Interactive Science Homework: An Experiment in Home and School Connections

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A quasi-experimental study was conducted on whether family involvement in homework in the middle grades benefits students. Results suggest that well-designed interactive homework assignments positively engage parents and promote student achievement. Findings should be useful to middle school administrators and teachers for improving curriculum decisions and homework designs in science.

Imagine the following homework-related communications at a middle school. Teachers at the school provide clear guidelines to students and parents about their expectations for homework and design meaningful homework assignments that encourage students to master skills, apply concepts to real-world problems, and engage student interest. They also regularly assign work that promotes parent-child discussions of schoolwork at home. Students and parents feel comfortable providing teachers feedback on homework assignments, and teachers respond to questions or concerns that are raised. In addition, students enjoy demonstrating and showing parents the skills they learn and are comfortable talking about schoolwork at home and in the classroom.

Most secondary school principals would see the above description as ideal but far from reality. Homework is assigned in most schools every day, but little attention is given to identifying homework problems and improving homework assignments and processes. Indeed, the everyday activity of

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homework affects students, teachers, parents, families, and principals, and all of these participants have expressed concerns, even in the best of homework situations. Teachers report that they receive little or no guidance on homework procedures. Very little information on the topic of homework is provided in teacher education programs (Jenson et al. 1994; Pribble 1993), underscoring the need for a clearer understanding of the purposes of homework, homework designs, and effective communications among principals, teachers, parents, and students.

Research on Homework in the Secondary Grades

Students benefit from spending time on homework assignments. Several studies suggest positive relationships between time spent on homework, completion of homework, and secondary student achievement and grades (Cooper 1989; Cooper et al. 1998; Epstein, Simon, and Salinas 1997; Keith et al. 1993; Van Voorhis 2000). Despite the strength of the connections between homework and achievement, not all students are productively engaged. Some students at the secondary level are not assigned homework or do not complete assignments, whereas other students complete more than two hours of homework per night (National Center for Education Statistics 2001).

Although time spent on homework is important to investigate, other variables in the homework process also deserve attention. Researchers have investigated the role of parents or other family partners in homework. Parental involvement in schooling tends to decline from elementary to middle to high school (Connors and Epstein 1994; Dauber and Epstein 1993; Lee 1994; Simon 2000). In addition, teachers in the middle grades tend to provide fewer opportunities for parental involvement than do their elementary school counterparts (Epstein and Dauber 1991). Despite this tendency, some parents remain involved in some aspects of the homework process in the middle and high school grades. This includes monitoring the homework process, checking assignments, helping or tutoring children on specific concepts or skills, and rewarding students for completing projects (Hoover-Dempsey et al. 2001).

Research indicates that certain types of parent involvement, such as parental discussions with the child about school-related topics, benefit students because these students show higher rates of homework completion and academic achievement in the middle and high school years (Fehrmann, Keith, and Reimers 1987; Ho and Willms 1996; Lee 1994; Keith et al. 1993; Simon 2000). Research also shows that parental involvement can sometimes hinder students' homework experiences or cause tension and stress in the family system (Cooper, Lindsay, and Nye 2000; Epstein 1988; Levin et al. 1997). For example, one study included surveys of 709 parents (representing grades 2, 4, 6, 8, 10, 11, and 12). Two-thirds of these parents reported

providing help that was negative or inappropriate, such as helping the child do work in order to finish more quickly or helping the child in ways that made the work harder for the student (Cooper, Lindsay, and Nye 2000). These findings speak to the importance of better teacher–parent communication about types of interactions at home that support student learning.

Few middle and high schools foster connections between teachers and parents about homework. In a national study of 1,011 middle schools, more than 75 percent of principals stated that less than half of the parents at their respective schools receive regular information from teachers about how to help their children with homework (Epstein and Lee 1995). It seems that principals recognize that teachers need better information about the various purposes of homework and how to design assignments that encourage productive interactions between students and their family members (Epstein and Van Voorhis 2001).

Studies are accumulating that indicate teachers play key roles in designing and assigning quality homework, and in communicating with students and parents about effective family involvement in homework. Presently, however, few teachers at the middle school level have mastered these skills. Current homework activities often are tedious and fail to generate student interest and creativity; parents do not feel prepared to discuss some homework concepts with their early adolescents; and parents and teachers need to know what strategies are appropriate for parental help at home in the middle grades. The studies suggest that new approaches that encourage, guide, and expect developmentally appropriate interaction may provide students, parents, and teachers with a promising strategy for increasing beneficial forms of family involvement.

Interactive Homework: Organized Home–School Connections

On the basis of findings from studies of homework and parental involvement, Epstein and colleagues developed an interactive homework program with research-based components for different subjects as well as prototype activities for students in the elementary and middle grades (Epstein, Salinas, and Jackson 1995a, 1995b). The assignments include clear objectives for learning, instructions for completion, and explicit instructions to the student for involving family members in certain portions of the assignment. TIPS (Teachers Involve Parents in Schoolwork) interactive homework assignments differ from traditional homework in that they are assigned once a week or twice a month; students are given several days to complete the activity (to permit time to involve family); certain sections of the activity guide students on how to involve family members; and parents provide feedback as to how effective and enjoyable the activity was for them and their

children. As with conventional homework, TIPS activities are integrated with the curriculum, graded, and designed to extend student learning.[1]

The TIPS interactive homework process helps schools correct many of the shortcomings in current homework practices. Use of the research-driven approach helps teachers identify topics in the curriculum that require interaction for better comprehension. Through the assignments, teachers provide a "script" for students to know exactly what to ask or demonstrate to inform parents about what they are learning, and how to engage parents in real-world applications of topics and skills. To protect family members from the potential embarrassment of not knowing specific concepts, teachers design interactive questions that parents can discuss without having a formal education or detailed knowledge of the subject at hand. The TIPS assignments include a section for home-to-school communications, which asks parents to communicate with the teacher about the effectiveness of the assignments. If students find the assignments to be too challenging or too easy, parents and students may provide feedback to the teacher to alter the assignments for future use.

Prior studies of TIPS language arts and math helped to inform the design of the present study of TIPS science (Balli 1995; Balli, Demo, and Wedman 1998; Epstein, Simon, and Salinas 1997). Epstein and her colleagues conducted a year-long investigation of TIPS language arts use with grade 6 and grade 8 students in an urban middle school, in which 70 percent of students received a free or reduced-price lunch. They found that parent participation in TIPS significantly improved students' writing scores as the year progressed, even after controlling for prior writing scores. Also, the completion of more TIPS assignments positively influenced student report card grades.

Balli's (1995) experimental study of regular math homework assignments in a middle class, midwestern middle school compared the effects of different prompts (instructions to parents from teachers or students or both) about involvement in math homework. Seventy-four students represented three classes of similar-ability-level students who participated in the three-month investigation. One class completed TIPS assignments that included instructions for the student to involve a family partner in the assignment and a home-to-school communication section. One class completed altered TIPS assignments without home-to-school communication sections. The third class completed altered TIPS assignments lacking both the home-to-school communication section and the instructions for the student to involve a family partner. Balli found that the groups with prompts

[1] More information on TIPS is available at: http://www.partnershipschools.org.

for family involvement more often involved families in math homework than did students without prompts. There were no significant differences in math achievement across the three groups, in part because all classes were taught by the same effective teacher.

The present study of TIPS science combined the strengths of both studies by including a variety of students with different ability levels in an experimental study spanning half of a school year. Many of the results support the findings from this prior research and also extend it in key ways.

Research on TIPS Science Interactive Homework

This study explored TIPS science interactive homework in the middle grades (Van Voorhis 2000). A quasi-experimental design was used to compare the effects of TIPS interactive homework (with instructions for students to involve a family partner in the assignment) with noninteractive homework (the same content as the TIPS assignment with no instructions for students to involve a family partner in the assignment). The study analyzed the effects of both types of homework on family involvement in homework, student homework completion and accuracy, student science achievement, and student attitudes about science.

Sample

The study was conducted with educators, students, and families at Clearview Middle School (grades 6–8), a suburban school in a mid-Atlantic state. Two grade 6 and two grade 8 teachers conducted the homework intervention over the course of the first two marking periods (18 weeks) of the 1999–2000 school year. Three classes from each grade 6 teacher and two classes from each grade 8 teacher participated in the study, for a total of 253 students. Fifty-three percent of the students were White, 36 percent were African American, and 11 percent were multiracial, Asian American, Hispanic, or Russian. Students represented low, average, and honors classes in grade 6, and average and honors classes in grade 8. Six classes were assigned TIPS interactive homework, and four classes were given noninteractive assignments.

Materials

Interactive assignments. The author worked with grade 6 and grade 8 teachers to develop TIPS science assignments for the first 18 weeks of the science curriculum. Teachers chose topics for weekly assignments on the basis of curriculum objectives and designed two test questions for each assignment. All TIPS science activities included eight important components (Epstein, Salinas, and Jackson 1995a, 1995b; Epstein and Van Voorhis 2001):

1. A letter to the parent, guardian, or family partner briefly explains the assignment topic and the skill(s) it stresses. The student writes in the due date and signs the letter.
2. Objectives explain the learning goals of the activity.
3. Materials are common, inexpensive, and easily available at home, or provided by the school.
4. The procedure guides the student, step by step, in a hands-on activity that requires the student to think and act like a scientist and to interact with a family partner.
5. A lab report or data chart provides space for the student to report findings.
6. Conclusions/discussions guide the student to discuss results and real-world applications of science with a family partner.
7. A home-to-school communication section invites the family partner to send an observation, comment, or question to the teacher about the skill the student demonstrated and the homework experience.
8. A parent or guardian signature is requested on each activity.

Each TIPS activity is interactive and linked to the curriculum in a meaningful way. Activities are the student's responsibility, easy to read and understand, attractive, and designed for two sides of one page.

Noninteractive assignments. From the TIPS activities, the author produced a set of noninteractive activities for the study. The noninteractive activities included the same homework content as the TIPS assignments, but they included no prompts for the student or family regarding involvement. There were no letters to the parent, home-to-school communications, or questions encouraging students to involve family partners in their experiments or discussions.

Procedure

Each participating student's family received a letter at the beginning of the school year describing either the interactive or noninteractive homework assignments. Both letters included information on the weekly use of the "green sheets" (both types of assignments were copied on green paper). Only the interactive (TIPS) letter stressed the importance of students involving family partners in sections of the assignment.

Each teacher assigned an activity once a week over the course of the study and included homework-related questions on student examinations. At the end of the second marking period, teachers asked students to complete a brief, in-class survey of their perceptions of family involvement in their interactive or noninteractive science homework assignments; their perceptions of family involvement in homework in other subjects; and their

general opinions about homework, school, and science. Parents also received a survey of their opinions of and experiences with the weekly science homework assignments.

Data

This study included several background and outcome measures. The background measures included prior science achievement, mother's education level, student class ability level, student race, gender, and grade level. The type of science homework assignment (interactive or noninteractive) served as the experimental variable in the study. The study addressed four main research questions to assess the effects of student background variables and the type of homework assignment on family involvement in homework, homework completion, science achievement, and attitudes toward science. A summary of the results of the study is shown in table 1.

Results

Family involvement. What was the relationship between type of science homework assignment (interactive or noninteractive) and family involvement in science homework? Students who completed the TIPS interactive homework assignments reported higher levels of family involvement than did students completing the noninteractive science homework assignments. More than 80 percent of TIPS interactive students said their families were sometimes, frequently, or always involved in science homework assignments. By contrast, more than 80 percent of students who completed the noninteractive science homework assignments said their families were never, rarely, or sometimes involved in the science homework assignments over the 18-week study period.

Mothers and fathers provided the most homework help. Seventy-five percent of students (58 percent named mothers; 17 percent named fathers) in both groups noted that their parents helped most often with science homework. Worthy of note is the fact that siblings, other relatives, and friends were important family partners in the learning process for about 25 percent of students in the study.

The analyses indicate clearly that specific instructions to students about how to work with family partners on science homework promoted significantly higher levels of family involvement. Teachers should note the variety of partners with whom students may work. Although parents were most often specified, some students worked on their science assignments with older siblings, grandparents, aunts, uncles, friends, and neighbors.

What was the relationship between the type of science homework assignment (interactive or noninteractive) and family involvement in homework in other subjects? Survey questions asked students to report how frequently

Table 1. Summary of Using TIPS Interactive and Noninteractive Science Homework

Results	TIPS Interactive Homework	Noninteractive Homework
Family involvement in science homework	80% of TIPS students reported that their family partners were sometimes, frequently, or always involved in the weekly science homework assignments.	20% of noninteractive homework students reported that their family partners were sometimes, frequently, or always involved in the weekly assignments.
Homework completion and accuracy	Students in both groups returned about 75 percent of their weekly science homework assignments over 18 weeks.	
Science achievement	In both groups, students' report card grades were influenced by prior science achievement and percentages of homework completed. Interactive homework design contributed even more to students' science report card grades.	
Parent–child interaction survey questions	91% of TIPS students said the assignments helped a parent see what they were learning in science.	88% of noninteractive students said the assignments helped a parent see what they were learning in science.
	76% of TIPS students reported that the family partner liked working on the green sheets with them.	60% of noninteractive students reported that the family partner liked working on the green sheets with them.
	90% of TIPS students said they were able to talk about science work with a family partner.	77% of noninteractive students said they were able to talk about science work with a family partner.

Note. TIPS = Teachers Involve Parents in Schoolwork.

their family partners worked with them on homework in three subjects (science, math, and language arts). Students rated whether their family partners were never, rarely, sometimes, frequently, or always involved in homework assignments in the three subjects. Although family involvement levels in science homework differed dramatically by type of science homework (interactive or noninteractive), family involvement levels did not differ in math and language arts, subjects that were not using the TIPS design.

This finding alerts educators to the importance of subject-specific instructions for family involvement. If teachers want family involvement in science, they must design science activities with instructions for involvement. Similarly, teachers may encourage family involvement in other subjects with targeted interactive assignments.

Homework completion and accuracy. Did students who completed interactive science assignments turn in more assignments than students who completed noninteractive homework assignments? Both the TIPS and noninteractive assignments were well-designed homework assignments linked to the teachers' science units. There were no significant differences in the students' homework completion or accuracy rates for the interactive and noninteractive groups, after controlling for differences in students' previous science grades, classroom ability grouping, parent education levels, race, gender, and grade level. Students in both groups did their homework about equally well (returning about 75 percent of the assigned homework). It is important to note that students whose families were more regularly involved in the homework and students who liked the assignments did more homework and did it better.

Science achievement. Did students who completed TIPS interactive homework assignments earn higher report card grades in science than students who completed noninteractive homework assignments? Not surprisingly, the amount of homework completed and previous science report card grades were the strongest predictors of present report card grades in science. Students who earned high grades in science in grade 7 were more likely to earn high science report card grades in grade 8. In addition, students who turned in a higher percentage of assignments during the 18 weeks of the study tended to earn higher report card grades in science.

The results also showed that TIPS students earned significantly higher report card grades than did students assigned noninteractive homework, even after controlling for prior science report card grades, other background variables, and the percentage of homework assignments returned. This difference in achievement emerged after only 18 weeks. It is possible that the cumulative effects of such homework interventions on student achievement would be even more dramatic. Future studies of interactive

homework should be designed to pinpoint and measure the specific components of the TIPS process that may promote student learning and achievement over time.

Time on homework. Students and families reported on surveys how much time students spent on the TIPS and noninteractive science homework assignments. Eighty-nine percent of the parents surveyed in both the groups reported that their children spent 45 minutes or less on each science homework assignment. Student estimates were lower, with more than 80 percent of students in both groups reporting that they spent 30 minutes or less on each science homework assignment. This suggests that it is possible to engage families and students in meaningful homework assignments that take a reasonable amount of time each week.

Opinions of the homework assignments. Although almost all students and parents were positive about the interactive and noninteractive assignments, students and parents involved in TIPS assignments were more likely to agree with specific statements about parent–child interactions. Sixteen percent more TIPS students than noninteractive students reported that their family partners liked working on the science assignments. Also, 13 percent more TIPS than non-TIPS students agreed that they were able to talk about science work with a family partner. Finally, 10 percent more TIPS than non-TIPS parents also reported that their children worked as hard as they could in science.

Educational and Scientific Importance

Homework should never be assigned unless the teacher has a valid purpose in doing so. Researchers and educators have identified several purposes of homework—practice, participation, preparation, parent–child relations, parent–teacher communications, public relations, policy, and punishment—and the last is not a defensible purpose (Epstein 2001; Epstein and Van Voorhis 2001). One homework assignment may address several purposes, but most teachers do not think about how these various purposes guide the design of their homework assignments.

Results of this study show that well-designed, teacher-generated homework assignments in science can help students practice skills, prepare for the next class, participate in learning activities, develop personal responsibility for homework, promote parent–child relations, develop parent–teacher communication, and fulfill policy directives from administrators. Survey reports indicated that students and parents liked the well-designed interactive assignments; students rated them better than standard homework, and parents and students suggested that TIPS be used next year in school. Teachers appreciated the work they did in developing TIPS assignments. They reported value in using a regular schedule of science homework,

linking homework content to science unit tests, and guiding students to share their science work and ideas with their families (Association for Supervision and Curriculum Development 2001).

Although the results of this study of TIPS science homework are positive, teachers should not abandon other types of homework. Homework serves different purposes. Some homework should help students learn to study independently, but some homework also should be interactive so that students can share their work at home. Boredom and frustration can be avoided when teachers use a variety of homework designs with clearly defined and different purposes.

Much of today's homework is monotonous, pointless, discouraging to students, and disruptive of family time. Professional development time should be allocated to help teachers learn about the importance of well-designed homework, to share ideas about science, and to develop meaningful homework assignments that match the creativity found in many teachers' classrooms. TIPS interactive homework is one approach that helps teachers develop their skills in designing better assignments that increase students' skills and inform parents of what is going on in the classroom.

Will we ever see the day when all schools report the ideal homework practices described at the start of this article? Better homework designs that fulfill specific purposes and improve connections, as TIPS does, are steps in the right direction. As one parent commented, the TIPS process promoted "great three-way communication between teacher, parent, and student."

References

Association for Supervision and Curriculum Development (ASCD). 2001. *How to make homework more meaningful* [Videotape]. Alexandria, Va.: ASCD.

Balli, S. J. 1995. *The effects of differential prompts on family involvement with middle-grades homework.* Unpublished doctoral dissertation, University of Missouri, Columbia.

Balli, S. J., D. H. Demo, and J. F. Wedman. 1998. Family involvement with children's homework: An intervention in the middle grades. *Family Relations* 47: 142–46.

Connors, L. J., and J. L. Epstein. 1994. *Taking stock: Views of teachers, parents, and students on school, family, and community partnerships in high schools.* Report 25. Baltimore: Center on Families, Communities, Schools, and Children's Learning, Johns Hopkins University.

Cooper, H. 1989. *Homework.* White Plains, N.Y.: Longman.

Cooper, H., J. J. Lindsay, and B. Nye. 2000. Homework in the home: How student, family, and parenting-style differences relate to the homework process. *Contemporary Educational Psychology* 25: 464–87.

Cooper, H., J. J. Lindsay, B. Nye, and S. Greathouse. 1998. Relationships among attitudes about homework, amount of homework assigned and completed, and student achievement. *Journal of Educational Psychology* 90: 70–83.

Dauber, S. L., and J. L. Epstein. 1993. Parents' attitudes and practices of involvement in inner-city elementary and middle schools. In *Families and schools in a pluralistic society,* edited by N. Chavkin. Albany, N.Y.: SUNY Press.

Epstein, J. L. 1988. *Homework practices, achievement, and behaviors of elementary school students.* Report 26. Baltimore: Center on Families, Communities, Schools, and Children's Learning, Johns Hopkins University.

———. 2001. *School, family, and community partnerships: Preparing educators and improving schools.* Boulder, Colo.: Westview Press.

Epstein, J. L., and S. L. Dauber. 1991. School programs and teacher practices of parent involvement in inner-city elementary and middle schools. *The Elementary School Journal* 91 (3): 289–305.

Epstein, J. L., and S. Lee. 1995. National patterns of school and family connections in the middle grades. In *The family-school connection: Theory, research, and practice,* edited by B. Ryan, G. Adams, T. Gulotta, R. Weissberg, and R. Hampton. Thousand Oaks, Calif.: Sage.

Epstein, J. L., K. C. Salinas, and V. E. Jackson. 1995a. *Manual for teachers and prototype activities: Teachers Involve Parents in Schoolwork (TIPS) language arts, science/health, and math interactive homework in the middle grades.* Revised ed. Baltimore: Center on School, Family, and Community Partnerships, Johns Hopkins University.

———. 1995b. *TIPS language arts, math, and science prototype activities for grades 6, 7, and 8.* Revised ed. Baltimore: Center on School, Family, and Community Partnerships, Johns Hopkins University.

Epstein, J. L., B. S. Simon, and K. C. Salinas. 1997. Effects of Teachers Involve Parents in Schoolwork (TIPS) language arts interactive homework in the middle grades. *Phi Delta Kappa Research Bulletin* 18 (September).

Epstein, J. L., and F. L. Van Voorhis. 2001. More than minutes: Teachers' roles in designing homework. *Educational Psychologist* 36 (3): 181–93.

Fehrmann, P. G., T. Z. Keith, and T. M. Reimers. 1987. Home influences on school learning: Direct and indirect effects of parental involvement on high school grades. *Journal of Educational Research* 80: 330–37.

Ho, E. S., and J. D. Willms. 1996. Effects of parental involvement on eighth-grade achievement. *Sociology of Education* 69: 126–41.

Hoover-Dempsey, K. V., A. B. Battiato, J. M. Walker, R. P. Reed, J. M. DeJong, and K. P. Jones. 2001. Parental involvement in homework. *Educational Psychologist* 36 (3).

Jenson, W. R., S. M. Sheridan, D. Olympia, and D. Andrews. 1994. Homework and students with learning disabilities and behavior disorders: A practical, parent-based approach. *Journal of Learning Disabilities* 27 (2): 538–48.

Keith, T. Z., P. B. Keith, G. C. Troutman, P. G. Bickley, P. S. Trivette, and K. Singh. 1993. Does parental involvement affect eighth grade student achievement? Structural analysis of national data. *School Psychology Review* 22: 474–96.

Lee, S. 1994. *Family-school connections and students' education: Continuity and change of family involvement from the middle grades to high school.* Unpublished doctoral dissertation, Johns Hopkins University, Baltimore.

Levin, I., R. Levy-Shiff, T. Appelbaum-Peled, I. Katz, M. Komar, and N. Meiran. 1997. Antecedents and consequences of maternal involvement in children's homework: A longitudinal analysis. *Journal of Applied Developmental Psychology* 18: 207–22.

Pribble, C. J. 1993. *A homework survey of regular education and special education teachers.* Unpublished doctoral dissertation, University of Utah, Salt Lake City.

Simon, B. 2000. *Predictors of high school and family partnerships and the influence of partnerships on student success.* Unpublished doctoral dissertation, Johns Hopkins University, Baltimore.

National Center for Education Statistics. 2001. *National Assessment of Educational Progress (NAEP) 1984 and 1999 long-term trend assessment.* Indicator 22. Washington, D.C.: U.S. Department of Education.

Van Voorhis, F. L. 2000. *The effects of TIPS interactive and non-interactive homework on science achievement and family involvement of middle grade students.* Unpublished doctoral dissertation, University of Florida, Gainesville.