the whole sample ($n = 58$) for both the pre and post assessment scores. Results for the pre-test were Levene's Homogeneity of Variance was violated ($p < .05$) meaning the variance between groups was statistically different and the second line of data were used to account for the difference in variance. The t-test showed non-significant differences between the mean scores on the pre-tests between the two groups $t(48.60) = -.55$, $p > .05$. This means the null hypothesis can be accepted and there is no significant difference between the means on the pretest for both the control and treatment groups; therefore, comparison between the groups is acceptable (see Table 1).

Results for the post-test were: Levene's Homogeneity of Variance was not violated ($p > .05$) meaning the variance between groups was not statistically different and no correction was needed. The t-test showed no statistically significant difference: $t(51) = 1.05$, $p > .05$, between the treatment and control groups on the posttest. This means the null hypothesis is accepted and there is no significant difference between means on the posttest for each group (see Table 1).

Although the t-test did not show statistically significant difference in posstest scores, the control group (*M* = 12.07, *SD* = 6.41) scored higher than the treatment group (*M* = 10.12, *SD* = 7.19), therefore the students who received non TIPS homework scored higher than the students who had TIPS homework. Therefore, the original hypothesis that TIPS homework would increase student's competency was rejected as the findings show that the control group scored higher than the treatment group, indicating that the intervention was not successful.

Table 1

Results of Independent Samples T-Tests

	Mean	SD
Pre Test		
Treatment	8.96	8.87
Control	8.00	5.70
Post Test		
Treatment	10.12	7.19
Control	12.07	6.41

Note. SD = Standard Deviation.

After determining the differences between pre and post assessment scores between groups, two paired t-tests were run for both groups (i.e., treatment and control) to determine if participants mean scores from pre to post were significantly different within each group (see Table 2). Results for each group were as follows: treatment group, $t(26) = -1.17$, $p > .05$; control group, $t(27) = -2.99$, $p < .05$; meaning that the control group showed a statistically significant difference in mean scores from the pre to the posttest, however the treatment group did not. Additionally, the negative t-value for each group indicates an increase in scores from pre to post assessment. Therefore, both groups learned and increased their competencies from pretest to posttest; however, the control group had greater and statistically significant growth which rejects the hypothesis that using TIPS homework improved students' comprehension above and beyond their normal instruction.

Table 2

Results of Paired T-Tests

	Mean	SD
Treatment Group		
Pre	8.96	6.87
Post	10.12	6.41
Control Group		
Pre	8.00	5.70
Post	12.07	7.19

Note. SD = Standard Deviation.

Discussion

The purpose of the study was to determine if parental involvement influenced the effectiveness of homework as a learning tool. According to findings by Epstein and Dauber (1989) and Fehrmann and colleagues (1987), parental homework participation positively correlated with student academic performance. Using a quantitative experimental approach, comparing pre and post test scores between control and intervention groups, this study sought to observe the impact of parent homework support upon student learning. Using convenience sampling, two classes, each containing 28 students, were randomly selected to act as the intervention and control groups. The intervention group was administered TIPS homework assignments which solicited parent participation; whereas, the control group was given a non-TIPS assignment. The pre and post test results of both groups were compared across a three week intervention period.

According to the data, both the TIPS intervention and non-TIPS control groups showed an increase in test scores between the pretest and posttest; however, the control group experienced greater score improvements suggesting parental involvement had either a negative or null effect on student learning through homework. These findings are contrary to all examined studies done in the field with students between elementary and high school grade levels (Fehrmann et al., 1987; Gonida et al., 2014; Maltese et al., 2012; O'Sullivan et al., 2014). The difference in findings suggest results may be erroneous and repeat testing may be needed.

Certain extraneous factors and limitations may have contributed to any uncertainties in the data. First, students were given 15 minutes to complete all pre and post tests. The time limit may have created a stressful testing environment, impacting student scores. Second, cheating may have occurred during the testing period. Although students were given privacy shields to conceal their work, cheating may have taken place outside of ability of the teacher to monitor or control. Third, students were given a week to complete the TIPS and non-TIPS homework assignments. As a result, some students completed their assignments on the first day; whereas, other students completed their assignment on the last day. The large time span may have caused some students to forget the tested concepts. Fourth, homework collection was also a challenge. Although a clear timeline and grade points were given to encourage timely submission, many students needed constant reminders and extended submission time. This added days to the period before the posttest. Fifth, using convenience sampling to select a small group of students for testing may also have contributed to experimental errors. In the future, selecting a larger sample group may help dampen the effects of the before mentioned extraneous factors. Finally, although students in the intervention group were required to seek parental help and provide parent signatures as proof of participation, students may have been dishonest and forged the signatures. Parents may also have signed TIPS homework assignments without fully participating in their child's homework.

In order to not replicate limitations in this study, future studies should look to the following suggestions. One, future direction may include repeating the same experiment with a larger sample. By increasing the number of participants, the effects of extraneous factors may be minimized due to the increased ratio of compliant subjects. Second, extending the length of the study may also be vital in allowing students and TIPS partners the time to acclimate to assignment expectations. In addition, extending the current three week intervention window will allow researchers to modify and refine their TIPS activity accordingly, tailored to the practical needs of implementation such as assignment length, question style, parent feedback, and developing incentives to maximize student participation.

Summary

Homework is a prominent learning tool in education. For decades, its effectiveness has been a contentious topic of debate amongst researchers, students, parents, and teachers (Cooper, 1989). In lieu of homework's controversial nature and dominance in today's educational system, it is important to investigate and identify the factors that make homework effective. Parent involvement is one such factor that has been shown in previous studies to improve student performance (Fehrmann et al., 1987; Gonida et al., 2014; Maltese et al., 2012; O'Sullivan et al., 2014)). As a result, studies that seek to clarify this relationship are vital in helping teachers create assignments that can one day maximize homework's teaching potential. Given the results of the current study, it appears that parent homework involvement is a complex expectation that requires committed participation between teachers, students, and families. Their feelings and attitudes towards TIPS and non-TIPS homework should be considered in conjunction with pretest and posttest data in an effort to discern any correlations between participant buy-in, compliance, homework success, and test scores.

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Appendix A

Pretest and Posttest

Name: __________________ Date: ___________________________ Period: ___________

Express the following quantities in scientific notation

1) 700m:
2) 38 000 m:
3) 4 500 000 m:
4) 685 000 000 000 m:
5) 0.0054 kg:
6) 0.000 006 87 kg:
7) 0.000 000 076 kg:
8) 0.000 000 000 8 kg:

Express the following quantities in ordinary (standard) notation.

9) 8.348×10^{6} km:
10) 3.402×10^{3} g:
11) 7.6352×10^{-3} kg:
12) 3.02×10^{-5} km:
13) 1.1×10^{-6} mL:
14) 8.54×10^{-3} mL:
15) 7.31×10^{4} mL:
16) 4.8×10^{5} km:

Appendix B

Fidelity Checklist

Date	Treatment Or Control	Parent Letter and Signatures	Parent Involvement HW #1	Parent Involvement HW #2	Pre	Post	Initials

Appendix C

Intervention TIPS Homework Assignment

SCIENTIFIC NOTATION TIPS HOMEWORK

Dear __________________________________(Family Partner)
In chemistry, we are reviewing how to convert between scientific and standard notation. This assignment is due ________.

Sincerely,

____
Student signature

<u>PART #1:</u> LOOK THIS OVER: Read and explain the following to your family partner.

In science, I am often asked to handle very long numbers. These numbers can represent very small (**example:** 0.0000001) or very large (**example:** 1200000000) quantities. I am going to teach you an **easy way** to write long numbers using a **shorthand** called **scientific notation**.

In other words, I am going to talk about how to convert standard numbers **(1200000)** into scientific notation **(1.2×10^6)**. Although written differently, they mean the **same** thing.

<u>Let's begin by examining LONG and LARGE numbers (greater than 1):</u>

1) Given a large (LONG) number greater than 1 such as **1200000**, point to where the decimal is **<u>now</u>!**

1200000. ←

2) Move the decimal until the number is between **1-10 (not including 10).**

1.200000

3) Drop the ending and/or beginning zeros (keep any middle zeros)

1.2

4) You started with **1200000** and ended up with **1.2** Since my number **got smaller**, I will make sure my **exponent is positive**. I moved the decimal 6 spaces to the left; therefore, raise **x10** to the power of **+6**.

1.2×10^6 is equal to 1200000

5) If my number got bigger, I will make sure my exponent is negative. The exponent will still represent the number of decimal places moved.

TIPS PARTNER Questions/Comments:

____

<u>NOW TRY THIS:</u> show your family partner how you did this example:

PROBLEM #1:

1) Given a large number **(greater than 1)** such as point to where the decimal is **<u>now</u>!** **48072000**
2) Move the decimal until the number is between **1-10 (not including 10).**
3) Drop the ending and/or beginning zeros (keep any middle zeros)
4) You started at __________ and ended up with _____________. If your number got smaller, make sure your exponent is positive.

Raise $x10^{\text{NUMBER OF DECIMAL PLACES MOVED TO THE LEFT OR RIGHT}}$

TIPS PARTNER: CHECK YOUR ANSWER: 4.8072×10^7. Do you feel the student has mastered the concept? What mistakes did they make?

____

<u>PRACTICE SECTION:</u> Complete these examples on your own. Convert the bolded numbers into scientific notation.

The closest star from our sun, Proxima Centauri, is **24690000000000** (Sci notation: _____________) miles away.
If you were traveling at a speed of **150000** miles/hour (Sci notation: _______________), it would take you **17900** years (Sci notation: ______________________) to reach this star.
Light travels much faster at a speed of **671000000** miles/hour (Sci notation: _________) and can reach Proxima Centauri in 4.2 years.

Check Your Answers: $\mathbf{2.469 \times 10^{13}}$; $\mathbf{1.5 \times 10^{5}}$; $\mathbf{1.79 \times 10^{4}}$; $\mathbf{6.71 \times 10^{8}}$

<u>PART #2:</u> LOOK THIS OVER: Read and explain the following to your family partner.

NOW THAT YOU UNDERSTAND HOW TO WRITE LARGE NUMBERS IN SCIENTIFIC NOTATION, LET'S TRY SMALLER NUMBERS.

Let's continue by examining LONG and small numbers (less than 1):

1) Given a small (LONG) number less than 1 such as **0.00000001020**, point to where the decimal is **<u>now</u>!**

0.00000001020

2) Move the decimal until the number is between **1-10 (not including 10).**

1.020

3) Drop the ending and/or beginning zeros (keep any middle zeros)

1.02

4) You started with **0.00000001020** and ended up with **1.02** Since my number **got LARGER,** I will make sure my **exponent is negative**. I moved the decimal 8 spaces to the right; therefore, raise **x10** to the power of **-8.**

1.02×10^{-8} is equal to 0.00000001020

TIPS PARTNER Questions/Comments:

____

NOW TRY THIS: show your family partner how you did this example:

PROBLEM #1:

5) Given a small number (**greater than 1**) such as point to where the decimal is **now!**
0.00290

6) Move the decimal until the number is between **1-10 (not including 10).**

7) Drop the ending and/or beginning zeros (keep any middle zeros)

8) You started at __________ and ended up with _____________. If your number **got bigger**, make sure your **exponent is negative**.

Raise $x10^{\text{NUMBER OF DECIMAL PLACES MOVED TO THE RIGHT}}$

TIPS PARTNER: CHECK YOUR ANSWER: 2.9×10^{-3}. Do you feel the student has mastered the concept? What mistakes did they make?

____

____

PRACTICE SECTION: Complete these examples on your own. Convert the bolded numbers into scientific notation.

Assuming a cell density of 1.03 g/ml, the cell would weigh **0.0000000035** grams (Sci notation: _____________). Since protein accounts for approximately 20 percent of a cell's weight, the total weight of cellular protein is **0.0000000007** grams (Sci notation: _____________).

Check Your Answers: 3.5×10^{-9}; 7.01×10^{-10}

WITH YOUR TIPS PARTNER - LIST 5 EXAMPLES OF HOW SCIENTIFIC NOTATION MIGHT BE USEFUL IN YOUR LIFE.

Dear Parent/Family Partner,

Please give your reactions to your child's work on this activity.
*Write **YES** or **NO** for each statement.*

___________ *My child understood the homework and was able to complete it.*
____________*My child and I enjoyed the activity.*
____________*My child needs further practice.*

Any other comments:
____

Family Partner Signature:
____

THANK YOU FOR YOUR PARTICIPATION

Appendix D

Letter Sent Home to Parents

Teachers Involve Parents in Schoolwork
A GRADED ASSIGNMENT - PARTICIPATION Dear Parents/Guardians/TIPS Partners,

Research shows that family involvement improves student achievement. In other words, when families and students collaborate on class assignments, students do better in school. As a result, your child's chemistry class will be participating in a four week homework program known as **TIPS** (Teachers Involve Parents in Schoolwork). Your child will be receiving homework assignments designed to encourage collaboration between you and your child. We value your support, participation, and feedback.

Please see below for a list of student and parent/guardian/TIPS Partner responsibilities:

What the <u>student</u> does:

1) Looks over the TIPS homework assignment. Asks the teacher any questions about procedures and directions that are not clear.
2) Takes the TIPS assignment home, shows it to a parent/guardian/TIPS Partner. The child will gather needed materials and finds a location in which to work.
3) Follow the directions, talks with parent/ guardian/TIPS Partners as directed in the assignment, and completes the homework. This should be an enjoyable exchange of ideas and information.
4) Asks a parent/guardian/TIPS Partner to respond to the Home-to-School Communication and to sign the activity.
5) Return the assignment to the class on the due date. Share responses and questions about the activity.

What the parent/guardian/TIPS Partner does:

1) Participates and interacts with the student as required in each TIPS homework activity.
2) Checks each we to see if there is a TIPS homework activity and encourages the student to think about and discuss the homework assignment.
3) Completes the home-to-school communication, adds a comment if desired, and **<u>signs</u>** each TIPS activity. Communicates with the teacher about any questions or concerned.

THANK YOU FOR YOUR SUPPORT

Sincerely,

- -

I have read the above conditions and I will help my child with their TIPS homework to the best of my ability.

Student Name: ______________________________ Period: ________ Date: _____________
Parent/Guardian/TIPS Partner Signature ____
Parent/Guardian/TIPS Partner relationship to student: ___________________________________

Appendix E

Control TIPS Homework Assignment

TIPS HOMEWORK
REVIEW OF SCIENTIFIC NOTATION

In chemistry, we are reviewing how to convert between scientific and standard notation. This assignment is due ________________.

PART #1: LOOK THIS OVER:
In science, I am often asked to handle very long numbers. These numbers can represent very small (**example:** 0.0000001) or very large (**example:** 1200000000) quantities. I am going to teach you an **easy way** to write long numbers using a **shorthand** called **scientific notation.**

In other words, I am going to talk about how to convert standard numbers **(1200000)** into scientific notation (**$1.2x10^6$**). Although written differently, they mean the **same** thing.

Let's begin by examining LONG and LARGE numbers (greater than 1):

1) Given a large (LONG) number greater than 1 such as **1200000**, point to where the decimal is **now**!

1200000.

2) Move the decimal until the number is between **1-10 (not including 10)**.

1.200000

3) Drop the ending and/or beginning zeros (keep any middle zeros)

1.2

4) You started with **1200000** and ended up with **1.2** Since my number **got smaller**, I will make sure my **exponent is positive**. I moved the decimal 6 spaces to the left; therefore, raise **x10** to the power of **+6**.

1.2×10^6 is equal to 1200000

5) If my number got bigger, I will make sure my exponent is negative. The exponent will represent the number of decimal places moved to the right.

NOW TRY THIS:
PROBLEM #1:

1) Given a large number (**greater than 1**) such as point to where the decimal is **now**! **48072000**
2) Move the decimal until the number is between **1-10 (not including 10)**.
3) Drop the ending and/or beginning zeros (keep any middle zeros)
4) You started at __________ and ended up with _____________. If your number **got smaller**, make sure your **exponent is positive**. If your number got bigger, make sure your exponent is negative.

Raise $x10^{\text{NUMBER OF DECIMAL PLACES MOVED TO THE LEFT OR RIGHT}}$

CHECK YOUR ANSWER: 4.8072×10^{7}. Have you mastered the concept? What mistakes did you make?

____

____

PRACTICE SECTION: Convert the bolded numbers into scientific notation.

The closest star from our sun, Proxima Centauri, is **24690000000000** (Sci notation: _____________) miles away. If you were traveling at a speed of **150000** miles/hour (Sci notation: ________________), it would take you **17900** years (Sci notation: _________________________) to reach this star. Light travels much faster at a speed of **671000000** miles/hour (Sci notation: _________________) and can reach Proxima Centauri in 4.2 years.

Check Your Answers: 2.469×10^{13} ; 1.5×10^{5} ; 1.79×10^{4} ; 6.71×10^{8}

PART #2: LOOK THIS OVER:

NOW THAT YOU UNDERSTAND HOW TO WRITE LARGE NUMBERS IN SCIENTIFIC NOTATION, LET'S TRY SMALLER NUMBERS.

Let's continue by examining LONG and small numbers (less than 1):

1) Given a small (LONG) number less than 1 such as **0.00000001020**, point to where the decimal is **now**!

0.00000001020

2) Move the decimal until the number is between **1-10 (not including 10)**.

000000001.020

3) Drop the ending and/or beginning zeros (keep any middle zeros)

1.02

4) You started with **0.00000001020** and ended up with **1.02** Since my number **got LARGER**, I will make sure my **exponent is negative**. I moved the decimal 8 spaces to the rightt; therefore, raise **x10** to the power of **-8**.

1.02×10^{-8} is equal to 0.00000001020

NOW TRY THIS:

PROBLEM #1:

5) Given a small number (**greater than 1**) such as point to where the decimal is **now**! **0.002090**
6) Move the decimal until the number is between **1-10 (not including 10)**.
7) Drop the ending and/or beginning zeros (keep any middle zeros)
8) You started at __________ and ended up with _____________. If your number **got bigger**, make sure your **exponent is negative**.

Raise $x10^{\text{NUMBER OF DECIMAL PLACES MOVED TO THE LEFT OR RIGHT}}$

CHECK YOUR ANSWER: 2.09×10^{-3}. Have you mastered the concept? What mistakes did you make?

____

____

PRACTICE SECTION: Convert the bolded numbers into scientific notation.

Assuming a cell density of 1.03 g/ml, the cell would weigh **0.0000000035 grams** (Sci notation: _____________). Since protein accounts for approximately 20 percent of a cell's weight, the total weight of cellular protein is **0.000000000701 grams** (Sci notation: _____________).

Check Your Answers: 3.5×10^{-9} ; 7.01×10^{-10}

LIST 5 EXAMPLES OF HOW SCIENTIFIC NOTATION MIGHT BE USEFUL IN YOUR LIFE.

Did you get help completing this homework assignment?   YES or NO.

If Yes, from whom? ___________________________________
Date and Time of homework completion___________________