Interactive High School Geometry Homework

To Increase Family Involvement

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Abstract

By the time students reach high school, many parents do not feel equipped to assist their children with homework. However, research shows that even through high school parent involvement in homework can lead to positive student outcomes. The National Network of Partnership Schools at Johns Hopkins University developed a program to strengthen school-home partnerships, by getting parents involved in homework. Teachers Involve Parents in Schoolwork (TIPS) interactive homework is a homework program designed to get parents involved in homework without actually having to teach content. Much of the research on TIPS interactive homework has been focused on the elementary and middle school levels. The purpose of this project is to extend the TIPS program to high school geometry. What are the design features of a TIPS interactive homework program in geometry? In this project three interactive geometry homework assignments are developed based on elements of homework design, the funds of knowledge framework, and the geometric habits of mind framework. The activities align with the developed integrated model. An assessment system to evaluate interactive geometry homework assignments is developed that includes discussion, communicating feedback, and developing a portfolio. Further research is recommended and described in evaluating the effectiveness of such a homework program in high school geometry. This project represents knowledge of the learner and learning principles, learning environment, curriculum and strategies, and assessment.

Key Words: TIPS interactive homework, geometry homework, parent involvement in homework, learning at home, geometry activities

A goal nationwide is to increase the nature of school-home partnerships (US Congress, 2000). At the center of this relationship is homework. As students move into high school many parents feel they can no longer support their children during homework time, especially during high school math. In fact, parental involvement tends to decline from the elementary to secondary years. However, research shows that parental involvement at all grade levels can lead to a variety of positive student outcomes (Van Voorhis, 2011; Epstein & Van Voorhis, 2010; Hoover-Dempsey et al., 2001; de Carvalho, 2001; Kreider, Caspe, Kennedy, & Weiss, 2007).

Six types of parent involvement as outlined by Epstein (2004) include parenting, communicating, volunteering, learning at home, decision making, and collaborating with the community. This project focuses on the learning at home element. The National Network of Partnership Schools at Johns Hopkins University developed an alternative way to involve parents in homework. The Teachers Involve Parents in Schoolwork (TIPS) interactive homework program allows students to talk with someone at home about something they are learning in class. TIPS interactive homework does not require parents to teach content but be active participants in the learning. Much of the research with TIPS interactive homework focuses on the elementary and middle school level. However, the developers suggest that the program can be implemented in high school.

The purpose of this project is to adapt the TIPS interactive homework program to high school geometry. What would an interactive homework assignment look like in a geometry setting? What elements would shape the design of an interactive geometry homework assignment?

How would such an assignment be assessed? What are the considerations for implementing such a program in high school?

Interest in this topic follows from prior learning experiences including a parent workshop that discussed the use of interactive homework, an independent study on parent involvement, and a course on parents, school, and the community.

The research begins with a literature analysis describing the state of homework including the history, purposes, and problems of homework. A conceptual framework is then established through an integration of elements of homework design, the funds of knowledge, and geometric habits of mind. Lastly, the interactive geometry homework assignments are presented followed by an analysis, assessment strategies, and questions for consideration.

Elements of the learner and learning principles such as diversity and developmental needs are addressed in the parent involvement in homework section and the funds of knowledge section. The learning environment is addressed with the funds of knowledge and the idea of extending learning into the home. Curriculum and strategies are addressed throughout the paper as this project focuses on developing a part of curriculum, homework that will meet the needs of diverse learners. Assessment is focused on in the purposes and problems of homework section, as homework is viewed as an informal assessment. Assessment of the interactive homework assignments is also addressed.

The State of Homework

History

Homework has evolved throughout American history. Homework has changed in its purpose and format. There have been disputes about the importance of homework in American education throughout history. De Carvalho (2001) provides an overview of how homework has changed through United States history.

Prior to the common school era when learning occurred in the realms of family, community, and economic production, homework was just practical and productive work done at home such as household chores. During the common school era when school attendance became normal, work was not sent home as to not interfere with the work required by family members to survive.

Throughout the 20th century homework began to be viewed as schoolwork sent home. This suggested that learning had not remained confined to the school. During this time there was constant talk about the importance of homework. The Progressives did not support homework policies associated with traditional learning as they emphasized interest and joy versus will and effort. In fact, many school districts abolished homework and encouraged more creative use of non-school hours by children and families. In the 1950s, pro-homework positions took lead as attacks were made of progressive education for not stressing academic rigor. To compete with the Russians during the context of the Cold War politicians began to stress the importance of a quality education. Homework became to be known as an integral part of schoolwork.

The 1960s, in light of the Civil Rights Movement, marked a period where issues of equity in educational opportunities arose. The 1966 Coleman report, *Equality of Educational Opportunity,* showed the first documentation of an achievement gap between minority students and their mainstream counterparts. This period started to identify high and low achieving students. Homework was believed to be beneficial to these low achieving students. It served as a way to practice skills so low achievers could catch up with their peers. The mid-1970s reported signs of a small anti-homework phase. A study showed that American high schools assigned far less homework than they had fifteen years earlier (de Carvalho, 2001).

The 1980s marked another pivotal time in education and how people viewed homework. The publication of *A Nation at Risk (1983)* "which credited the United States political, economic, and moral downfall to a soft pedagogy" (de Carvalho, 2001, p. 128) sparked interest once more in pro-homework views. On an international scale, Japanese and Chinese students were spending more hours on homework per week than Americans (de Carvalho, 2001). To compete with these countries America had to increase the rigor of its curriculum. The 1980s saw an expansion of formal homework policies throughout the country's school districts. Homework was necessary for increasing achievement.

The 1990s emphasized family accountability and school choice. Parental empowerment and involvement in school reform were stressed. Regular homework became a strategy that was said to improve academic performance. Today policy calls for broad school-family partnerships as described in *GOALS 2000* and the *No Child Left Behind Act of 2001*. Homework has always

been central to home-school partnerships. Today there are many different purposes and formats for homework.

Purposes

There are ten broad purposes of homework reflected across the research. The purposes are as follow: practice, preparation, participation, personal development, parent-child relations, parent-teacher communications, peer interactions, policy, public relations, and punishment (Epstein & Van Voorhis, 2010; Hoover-Dempsey et al., 2001; Van Voorhis, 2004; de Carvalho, 2001). In designing homework teachers must be clear about their purpose of the homework assignment, and also be able to communicate that purpose to students and parents. The purposes can be summarized into three categories: instructional, communicative, and political (Van Voorhis, 2004).

Homework also serves as informal assessment. Assessments are essential because they provide feedback for the student, teacher, and other inquirers (Bransford, 2000). Homework as a form of assessment fits this role as it also provides information and feedback for the teacher and student. It serves as a type of formative evaluation, which is an evaluation used to improve students' skills and understandings (Bransford, 2000). Homework also helps improve metacognitive awareness, giving students a sense of where they are in terms of meeting academic goals. The assessment of homework can sometimes provide difficulties as discussed in the next section.

Problems

As mentioned previously, homework has not always been viewed as important in American education. Research shows some of the current concerns with homework. School homework often interferes with the basic needs of a family (de Carvalho, 2001). Homework takes up time from doing family activities, as well as doing household duties or chores. Creating learning opportunities in the home can also be time consuming for parents (de Carvalho, 2001; Van Voorhis, 2011). Parents often feel unprepared to assist their children with homework (Van Voorhis, 2011; Cosden, Morrison, Gutierrez, Brown, 2004; Epstein, 2004; Van Voorhis, 2004; Hoover-Dempsey et al., 2001; Patall, Cooper, Robinson, 2008). Parents may be unfamiliar with the content or the way the teacher has been teaching the content (Ginsberg, Rashid, English-Clarke, 2008). There may be language barriers preventing parents from engaging with homework. Homework often lacks a clear purpose (Epstein & Van Voorhis, 2010; de Carvalho, 2001; Van Voorhis, 2011; Hoover-Dempsey et al., 2001).

Homework as a formal assessment also brings up issues. Traditionally homework was evaluated in order to improve instruction and provide individual feedback. It was not graded. Now homework is often assigned a grade which can create some difficulties. Is homework graded on accuracy or completion? Some students score high on tests but fail to complete homework. When homework is graded the overall grade is affected. Often students in this type of situation do not see the purpose of homework when they seem to understand the content and excel on tests. At the same time, students who do not perform well on tests can use grades they get on homework to balance out their overall grade. A main concern is that assessing the process of learning and not the outcome is complicated when the process occurs at home, away from the teacher (de Carvalho, 2001).

The Teachers Involve Parents in Schoolwork (TIPS) interactive homework approach combats these problems by providing quality homework assignments that are not too time-consuming. Students get plenty of time to complete the assignment as to meet the scheduling needs of the family partner. With TIPS interactive homework, parents are not asked to teach any content. Instead, they are asked to engage with the child in discussion about the content. Parents and family members get an opportunity to get a sense of what their children are learning in school. The TIPS program will be discussed more in detail later in this paper.

Parent Involvement in Homework

Whether guided or not parents are consistently involved in homework (Van Voorhis, 2004). As Hoover-Dempsey et al. (2001) argue parents appear to involve themselves in their children's homework for three major reasons: "they believe that they should be involved, that their involvement will make a positive difference, and they perceive invitations to involvement" (p. 201). Involved parents believe it is a normal requirement and responsibility of parenting to be involved. There is great diversity in how parents help with homework and what role they take on depending on the age of the student, family situation, and skill level of the student.

There are many positive affects related to parent involvement and student outcome. Parent involvement in homework models positive attitudes and study skills needed to succeed (Cosden et al., 2004; Hoover-Dempsey, 2001; Epstein & Van Voorhis, 2010; Patall et al., 2008). Students develop more positive attitudes about homework and school learning as a result of positive parental attitudes toward homework. Parent involvement during homework can also influence students' perceptions of their personal competence, ability, and academic self-concept

(Hoover-Dempsey, 2001; Patall et al., 2008). The reciprocal communication between home and school by involving parents in homework also affects achievement positively (Sirvani, 2007).

Although strong family-school connections contribute to academic success at all grade levels, family involvement tends to decline as students move from elementary to middle to high school (Simon, 2004; Sirvani, 2007; Kreider, Caspe, Kennedy, Weiss, 2007; Viadero, 2009). During adolescence, parents and students have fewer discussions about school and homework; and, parents and teachers communicate less frequently with each other (Sirvani, 2007; Simon, 2004). Developmental reasons play a role in this decline in parent involvement.

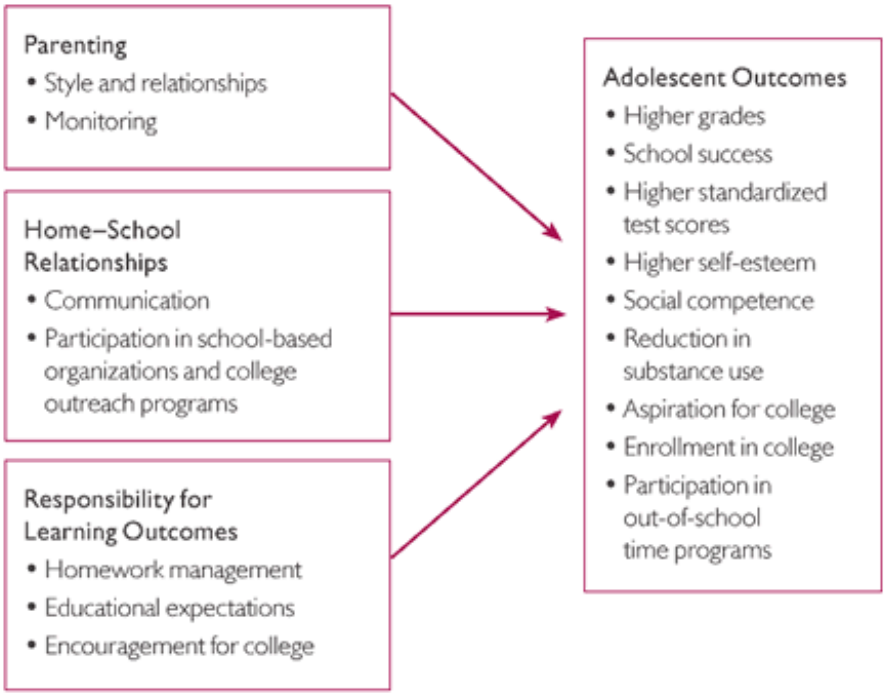
Adolescence is a time of rapid change. During this period youth experience puberty, develop abstract thinking abilities, and expand their peer groups (Kreider et al., 2007). During this time adolescents are at greater risk of school dropout, arrest, drug use, and sexual misconduct than any other age groups. Adolescents need trusting and caring relationships. As Kreider et al. (2007) suggest they also need to "form their own identities, engage in autonomous self-expression, and take part in challenging experiences that will develop their competence and self-esteem" (p. 1). Adolescents desire autonomy, independence, and time with peers, but at the same time, they need guidance from parents and other adults.

Despite the decline in parent involvement in the adolescent years, family involvement is still important. Figure 1 from Kreider et al. (2007) shows three processes of family involvement for adolescents (parenting, home-school relationships, responsibility for learning outcomes) and the adolescent outcomes they affect. The outcomes include higher grades, school success, higher self-esteem, social competence, aspiration and enrollment in college, and also

participation in out of school activities. Parenting styles and relationships as well as parent monitoring can affect these outcomes.

Relative to family involvement in homework is the home-school relationships process emphasizing communication. Homework can be a tool for ongoing communication between the school and family. The aspect of homework management in the responsibility for learning outcomes process is also important. As quoted from Kreider et al. (2007), "parental encouragement and concrete help in managing homework supports adolescents' learning, helping them to complete homework more accurately, so that when they study on their own, they can do so with fewer problem behaviors" (p. 7).

Figure 1. Processes of family involvement and adolescent outcomes



In order for parents of students at any grade level to be successfully involved in student homework they need the necessary support. Parents generally want to help if they are aware of the problem (Sirvani, 2007), but as previously mentioned they often do not know how to help. The TIPS interactive homework program gives clear roles for parents during homework time so that they can engage in the learning with their child.

TIPS Interactive Homework

The National Network of Partnership Schools at Johns Hopkins University developed an interactive homework program called Teachers Involve Parents in Schoolwork (TIPS). As part of their homework assignment, students are expected to share their work and express their ideas with someone at home. The parent or family partner is not expected to teach any content, but instead pose questions and comments and give feedback to the teacher on the assignment. The parent or family partner's role is to participate in the homework assignment by either providing data or joining the student in conversation.

A study done implementing TIPS math interactive homework in an urban setting showed that the students who were assigned TIPS assignments showed more positive feelings and attitudes about math, higher standardized math scores, and higher levels of family involvement than the control group whom were not assigned TIPS homework (Van Voorhis, 2011). Other studies have also been conducted in the areas of language arts (Epstein, Simon, & Salinas, 1997) and science (Van Voorhis, 2001, 2003) in the middle grades. These studies showed the importance for subject-specific family involvement for subject-specific results for students.

A big idea with TIPS interactive homework is that it opens up room for conversation. The assignments are written to promote conversations between the student and parent or other family member (e.g. grandparent, older sibling, or other person who is willing to explore the topic with student). Communication is important for building strong home-school partnerships. The fact is that there are fewer discussions about school and homework during the adolescent years (Simon, 2004). However, there are studies showing that communication between parents and students at the high school level are linked to positive student outcomes (Sirvani, 2007; Viadero, 2009).

TIPS assignments will look differently in different subjects and in different grade levels. However, there are four main components of every TIPS assignment. These components include: "(a) a brief letter to the family partner that includes the objectives of the assignment, (b) clear instructions and directions for students to involve a family partner in particular conversations and activities, (c) a home-to-school communication section, and (d) a two-page limit" (Van Voorhis, 2004, p. 209).

In summary, homework has evolved over time in format and purpose throughout American history. Although there are issues with homework today, the need for purposeful, engaging, high quality homework is essential for positive student outcomes. Parent involvement in homework at the high school level helps with a number of student outcomes such as school success, higher self-esteem, and social competence as shown previously in the Kreider model (Kreider et al., 2007). Much of the research of the TIPS interactive homework program is focused on the elementary and middle school level. However the developers suggest that the

program can also work at the high school level. The purpose of this project is to extend the TIPS model to the high school level, specifically high school geometry.

Conceptual Framework

The state of homework as described previously inspired the design of this project. Homework must be purposeful, meaningful, engaging, and not too time consuming. This project is also grounded in two conceptual frameworks, the *funds of knowledge* and *geometric habits of mind.*

Funds of Knowledge

Funds of knowledge for teaching is an approach that brings students' cultural backgrounds and families' funds of knowledge into the classroom. The term *funds of knowledge* refer to the "historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being" (Moll, Amanti, Neff, & Gonzalez, 1992, p. 133). Moll and colleagues worked with teachers and families to study the households of working class Mexican American families. They wanted to get an understanding of households and classrooms qualitatively. The idea was to expand the learning environment beyond the school into the households of the students. In the study, Moll and colleagues found a broad base of household knowledge that contributed to the well-being of the families. Funds of knowledge ranged from agriculture, mining, economics, household management, repairing, medicine, and religion (Moll et al., 1992; Gonzalez, Andrade, Civil, & Moll, 2001). These areas were to be brought into classroom lessons and homework assignments thus bridging the home and school learning environments.

Some aspects of the household as a learning environment contrast sharply with the classroom learning environment (Moll et al., 1992). The household networks tend to involve multiple people from outside the home. The household networks tend to be flexible, adaptive, and active. In contrast, the classroom environment is often isolated from community resources and community social life. The family members in the home environment also tend to see the student in multiple settings and activities, thus getting a complete picture of the student. The teacher, in contrast, only gets a small snapshot of the student based on his or her performance in a limited context. Every interaction with relatives, friends, and neighbors constantly provides situations in which learning can occur, and where children have multiple chances to be active participants in the learning.

American schools today are filled with a great diversity of students. Students are diverse through means of race, ethnicity, social class, culture, geography, religion, interests, language, and special needs. The funds of knowledge approach allow teachers to use culture as a resource and not as a disadvantage. This approach undermines the cultural deficit view where students of minority backgrounds are viewed as lacking something and thus need to be assimilated to the mainstream culture (Gay, 2010). With this in mind, all students experience daily activity that requires a knowledge base and often links to school learning. However, the connections with academic learning are not often made. The TIPS interactive homework program attempts to make some of these connections explicit.

Geometric Habits of Mind

New reform mathematics calls for changes in mathematics education. As described by Gonzalez et al. (2001) these changes capitalize on the following needs:

> to teach mathematics to all children, to help them make connections with their everyday world, to engage them in doing mathematics and in constructing meanings, and to move away from the teacher and textbook as the authority on what counts as mathematical activity (p. 119).

TIPS interactive homework aligns with these goals by providing activities that all students can access and by making connections with their everyday lives.

The second framework guiding the design of this project is the geometric habits of mind. Mathematical habits of minds are productive ways of thinking that support learning and application of formal mathematics. The Geometric Habits of Mind framework outlines several habits that are essential to developing geometric thinking. As Mark Driscoll (2007) outlines the habits are as follows:

> **Reasoning with relationships.** This is actively looking for relationships (e.g., congruence, similarity, parallelism), within and between geometric figures, in one, two, and three dimensions, and thinking about how the relationships can help your understanding or problem solving. Internal questions (i.e., questions problem solvers ask themselves) include: “How are these figures alike?” “How are these figures different?” (p. 12)

Generalizing geometric ideas. This is wanting to understand and describe the *always* and the *every* related to geometric phenomena. Internal questions include: "Does this happen in every case?" "Why would this happen in every case?" "Have I found all the ones that fit this description?" (p. 12)

Investigating invariants. An invariant is something about a situation that stays the same, even as parts of the situation vary. This GHOM shows up, for example, in analyzing which attributes of a figure remain the same and which change when the figure is transformed in some way (e.g., through translations, reflections, rotations, dilations, dissections, combinations, or controlled distortions). Internal questions include: "How did that figure get from here to there?" "Is it possible to transform this figure so that it becomes that one?" "What changes? Why?" "What stays the same? Why?" "What happens to the figure if I keep applying the same transformations over and over again?" (p. 13)

Balancing exploration and reflection. This is trying various ways to approach a problem and regularly stepping back to take stock. This balance of "What if . . ." with "What did I learn from trying that?" is representative of this habit of mind. Internal questions include: "What happens if I (draw a picture, add to/take apart this picture, work backward from the ending place, etc.)?" "What did that action tell me?" "How can my earlier attempts to solve the problem inform my approach now?" "What intermediate steps might help?" "What if I already had the solution . . . what would it look like?" (p. 14)

These geometric habits of mind make up the foundation for the design of the TIPS geometry interactive homework activities.

TIPS Interactive Homework in High School Geometry

The purpose of this project is to extend the TIPS interactive homework program into the context of high school geometry. TIPS interactive homework bridges the gap between home and school partnerships. By the time students reach high school, especially upper level math, many parents do not feel equipped to help their children with homework. However, at this stage of adolescence many students seek independence and do not want their parents help. This model of homework design addresses these issues by allowing parents to be engaged in the homework without teaching content. It also provides room for students to be independent as they take responsibility for completion of the assignment as well as do a portion of the assignment individually.

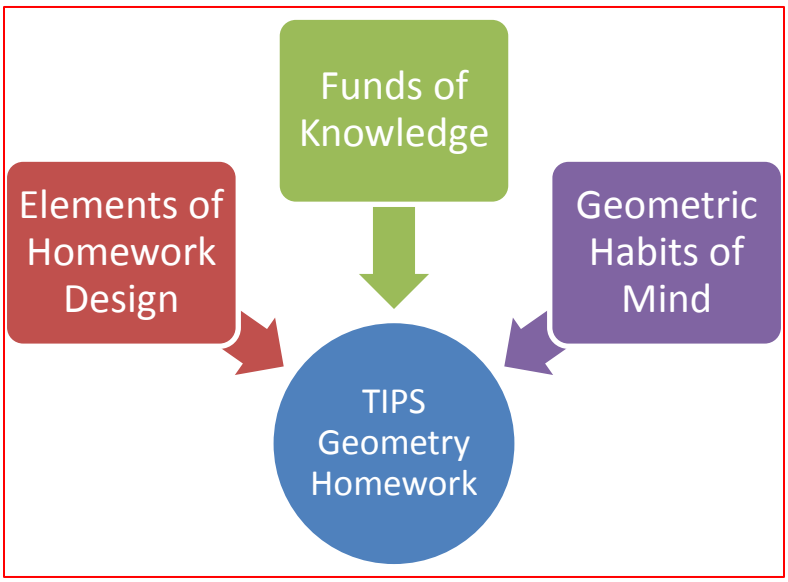
Methodology

The design of this project is based off aspects of homework design, the funds of knowledge, and geometric habits of mind. The following developed model in Figure 2 integrates these constructs and serves as the foundation for the design.

The elements of homework design focused on in this model include: homework purpose, meaningful and engaging tasks, and feedback. The funds of knowledge element focus on extending the learning environment by integrating academics and daily household knowledge. The geometric habits of mind focus on the ways of thinking geometrically (e.g. generalizing,

reasoning with relationships, investigating invariants, and balancing exploration with reflection) that will support student learning. These three elements constitute the framework for the design of the interactive geometry homework activities.

Figure 2. Integrated Model for TIPS Geometry



The geometric areas covered in this project include surface area and volume, scale factor and similarity, and transformations. These topics were chosen after reviewing the textbook *Geometry* published by McDougal Littell (2004). The use of various broad topics in this project will help provide some insight into whether certain topics are more feasible to incorporate in interactive homework.

After reading the research, developing the framework, and referring to the *Geometry* textbook, the following interactive homework assignments were developed.

Results

Based on the integrated model for TIPS interactive geometry homework, three assignments were developed (see Appendix A for full assignments). All three assignments follow a general format as adapted from the TIPS interactive homework format (Epstein & Van Voorhis, 2010). The first part of the assignment is a letter to the parent describing the topic and the purpose of the homework assignment. The student will fill in the due date as well as sign the letter indicating that he or she will take full responsibility for the completion of the assignment. After the letter is a brief objective statement summarizing what will take place during this homework activity. Next the student is to list the family partner's name and relationship. This will help the teacher see who the student is working with and whether or not the student consistently works with the same person or not.

The second section of every Geometry interactive homework assignment is the *Look this Over* section. In this section the student is expected to share some basic information with the family partner, such as key terms or examples. Prior to receiving the interactive homework the student would have had practice with the topic. He or she should be able to explain the basics of the topic. When learning concepts it is helpful to explain them to someone else. If one can successfully explain something to someone else then he or she has established some understanding of the topic. The examples given will help refresh students' memory of the types of problems involved with the given topic.

The next section is the *Let's Find Out* section where the homework task will be described. Roles for the family partner and student are established. Guidelines and tips are provided in

this section. The following section is called *Independent Time*. This section was added specifically for high school students. As students seek to become independent learners, they need opportunities to work independently. However, this level of independence is something that is established over time. Parents can help guide students to this level by acting as homework managers, monitoring work and making sure it gets done. After the independent work is complete the students will share their findings with the family partner.

The last section is the *Home to School Communication* area. The family partner will complete this section by providing their reactions to the assignment. The family partner will answer yes or no the following statements: 1) My student understood the homework and was able to discuss it, 2) My student and I enjoyed the activity, and 3) This assignment helped me to know what my student is learning in math. The family partner also has room to offer comments at the end. The last requirement is for the family partner to offer a signature showing that he or she has completed and approved the work done by the student.

Analysis

The geometric topics focused on in the interactive homework include surface area and volume, scale factor and similarity, and transformations. The integrated model for TIPS geometry homework described in the methodology section suggest that there needs to be evidence of the elements of homework design, funds of knowledge, and geometric habits of mind present in the interactive homework assignments. In this section, these elements will be described for each of the activities.

The first activity is called *Looking for Surface Area and Volume*. The purpose of this assignment is to investigate surface area and volume using items identified in the household. The activity is engaging for the students and family partner as they work together to locate items that resemble the abstract three dimensional figures given. The funds of knowledge used in this assignment relate to the idea that students are looking for things in their household that they see and use every day. They are relying on their own resources and using it as important data. The geometric habit of mind reasoning with relationships is used in this activity as students and family partners compare their household items to the 3D figures given. They are constantly thinking about whether their chosen items possess the same shapes as the given figure. They then experiment with balancing exploration and reflection. If they choose items that do not match well they stop, see why they items do not match, and use that knowledge to find a new item. When the student calculates the surface area and volume he is generalizing those formulas to real life items. The calculations might be messy because often math outside of the textbook tends to not give exact whole numbers.

The second activity that focuses on scale factor and similarity is called *Scale Drawing Photos.* The activity also follows the elements of homework design. It has clear purpose which is stated in its objective: to create scale models of a meaningful photo or item to produce similar figures. The activity is engaging requiring the creativity of the family partner and student. The activity will provide feedback for the teacher as to how students are thinking about scale factor as well as information about the students' culture based on the item they choose. The funds of knowledge are applied here because students are able to bring something that is meaningful to their family into the learning. Students again rely on their own resources in the home. The

geometric habits of mind applied include reasoning with relationships. Students have to consider the lengths of the objects in the photo or item and make sure they are represented accurately in their scale models. Students are investigating invariants. When comparing the original photo or item to the scale factor they will be noting what changed and what stayed the same when they try to explain whether or not the figures are similar. Students are generalizing what they have learned about scaling to apply that knowledge to scale any item. As students construct their scale models they will be exploring what areas of the photo or item they need to pay extra attention to and which areas might not matter as much. They will use this knowledge to draw detail in the scale model.

The last activity titled *Describing Patterns of Reflections, Rotations, and Translations* is focused on basic transformations. Again a clear purpose is stated in the objective. The activity is engaging and interactive and the teacher is provided with feedback. The funds of knowledge again focus on using the students' households as educational resources. Students and family partners will be investigating their households and searching for patterns in areas they interact with regularly. The geometric habits of mind addressed include reasoning with relationships. Students have to investigate patterns and be able to see if the pattern holds symmetry and what type of symmetry. Investigating invariants is important in this activity. As students determine what the pattern is transformed they must point out an original image and see what changes and what stays the same after the transformation. Students will generalize what they know about distinct transformations to all transformations when it comes to figuring out if multiple transformations or compositions of transformations are represented. Students will experience balancing exploration and reflection. As they complete the given chart for each

item they will explain whether or not it has the specified symmetry. Knowledge of knowing one area of symmetry for that item will affect knowledge of other areas of symmetry for that item. In this habit they are using what they have found to help them answer the other questions for that object.

Assessing Interactive Homework

To assess the interactive homework assignments a variety of strategies will be used. Students will first have the opportunity to talk about their work in small groups. They will share with each other items they found, pictures they used, or patterns they located around the house. A list of sample questions will be given for each homework assignment to guide students through group conversations. During the debriefing period of the homework assignments a few students will share aloud with the whole class their work. Throughout the year each student will have a chance to share one of the assignments with the whole class. Students will submit their homework assignments in their folders to the teacher.

To check for understanding, the teacher will develop a short rating scale rubric for each homework assignment based on the objectives or standards addressed by each assignment. The levels used in the rubric will be proficient, emergent, and not evident. The rubrics will give the teacher a quick understanding of where the students are in terms of showing understanding of the objective. They will also help the teacher determine the next instructional steps. The teacher can also provide comments on the rubric as necessary. Students will be given back their folders with rubrics enclosed so that they too have an idea of where they are in

terms of meeting the objective. An example rating scale rubric for the activity *Looking for Surface Area and Volume* can be seen in Figure 3.

To show evidence of growth and parent interaction throughout the school year, students will lastly assemble their interactive homework assignments into a portfolio to be shared with parents, administrators, and other stakeholders. Students will be allowed to choose which assignments they want to include in the portfolio. Students will also include a reflective piece where they might not about why they chose certain pieces or what they learned from completing these assignments. These portfolios will be shared near the end of both semesters to serve as a culmination of student learning and student-parent interaction during homework time.

Figure 3. Sample rating scale rubric for Looking for Surface Area and Volume

Looking for Surface Area and Volume

Objective: To find surface are and volume of 3D solid items identified around the home

Student: _____ Date: _____

	Proficient	Emergent	Not Evident
1. Recognizes 3D objects	☐	☐	☐
2. Uses appropriate units to measure objects	☐	☐	☐
3. Calculation of surface area	☐	☐	☐
4. Calculation of volume	☐	☐	☐

Comments: _____
_____
_____

Implications

TIPS interactive homework can be adapted to the high school Geometry level with some considerations. The assignment must have a purpose and that purpose must be communicated to the student and to the parent. The assignment needs to have an element of independence as students acquire to become independent learners. The assignment must connect to the math content knowledge. Considerations need to be taken into account for diverse learners. For the activities in this project students would be provided with tools to take measurements such as measuring tape or rulers. Linguistic challenges need to be taken into account. Will students and families of all linguistic backgrounds be able to access this assignment?

When giving interactive homework assignments time constraints need to be taken into account. Usually assigning the interactive homework on the weekend is more beneficial for the family partners. The students need plenty of time to coordinate with the family partner's schedule. The design of the assignments also takes time and careful thought.

At the beginning of the school year before the first interactive homework is given parents and students will need support for how to complete these assignments. Open houses at the beginning of the school year, as well as newsletters and emails sent out to the parents, will be a good time to address concerns. Teachers will also need to model interactive homework for the students so that they know how to successfully engage their parents with what they are doing.

More research is needed in the TIPS interactive homework program. From the work done in this project the next step would be to evaluate these activities to consider the effectiveness of this type of program at the high school level. A survey will be administered to high school math

teachers, prospective high school math teachers, and college level math education professors. Using the data in this project, the interactive homework program would be introduced to these individuals, highlighting the purposes and goals of the program. The three sample examples of interactive geometry homework will be shown and described. The educators would then have an opportunity to ask questions about the program. They will then complete a survey where they will give their responses to the following statements on a 1-5 scale, with 5 being strongly agree and 1 being strongly disagree. Each statement will be followed by an area where they can write a comment justifying their position. The statements will be similar to those that follow:

I would use an interactive homework program in my classroom.
Students will like doing interactive homework.
Parents in my school will support this program.
Administrators in my school will support this program.
This program aligns with and supports my goals.
This program will be easy to implement in my school.
Interactive homework will result in greater homework completion.
Interactive homework will improve students' attitude towards math.
This program is accessible for all my students.
The benefits of this program outweigh the costs.

The best things about interactive homework include:
My concerns about this program include:

The results will be interpreted and analyzed and taken into account for measuring the possibility of this type of program in high school.

Conclusion

The purpose of this project was to adapt the Teachers Involve Parents in Schoolwork (TIPS) interactive homework to high school geometry. As students move into upper level math courses many parents feel like they are not equipped to help their children with homework for

a variety of reasons. TIPS interactive homework provides an alternative for parents such that they are not asked to teach any content, but can still be engaged in the homework process.

The form and purpose of homework has changed throughout the history of American education. As students of American education become more diverse the need to adapt curriculum and strategies is necessary to meet this change. Frameworks such as the Funds of Knowledge call for teachers to use students' culture and daily household knowledge as a resource. The funds of knowledge framework extend the learning environment to the home giving students multiple opportunities to engage in meaningful learning experiences.

The Geometric Habits of Mind is another framework that aligns with changes in American math education. As new reform math calls for teaching math to all students, making connections to students' everyday lives, and engaging students in higher order thinking, the geometric habits of mind supports these changes.

A model integrating elements of homework design, the funds of knowledge, and geometric habits of mind supported the foundation for the development of three geometry interactive homework tasks. These tasks focused on big concepts in geometry such as surface area and volume, scale factor and similarity, and transformations.

Assessment of interactive homework calls for students to discuss their work with their peers, get feedback on their work from the teacher, and organize their work in portfolios to share with other teachers, administrators, or community members.

Further research needs to be done in extending TIPS to the high school level. The next steps in this project would be to evaluate the possible implementation of a TIPS geometry program by eliciting feedback from professionals.

References

Bransford, J. (2000). *How people learn: brain, mind, experience, and school*. Washington, DC: National Academy Press.

Coleman, J. et al. (1966). *Equality of Educational Opportunity.* National Center for Educational Statistics. Washington, D.C.: US Government Printing Office.

Cosden, M., Morrison, G., Gutierrez, L., & Brown, M. (2004). The effects of homework programs and after-school activities on school success. *Theory into Practice,* 43(3), 220-226.

Damon, W. & Lerner, R. (2008). *Child and adolescent development: An advanced course.* Hoboken, NJ: John Wiley & Sons, Inc.

De Carvalho, M.E.P. (2001). *Rethinking family-school relations: a critique of parental involvement in schooling.* Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc.

Driscoll, M. (2007). Fostering geometric thinking: a guide for teachers grades 5-10. Portsmouth, NH: Heinemann.

Epstein, J. & Salinas, K. (2004). Partnering with families and communities. *Educational Leadership,* 61(8), 12-18.

Epstein, J. & Van Voorhis, F. (2010). More than minutes: teachers' roles in designing homework. *Educational Psychologist*, 36(3), 181-193. DOI: 10.1207/S15326985EP3603_4.

Gay, G. (2010). *Culturally responsive teaching: Theory, research, and practice.* 2nd edition. Columbia: Teachers College Press.

Ginsberg, L., Rashid, H., English-Clarke, T. (2008). Parents learning mathematics: for their children, from their children, with their children. *Adult Learning,* 19(3&4), 21-26.

Gonzalez, N., Andrade, R., Civil, M. & Moll, L. (2001). Bridging funds of distributed knowledge: creating zones of practices in mathematics. *Journal of Education for Students Placed at Risk,* 6(1&2), 115-132.

Hoover-Dempsey, K., Battiato, A., Walker, J., DeJong, J., Reed, R. & Jones, K. (2001). Parental involvement in homework, *Educational Psychologist,* 36(3), 195-209.

Kreider, H., Caspe, M., Kennedy, S., & Weiss, H. (2007). Family involvement in middle and high School students' education. *Family Involvement Makes a Difference, Harvard Family Research Project,* 3, 1-12.

Larson, R., Boswell, L., Stiff, L. (2004). *Geometry.* Evanston, IL: McDougal Littell, a division of Houghton Mifflin Company.

Moll, L., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching: using a qualitative approach to connect homes and classrooms. *Theory into Practice,* 31(2), 132-141.

No Child Left Behind Act (2001). Washington, DC: US Department of Education.

Patall, E., Cooper, H., Robinson, J. (2008). Parent involvement in homework: a research synthesis. *Review of Educational Research,* 78(4), 1039-1101. DOI: *10.3102/0034654308325185.*

Simon, B. (2004). High school outreach and family involvement. *Social Psychology of Education,* 7, 185-209.

Sirvani, H. (2007). The effect of communication with parents on students' mathematics Achievement. *American Secondary Education,* 36(1), 31-46.

U.S. Congress. (2000). GOALS 2000 Legislation. Washington, D.C.

Van Voorhis, F. (2004). Reflecting on the homework ritual: assignments and designs. *Theory into Practice,* 43(3), 205-212.

Van Voorhis, F. (2011). Adding families to the homework equation: a longitudinal study of mathematics achievement. *Education and Urban Society,* 43(3), 313-338. DOI: 10.1177/0013124510380236.

Viadero, D. (2009). Parent-school ties should shift in teen years. *Education Week,* 29(12), 1-14.

Student's Name: _____ Date: _____

Looking for Surface Area and Volume

Dear Family Partner,

In geometry, we are studying **Surface Area and Volume.** Please help me identify 3D shapes around the house to measure so I can find the surface area and volume of the items. I hope you enjoy this activity with me. This assignment is due _____.

Sincerely,

_____

(Student's Signature)

OBJECTIVE: To find the surface area and volume of 3D solid items identified around the home.

Who is your family partner?

Name: _____ Relationship: _____

LOOK THIS OVER: **Explain the following vocabulary words and examples to your family partner.**

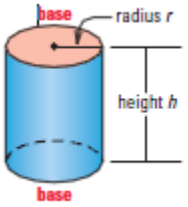
Surface Area is the sum of all the areas of all the shapes that cover a figure.

Volume is the amount of space an object occupies. It is the amount of space enclosed in a figure. Volume can be found in terms of multiplying the area of the base times height.

Example

8 in

6 in



Surface area of soup can: total area of all the faces =

+

The diameter of the can is 6 in. so the radius is 3 in. Then the area of the top of the can is $A = \pi r^2 = \pi * 3^2 = 9\pi$. The area of the bottom of the can is 9π.

The net for this figure shows that the lateral area is equal to the perimeter of the base x height. So the area for this part of the can is $2\pi rh = 48\pi$.

Thus the total surface area is $9\pi + 9\pi + 48\pi = 66\pi\ in^2\ or\ 207.3\ in^2$

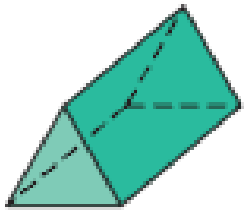
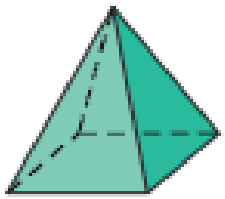
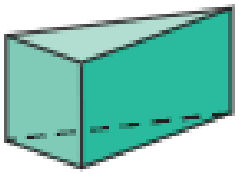
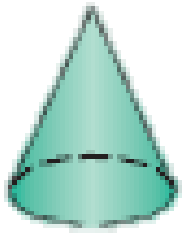
Volume of soup can: area of the base x height

In the previous example, the area of the base is $9\pi\ in^2$ and the height is 8 in.

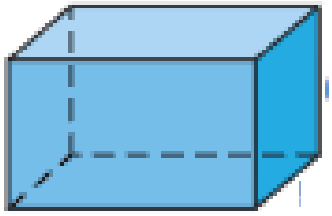
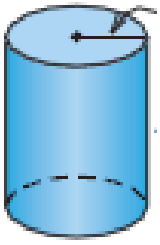
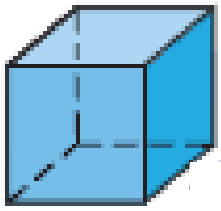
So the volume of the can is $(9\pi)(8) = 72\pi = 226.2\ in^3$.

LET'S FIND OUT: With a family partner, locate items around the house or community that resemble the shapes below. Determine the dimensions of the shapes using the appropriate measurements (in, cm, ft, etc). Describe the item and its dimensions in the space below each figure. Example items might include but are not limited to foods, containers, cleaning products, decorative items, boxes, or clothing.

Student's Name: _____ Date: _____

_____ _____ _____ _____

_____ _____ _____

INDEPENDENT TIME: On a separate sheet of paper find the surface are and volume for each item you found. Be sure to include the dimensions of the figures. You may refer to your textbook as a reference. Explain and show your work to your family partner. Family partners ask to see work.

HOME TO SCHOOL COMMUNICATION:

Dear Family Partner,

Thank you for working on this activity with the student. Please give me your reactions to your student's work on this activity. Write YES or NO for each statement.

_____ 1. My student understood the homework and was able to discuss it.
_____ 2. My student and I enjoyed the activity.
_____ 3. This assignment helped me to know what my student is learning in math.

Other Comments:

_____
_____
_____

Family Partner Signature: _____

Student's Name: _____ Date: _____

Scale Drawing Photos

Dear Family Partner,

In geometry, we are studying **Scale Factor and Similarity.** Please help me create similar figures by creating scale models. I hope you enjoy this activity with me. This assignment is due _____.

Sincerely,

_____

(Student's Signature)

OBJECTIVE: To create scale models of a meaningful photo or item to produce similar figures.

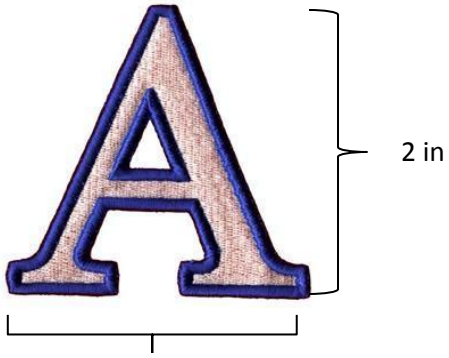
Who is your family partner?

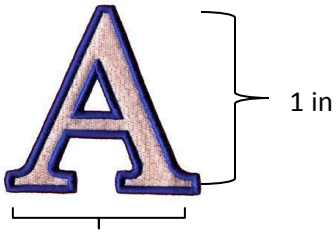
Name: _____ Relationship: _____

LOOK THIS OVER: Explain the following vocabulary words and examples to your family partner.

Scale factor is a number that scales, or multiplies, some quantity. It describes how much something enlarges or shrinks.

Similarity – Two objects are similar if they have the same shape. If one figure is equal to the other as a result of enlarging or scaling then they are similar. Corresponding sides of similar figures are proportionate. If two figures are similar then the ration of the lengths of the corresponding parts is called the scale factor.





The corresponding heights are 2 in. (big A) to 1 in. (little A) or 2:1 or $\frac{2}{1} = 2$.

The corresponding widths are 4 in. (big A) to 2 in. (little A) or 4:2 or $\frac{4}{2} = 2$.

Since the ratios are equivalent for both corresponding sides the two letters are similar, and they have a scale factor of 2. The big letter A is twice as large as the small letter A.

LET'S FIND OUT: Interview your family partner by asking them the following question.

What are some examples and uses of scale models today? (List three)

_____

_____

_____

Student's Name: _____ Date: _____

With a family partner, find a photograph around the house of something that is meaningful to your family. If you do not have a photo pick an object in the house that represents your family or that is significant to your family. Using the appropriate measurements (in, cm, m, etc.) determine the lengths of the things in the picture or item. Record these measurements. Pay attention to detail as they will help in your scale drawing.

INDEPENDENT TIME: Using a scale factor of your choice enlarge or shrink the item or photo. Pay close attention to detail within the photo or item. The model must be as accurate as possible. When you have constructed your scale model determine whether or not the two figures are similar. Show and explain your work to your family partner. Family partners ask to see work.

Discuss the importance of the photo or item you chose with your family partner. Be prepared to share these stories with the class.

HOME TO SCHOOL COMMUNICATION:

Dear Family Partner,

Thank you for working on this activity with the student. Please give me your reactions to your student's work on this activity. Write YES or NO for each statement.

_____ 1. My student understood the homework and was able to discuss it.
_____ 2. My student and I enjoyed the activity.
_____ 3. This assignment helped me to know what my student is learning in math.

Other Comments:

_____
_____
_____

Family Partner Signature: _____

Student's Name: _____ Date: _____

Describing Patterns of Reflections, Rotations, and Translations

Dear Family Partner,

In geometry, we are studying **Transformations.** Please help me identify patterns of reflections, rotations, and translations around the house. I hope you enjoy this activity with me. This assignment is due _____.

Sincerely,

_____

(Student's Signature)

OBJECTIVE: To investigate patterns of reflections, rotations, and translations around the house.

Who is your family partner?

Name: _____ Relationship: _____

LOOK THIS OVER: Explain the following vocabulary words and examples to your family partner.

Reflection is a type of transformation that produces a mirror image of the original image. Objects are reflected over a line of reflection.

Rotation is a type of transformation that turns the original image in a certain direction and by a certain amount. Objects rotate about a point of reflection.

Translation is a type of transformation that shifts or slides the original image in a certain direction and by a certain amount.

LET'S FIND OUT: Work with a family partner to find patterns throughout your home. The family partner will identify at least two patterns in each area of the home described in the first column of the chart. Describe or sketch those items in the first column of the chart so that the pattern is represented.

Area / Item with patterns	Lines of Symmetry	Rotational Symmetry (Y or N) if Yes describe	Reflection Symmetry (Y or N) if Yes describe	Translation Symmetry (Y or N) if Yes describe	Multiple Transformations (Y or N) if Yes describe
Bathroom					
Kitchen/Dining					

Student's Name: _____ Date: _____

Common Room					
Bedroom					
Yard					

INDEPENDENT TIME: After the items have been identified, complete the rest of the above chart. For each item, identify the number of symmetry lines. Then identify if the pattern has rotational symmetry, reflection symmetry, or translation symmetry. Describe the symmetry. A pattern can have more than one type of symmetry. Then determine if the pattern represents a pattern of multiple transformations (e.g. double reflections, a combination of rotation and reflection, etc.). Share the completed chart with your family partner.

Student's Name: _____ Date: _____

HOME TO SCHOOL COMMUNICATION:

Dear Family Partner,

Thank you for working on this activity with the student. Please give me your reactions to your student's work on this activity. Write YES or NO for each statement.

_____ 1. My student understood the homework and was able to discuss it.
_____ 2. My student and I enjoyed the activity.
_____ 3. This assignment helped me to know what my student is learning in math.

Other Comments:

_____
_____
_____

Family Partner Signature: _____