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Development of a Teacher Identification Form of Student Interest in Mathematics

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DEVELOPMENT OF A TEACHER IDENTIFICATION FORM OF
STUDENT INTEREST IN MATHEMATICS

A Thesis
Presented to
The Faculty of the Department of Psychology
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Specialist in Education

Sarah E. Thompson

August 2010

**DEVELOPMENT OF A TEACHER IDENTIFICATION FORM OF
STUDENT INTEREST IN MATHEMATICS**

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Directed by: Dr. Steven R. Winger, Dr. Pitt Derryberry, and Dr. Julia Roberts

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Comparing the mathematics performance of American students to their counterparts in other countries has been a common theme in recent literature, with conclusions generally finding that American students are falling far behind. One response to this problem may involve research which has shown a modest positive correlation between student interest and achievement in math (Koller, Baumert, & Schnabel, 2001; Schiefele, Krapp, & Winteler, 1992). Being able to identify students with high levels of interest in math may allow educators to provide advanced instruction to such students.

Current measures of student interest in mathematics are lacking in that they often are not based on any one theory, they do not cover all characteristics of individual interest, and are based on a self-report format. Therefore, the goal of this thesis was to develop a teacher identification form of student interest in mathematics to add to the literature a psychometrically sound measure of student interest in math which is assessed by classroom teachers instead of the students themselves.

The teacher identification form was developed based on the characteristics of individual interest as defined by Hidi and Renninger's (2006) Four-Phase Model of Interest Development. To determine reliability and validity of the form, second through sixth grade math teachers in six elementary schools in Warren County, KY completed the

form both in a pilot study and also later as part of an identification process for students to receive advanced math instruction.

For the purposes of data analysis, results were separated by grade. Reliability estimates for the form, as indicated by Cronbach's alpha, were found to be .934 for third grade, .925 for fourth grade, and .901 for fifth grade. The overall Cronbach's alpha for grades two through five was .926. These high reliability coefficients indicate high consistency among the items.

Validity of the identification form was established by correlating results with the Iowa Tests of Basic Skills (ITBS) math section, a standardized assessment taken by all students in the six schools. Correlations between teacher identification rating composites and ITBS math scores were as follows: .379 for third grade, .417 for fourth grade, and .460 for fifth grade. The sixth grade data set was incomplete, and thus that correlation for was .300. Each individual item on the identification form and the grade composite scores all correlated with ITBS math scores significantly at the .01 level, indicating sufficient validity of the form.

An important observation about the results is that the highest validity coefficients as well as the narrowest range of correlations were found for fifth grade data. The next highest correlations were found for fourth grade, and the lowest correlations and widest range of correlations were found for third grade data. The possibility that this pattern of results may be due to better developed individual interests of older students or that students' individual interests are more easily identified by their teachers in higher grades is discussed.

Literature Review

A significant amount of recent research has been conducted regarding the differences between students' academic performance in the United States and other foreign countries, specifically in mathematics. Unfortunately, what the trends seem to be showing are patterns of students in the United States performing significantly below students in other countries in terms of school achievement and performance on standardized tests. One project demonstrating this recent trend is the Trends in International Mathematics and Science Study (TIMSS; National Center for Education Statistics, 2007), sponsored by the National Center for Education Statistics (NCES) and the International Association for the Evaluation of Educational Achievement (IEA). This large, ongoing project annually measures math and science achievement of fourth grade and eighth grade students in up to 48 countries around the world, including the United States. The most recent results from the TIMSS project (NCES, 2007) revealed that students in the United States are performing significantly below students in eight mostly Asian countries in the fourth grade, and significantly lower than five Asian countries in the eighth grade in terms of math performance.

Another large-scale research project dedicated to this issue is the Programme for International Student Assessment (PISA; Organisation for Economic Co-Operation and Development, 2006), in which the academic performance of 400,000 15-year olds from 57 countries around the world is measured. The most recent results from PISA paint a grim picture for the United States: the United States' score in mathematics achievement (474) was significantly lower than the Organisation for Economic Co-Operation and Development (OECD) average of 500, as well as below the scores of 34 of the 57

countries participating in this project. The fact that there are so many other countries outperforming the United States in mathematics in the fourth and eighth grades as well as in samples of 15-year olds is most definitely a cause for concern.

Despite all of this research evidence showing the United States' unsatisfactory performance in mathematics, it is unclear about what should be done to remedy this problem. One starting point may be to identify students who show an increased amount of interest in mathematics and to do more to help facilitate the learning of these students. Or, it may be more practical to attempt to strengthen interest in math for all students. Either way, research has supported a relatively strong correlation between students' level of interest and their corresponding academic performance in mathematics. In a meta-analysis of research regarding all main school subjects, a 0.31 correlation was found between academic achievement and level of student interest in the corresponding subject matter (Schiefele et al., 1992). Specifically in the area of mathematics, there was an average of a 0.32 correlation found across the literature regarding the relationship between achievement and interest in mathematics, with a standard deviation of 0.086 (Schiefele et al., 1992). This is a moderate correlation, indicating that students who are more interested in math are more likely to be successful in the subject in school.

A similar study conducted in Germany, however, found a somewhat different explanation for this relationship between interest and achievement. Koller et al. (2001) found that interest did not have a direct significant effect on students' math achievement after controlling for previous knowledge. Instead, it was shown that students with high levels of interest were more likely to choose an advanced course in mathematics when given the option, and therefore increased their subject knowledge through those courses.

The same study also explained that when students have low levels of interest, this negatively affects their motivation to learn and subsequently negatively affects their math achievement (Koller et al., 2001). Therefore, having a well developed interest in math not only facilitates increased knowledge and achievement, but a lack of interest can have the opposite effect.

Because mathematics is such a difficult subject for so many students, it seems reasonable that students who are interested in math are more likely to put forth the hard work and effort to achieve more in the classroom, and to go above and beyond what is required for them to pass their class. Therefore, being able to identify students who have high levels of interest in mathematics might enable educators to identify students who are more likely to succeed in the area of mathematics. However, before any of this can be done, it is first necessary to provide an operational definition for the term interest, and to understand how it can be objectively measured.

Like many other areas of research, the construct of interest has gone through ups and downs in terms of popularity as an experimental topic. However, interest has been linked to the ideas of philosophers and psychologists as far back as Herbart in the 1800's, William James in the 1890's, and John Dewey in the early 1900's. Herbart was a German philosopher who proposed that interest leads to long-term learning and knowledge, as well as motivation for future learning (Schiefele, 1991). One of Dewey's main contributions to the field of interest research was his book, *Interest and Effort in Education* (1913), in which he proposed that interest guarantees students' attention. In this book, Dewey characterized interest as being a unified activity which is active, objective, and personal. He also emphasized the difference between interest and effort, in

that effort leads to a separation between the individual and the activity or task at hand (Dewey, 1913). The concept of interest was also important in many ways to William James's famous work, in which he refers to "selective interest" many times as giving attention to some things but not others. According to James, "Our *interest in things* means the attention and emotion which the thought of them will excite, and the actions which their presence will evoke," (James, 1890, p. 320). These early views of interest were mainly based on philosophical ideas, with little or no supporting empirical evidence to reinforce their views (Schunk, Pintrich, & Meece, 2008).

During the time when behaviorism was the more popular view in psychology, researchers focused on overt behaviors, and little attention was given to the topic of interest because it was not something that could be directly observed or measured. However, during the 1980's and 1990's when the cognitive psychology movement was gaining strength and popularity, researchers refocused on the fact that some components of interest were not accounted for in previous theories of interest, and have since devoted much time and effort to defining and measuring interest. A common theme in this renewed attention to the construct of interest has been that interest results from the interaction between an individual and the environment (Krapp, Hidi, & Renninger, 1992).

Another widely accepted idea in current interest literature is that there are two main kinds of interest: individual/personal interest and situational interest (Hidi & Renninger, 2006; Mitchell, 1993; Schiefele, 1991). Individual interest refers to a relatively stable psychological state in a person which makes that person more likely to reengage in the content of interest over a period of time, whereas situational interest is when the context of the situation initially draws a person's attention, but that interest does

not last longer than the context of the situation. It is mostly agreed upon by researchers that situational interest is the initial building block for the development of individual interest to occur. However, there have been some contrasting views about whether or not situational interest must remain for individual interest to persist. Hidi and Renninger (2006) theorize that situational interest does not have to be maintained for individual interest to continue to develop. On the other hand, Mitchell and Gilson (1997) conducted a study investigating this issue examining the relationship between students' situational interest in the classroom, individual interest in mathematics, and anxiety towards mathematics. It was found that in general, classroom environments that were rated high in situational interestingness were associated with increases in students' individual interest, whereas classrooms with low levels of situational interest were associated with decreased individual interest. These results show us that situational interest can be the building blocks for individual interest, but also that if situational interest is not present, it may be likely that a person's individual interest in a topic may decrease. However, it is unclear from this study as to whether students in classrooms with low situational interest previously had high levels of individual interest which decreased due to the nonstimulating classroom or whether the students never fully developed an individual interest in the first place.

Even though this distinction between individual interest and situational interest is commonly seen in the current literature, there are still some researchers who do not make this distinction. This brings us to one of the main drawbacks in studying the history of interest research, which is that researchers have defined interest in a wide variety of ways, making it hard to provide a consistent definition of interest that applies to all

previous research. Some past researchers who claimed to have been studying interest might really have been studying similar constructs, such as intrinsic motivation, but not necessarily interest. There is even a wide range of definitions of interest in modern research. For example, Renninger defines individual interest as including both high value for an activity and a high amount of stored knowledge about the content area or activity (Renninger, 1992). In contrast, Tobias (1994) has defined individual interest as consisting of a high value component, but not necessarily high previous knowledge. Although high amounts of knowledge may be present, it is not a requirement, and it is possible for a person to have high value and a low amount of knowledge about something, but still have an interest in that area. According to Tobias, although this high-value, low-knowledge category may not occur frequently, it might be found more often in children, who may not know much about a specific topic or activity but still value and have interest in the topic.

These contrasting views on the role of previous stored knowledge in individual interest and whether situational interest must persist for individual interest to be present are just two examples of the many theoretical differences found between different researchers' perspectives on the construct of interest. Until recently there has been no completely thorough theoretical model that describes interest and how it develops which could be used by researchers to maintain a consistent way to study the construct of interest. Currently, Hidi and Renninger's (2006) Four-Phase Model of Interest Development has thus far provided the most thorough description of the stages through which interest progresses as it develops, as well as including the important components of

cognition and affect. For this reason, Hidi and Renninger's model was chosen for use as the foundational theory for this project.

Hidi and Renninger's (2006) model was based on the fundamental differences between situational interest and individual interest; however, these two categories are broken down even further into two phases of situational interest and two phases of individual interest. One of the basic assumptions of this model is that an individual progresses through the four phases in a developmental, sequential order, with the lower phases being necessary before the higher phases of interest can occur. Another important assumption of this model is that even though interest tends to start at the first phase and progress through the four phases sequentially, this is the complete process of interest development, and many interests do not progress through all four stages. Just because something starts out at the first stage of interest does not mean it will necessarily develop to the second phase of interest, or the third or fourth. Also, if interest in any particular phase of development is not sustained either through the individual's perseverance or through external supports, it is possible for interest to regress to a previous phase or to be terminated altogether. For the purpose of this model of interest development, the broad concept of interest is defined as, "a psychological state that, in later phases of development, is also a predisposition to reengage content that applies to in-school and out-of-school learning to young and old alike" (Hidi & Renninger, 2006, p. 111).

The first phase in Hidi and Renninger's (2006) model is triggered situational interest, which occurs when people find something in the environment that is engaging to them, such as a magazine article, a puzzle, or an attractive computer program. This phase is typically accompanied by positive affect when they become excited, surprised, or

happy when they come across the content which triggers their interest. However, this phase could also occur with negative affect, such as when students are scared into doing something by a teacher or parent, or when people see something that makes them feel sad or angry, such as seeing a story about a devastating natural disaster on a news program. Triggered situational interest is usually externally supported, meaning that interest in this phase occurs because of something that occurred or was observed in the environment, and not because of an individual's motivation or other internal factors. This phase is also associated with short-term cognitive and affective changes, and although it could lead to maintained situational interest, the second phase, this does not always occur.

In the phase of maintained situational interest, individuals continue to be involved with that which they initially found engaging. People in this phase of interest development are likely to feel some kind of personal involvement with the content, and also might begin to place some value on the content, meaning that the content could be useful in some way (Hidi & Renninger, 2006). An example of this might be a student coming across an article online about a new career that she had never heard of before. If she does further research on that career because she is considering it as a possible future career path, then she is likely to be in the maintained situational phase of interest development. Similar to the first phase, maintained situational interest is mostly externally supported.

The first two situational phases of interest are a necessary foundation for the third phase of interest development, known as emerging individual interest. It is during this phase that the interest becomes a relatively enduring psychological state, meaning that individuals in this phase of interest development would most likely pursue their interest

even if faced with a challenge but only with encouragement. This external support required for continuation at this phase of interest development might come in the form of similarly interested peers or instructional supports from teachers. Emerging individual interest is typically self-generated, and is characterized by positive affect, as well as knowledge about and value for the content. A student with an interest in this phase of development would most likely go above and beyond set requirements in assignments that involve the content area of the student's interest (Hidi & Renninger, 2006).

The fourth and final phase of interest development in Hidi and Renninger's (2006) model is well-developed individual interest, which is characterized by even more positive affect, knowledge, and value than in the emerging phase of individual interest. A person in this phase of interest development would be likely to continue to learn about and engage in the content area even when faced with challenges and even if facing the challenges alone. This phase of interest is self-generated, and individuals would not need many external supports to maintain interest once they reach this phase. Additionally, the fourth phase is characterized by more advanced learning strategies than any other phase regarding the content of interest. Phases three and four are similar in that in both phases, people will choose to engage in that particular content if given an option. Also, in both phases, people tend to generate their own questions about the content, but it is not until phase four that someone would go out and search for answers to such questions.

Each phase in the model includes both cognitive and affective components. It is in the situational phases of interest development when positive affect is most important because it is one of the best indicators of interest during those phases. However, during individual interest, knowledge and value are more important, yet positive affect still plays

a role. It is during these two later phases that an individual has reengaged in the content area more often, and thus has a better developed knowledge base for the content.

Another important aspect of this model is that even when individuals reach phases of individual interest, they are still capable of feeling situational interest for the same content for a brief period of time. For example, students with a well-developed individual interest in mathematics may still experience triggered situational interest in math if they were to be exposed to a new and appealing computer program designed to teach a mathematics concept in a fun way.

Using Hidi and Renninger's (2006) model of interest development thus provides the structure necessary to study and measure the construct of interest, which, as mentioned before, has been shown to be positively correlated with academic achievement. Similarly, interest has also been shown to be associated with deeper levels of cognitive processing. In several studies conducted by Schiefele (1991), it was shown that participants with high levels of interest in a subject matter were able to better answer questions about a text that they had read when the questions required a deep level of cognitive processing. This effect was not weakened even after knowledge and intelligence were accounted for. Also in a study by Schiefele (1991), highly interested participants were able to recall more components about a text that required deeper levels of cognitive processing, such as inferences and coherence of the text. What these results reveal is that because interest has been shown to be related to academic achievement as well as deeper levels of cognitive processing, it is of great importance to be able to measure interest using Hidi and Renninger's (2006) complete model in order to identify students who possess a high level of interest in mathematics.

Though there are no current measurement instruments reflecting Hidi and Renninger's (2006) model, interest as a broad construct has been measured in a wide variety of ways in the past. Unfortunately, interest specifically in mathematics has been less often the focus of these measurements. The literature reveals that the few instruments designed to assess students' interest in mathematics are self-report measures, and many of them do not even differentiate between situational and individual interest. One example of an existing measure of interest that does specially assess individual interest is the Mathematics Interest Inventory (MII) (Stevens & Olivárez, 2005). In their article concerning the development of this instrument, authors Stevens and Olivárez address the issue of the lack of empirically validated interest measures, and how this affects education. It is noted that being able to reliably and validly measure students' levels of interest in mathematics would make it easier for educators to plan individualized instruction and/or or interventions for students to help increase their level of interest in math. Therefore, the authors developed the MII in order to create a psychometrically sound measure of individual interest in mathematics that is based on knowledge, value, and positive emotion components. In the development of this instrument, Stevens and Olivárez created items based on a current review of the literature, and not one set theory, a possible weakness of this instrument. However, they did reference the difference between situational and individual interest as proposed by Hidi (2001).

The MII was standardized based on a sample of 724 students ranging from fourth to tenth graders. It is a self-report format with statements that students respond to using a Likert-type rating scale (1= *describes me not at all* and 7 = *describes me extremely well*). The MII consists of 27 items and attempts to measure the knowledge, value, and

emotional components of interest through items such as, “I give up easily when working on math,” “I want to talk about math with my friends,” and “I work more math problems than what I have to.” However, Stevens and Olivárez (2005) express concerns that these components as represented in the MII may not accurately reflect individual interest, and that students filling out the MII may instead be responding to the items based on their feelings of experiential states of interest. Although it has not been empirically supported, they suggest that these experiential states of interest would most likely not be reflected in students’ achievement in mathematics and that relationship would more likely be found with individual interest. Reliability evidence for the MII includes an internal consistency estimate of 0.87, as well as internal reliability estimates of 0.94 and 0.93 from two different sample administrations. Validity evidence for the MII is limited to three concurrent validity studies, in which correlations between scores on the MII and students’ mathematics grades were calculated, revealing correlations of 0.60, 0.32, and 0.37 for the three groups of students. Based on this data, the authors conclude that as interest in mathematics increases, grades increase as well.

Other recent work focusing on attempts to measure students’ interest in mathematics has been conducted by Mitchell (1993) and Singh, Granville, and Dika (2002). Both have developed instruments to assess student interest through self-report questionnaires. Mitchell (1993) based his instrument on the fundamental differences between situational interest and personal interest, which was established in the literature by Krapp (1989). According to Mitchell, personal interest can be described as an interest that people bring to a situation, therefore making it parallel to individual interest. Krapp’s (1989) theory also proposes that situational interest and personal interest are

related, in that an environment high in situational interest might contribute to an individual's increased personal interest over time. Working from this theory, Mitchell (1993) developed the Situational Interest Survey (SIS), which is composed of 45 items with Likert-type responses ranging from *strongly disagree* to *strongly agree*. Although the focus of this measure is on situational interest, the SIS also contains a personal interest (PI) component which consists of four items which are prefaced by the following instructions: "*Think about how you felt about mathematics before the school year began.*" These instructions help students to focus on their interest in the subject area of math, and not just a specific class or teacher. Examples of items from the PI component of the SIS include, "I have always enjoyed studying mathematics in school," and "Compared to other subjects, mathematics is exciting to me." There is only limited psychometric evidence reported for this measure, especially for the personal interest portion. An internal consistency analysis revealed a reliability estimate of 0.92 for the personal interest section of the measure. However, it must be kept in mind that this portion of the instrument only consisted of four items, and therefore this reliability may be questionable. Mitchell (1993) also reports that the overall instrument includes some evidence for construct validity, but no statistical evidence is provided and thus the validity of this instrument is limited.

Singh et al. (2002) conducted a study looking at the relationship between middle school students' achievement in math and science, their motivation, academic engagement, and attitude/interest. In this case, interest in and attitude about mathematics were viewed as one latent construct and thus were measured using the same items. These mathematics attitude/interest items on the self-report questionnaire consisted of three

statements, with responses in a Likert-type format from *strongly agree* to *strongly disagree*. These items measured things such as whether the student reports ever being bored at school, whether the student thinks math is useful in his/her future, and whether or not the student looks forward to math class. Because a significant relationship was found between attitude/interest and math achievement, many suggestions on how to increase students' interest in subjects were provided. However, this measure also shows how many current researchers differ in their views on interest and the way it should be measured. Singh et al. did not give a specific definition of interest for their research, and in fact they did not even distinguish interest from students' attitudes. Therefore, it makes one wonder whether the construct of interest or another similar trait was actually being measured.

One limitation to the interest measures of both Mitchell (1993) and Singh et al. (2002) are the short lengths of the (individual) interest components of their measures. Because there are very few items, whether the items account for the entire construct of individual interest is questionable. While Stevens and Olivárez's (2005) MII is composed of significantly more items, what all three measures have in common is their use of the self-report format, which is another potential limitation. Although these assessments do provide lots of valuable information about the students' self-perceived interests in mathematics, some concerns do arise about this format, especially when the instruments are used with elementary age groups of children. Being able to fill out a survey about one's own interest in a subject requires some degree of self-awareness, which may be difficult for such young children (Schunk et al., 2008). Additionally, it may be difficult for students to provide accurate information about their level of

individual versus situational interest if they do not understand the conceptual difference between the two types of interest. For example, if a measure is given to a group of first-grade students that is inquiring about their level of individual interest in a topic, they may mistakenly think about a time when they did a fun activity related to the topic at school, and focus on that when filling out the survey, when in actuality the interest in the topic felt by the child has not developed into an individual interest. The problem therefore is that even though self-report measures of interest are generally quick and easy to give, they may not always provide the researcher with the most accurate representation of the student's individual interest or lack thereof, especially in young children.

Purpose of Current Study

In response to this problem, the development of an instrument that allows classroom teachers to assess accurately the individual interest of their students was the main purpose of the current project. Other than the student, the teacher would be the individual most likely to have the most experience with the student and the topic of interest. Using a teacher's response format instrument in compilation with other available information on student interest (i.e., self-report measures and direct observations) would allow for a more complete understanding of students' individual interests in mathematics. This project and the development of this instrument is just one part of an overarching project aimed at developing a process to identify students who would benefit from advanced mathematics and science instruction.

When teachers are currently given questionnaires about their students' involvement with mathematics, they are typically more content specific and do not involve well developed interest components. For example, in the TIMSS project

mentioned at the beginning of this article, there is a teacher questionnaire that accompanies the research which is given to the teachers responsible for the students being tested for math and science achievement. In the most recent TIMSS (2007) study, the teacher questionnaires developed for this purpose focused on how well prepared the teacher felt that the students were for the specific math topics covered in the test, and other specifics about the everyday classroom environment, such as whether or not the students were allowed to use calculators to solve problems and how often students were required to do homework.

Because these content specific questionnaires are the closest thus far to teacher's assessments of their students' relationship with math, there is a clear need for a new instrument that is designed specifically to measure teacher's perceptions of their students' level of individual interest in math. Having this information available makes it possible for more accurate recommendations and individualized instructional planning for students with differing levels of interest in math. Also, being able to identify students with well developed individual interests in mathematics would better enable teachers to identify those students who are more likely to succeed and to persevere when faced with challenging situations dealing with math. These students are the ones who would most likely benefit from receiving gifted instruction in mathematics, which is why this new instrument will be used to aid in selecting students from several elementary schools in the Warren County, Kentucky area who will be receiving accelerated mathematics instruction through a specialized program (Roberts, 2008).

Methods

Participants

Teachers who completed the identification form included mathematics teachers of second through sixth grade students at six elementary schools in Warren County, Kentucky. Teachers were given a cover letter containing instructions about how to complete the identification form, with the form attached. Both the cover letter and the identification form are included in the appendix. As indicated in the cover letter, the teachers were assumed to be giving their implied consent to participate in this project upon completion of the form.

Operational definitions

Before developing any type of measurement instrument, it is first important to provide an operational definition for the construct being measured, which in this case is both interest and mathematics. Most of the focus thus far has been on understanding and defining what is meant by the term interest and how individual interest can be measured depending on its definition. However, for the purpose of review, the definition of individual interest which is being used in designing this new instrument is “a relatively enduring predisposition to reengage particular contents over time,” (Hidi & Renninger, 2006, p. 111). While providing a definition for mathematics may seem like a more self-explanatory task, it is still difficult to encompass all different areas of mathematics that would be relevant to this project. Instead of an explanation, a definition was chosen that is mostly a compilation of examples of what is meant by the term mathematics at the elementary school level. For the purpose of this project, mathematics was defined as counting, adding, subtracting, multiplying, dividing, using fractions, decimals, tables, graphs, charts, equations, geometry, symmetry, and number problems.

The next step was to examine closely Hidi and Renninger's (2006) Four-Phase Model of Interest Development, the chosen theory of interest development. The four phases included in this model clearly identify the stages through which interest can develop, and also includes important affective and cognitive components. Wininger (2008) created the two tables below summarizing his understanding of the main components of Hidi and Renninger's (2006) theory, which was useful in organizing and clarifying all of the information.

Table 1

Key Characteristics of the Four Phases of Interest Development

Phase	Defining characteristics	Locus of interest	Means of support
Triggered Situational	Catching one's attention; "attraction"	External	Puzzles, computer-adapted lessons, group work
Maintained Situational	Sustained attention via meaningfulness or personal involvement	External	Project-based learning, cooperative learning, one-on-one tutoring
Emerging Individual	Positive feelings towards, knowledge of, and value for a topic; self-generated curiosity	Internal	Learning is typically self-motivated but still requires instructional support from teachers & encouragement when confronted with difficulty
Well-developed Individual	Positive feelings towards, knowledge of, and value for a topic; self-generated curiosity (would we see "increased" knowledge here?)	Internal	Learning is typically self-motivated & is characterized by effortless learning, more advanced learning strategies, and perseverance when confronted with difficulty

Table 1, above, summarizes strictly what was inferred to characterize Hidi and Renninger's model, including defining characteristics, the locus of the interest, and the means of support for each phase of interest.

Table 2

Six Potential States of Interest

	Positive Emotions	Value	Knowledge	Meta-cognitive (Self-efficacy & learning strategies)
Indifference	Absent	Absent	Absent	Weak
Triggered situational	Present	Absent	Absent	Weak
Maintained situational	Present	Present	Absent	Weak
Emerging Individual	Present	Present	Present	Moderate
Well-developed individual	Present	Present	Present	Strong
Noninterest	Absent	Absent	Present	?

Table 2, above, is an extension of Hidi and Renninger's original four phases, but also includes indifference and noninterest as other potential states along the interest continuum. Wininger's tables were reviewed by one of the original authors, Suzanne Hidi, through an email contact, who confirmed that this conceptualization was consistent with what she and K. Renninger had intended in the model (S. Wininger, personal communication, May 2009). Personal contact was also made by Wininger with K. Renninger over the telephone, who also clarified some details regarding the tables (S. Wininger, personal communication, May 2009).

Instrument Development Procedure

After having a confirmed conceptual understanding of the chosen interest development model, I created questions for the new teacher assessment of student interest based on this understanding and the key characteristics described in Table 1. Student characteristics covered in the questionnaire included positive affect towards math, math knowledge, valuing math, confidence in math abilities, curiosity about math, advanced problem solving strategies, and perseverance when faced with difficulty. Preliminary data were collected by giving the questionnaire to 30 second through fifth grade mathematics teachers who used the form to identify their three top students in each area. Because the purpose of this questionnaire was to help identify interested students in math as part of a program to identify gifted students, the questions only reflected key characteristics of the stages of individual interest, not situational interest. As previously described, situational interest involves the generation of surface-level interest due to a stimulating environment or subject matter, while our focus was on individual interest, the more enduring, trait-like form of interest more likely to be found in gifted students.

Several minor changes were made to the format and instructions based on the feedback from teachers in the preliminary data collection, one of which was adding spaces for teachers to identify their top five students instead of just the top three. The final draft of the questionnaire is included in the appendix. An issue of concern that had to be addressed was what to do when students who were technically enrolled in one grade were placed in a more advanced math grade due to their gifted abilities. For example, there was one student who was in the second grade, but was in a third grade classroom just for mathematics because she was so advanced. This particular student's name

appeared on both second and third grade interest identification forms, which caused problems in scoring. In response to this issue, the directions had to be clarified to state specifically what should be done in the particular cases of such students, and example scenarios were given in the cover letter to the teachers introducing the form to help reduce confusion about such ambiguous situations.

Scoring

Another issue of concern was that several teachers would rank who they perceived to be their top students for question number one, and then would write “same as above” for the remainder of the questions. This pattern of teacher responses brought into question how well the teacher had read through the questionnaire and whether much thought had been given to the other six questions. However, because this response pattern could have been reflecting the true insight of the teacher, the teacher was given the benefit of the doubt and data were entered exactly as written by the teacher.

For scoring purposes, students listed as number one on any question were given a value of “5” for that question. Students listed as numbers two, three, four and five were given values of “4, 3, 2, 1,” respectively. One issue is that this type of questionnaire and scoring procedure leads to a severely skewed distribution, because there will ultimately be a few students in each classroom with high scores, while the majority of students will have scores of “0.” While this would typically be a major cause for concern, it is important to keep in mind the purpose of this instrument, which is to provide assistance in identification of gifted students at the elementary school level. It is therefore not necessary to have a normal distribution as long as students who are truly highly interested

in mathematics are being identified by their teachers on this form as one of the top students.

Reliability

Two types of reliability were calculated to determine the level of consistency among the items and also to determine the questionnaire's psychometric properties. A test-retest reliability analysis was calculated to determine the questionnaire's stability over time, as several third, fourth, and fifth grade teachers in six schools completed this questionnaire in October 2009 and May 2010, using the same group of students. Second, coefficient alpha was calculated to determine the questionnaire's level of internal consistency based on the data from October 2009 only.

Validity

Determining the validity for this measure and the most appropriate statistic to use was somewhat more difficult. It was decided that the best way to provide evidence for its validity would be to examine the correlation between students' scores on the Iowa Math test from May 2009, an achievement test taken by all of the students in the classrooms being studied, and the students' scores from the interest identification form. The Iowa Math test is a subtest of the comprehensive Iowa Tests of Basic Skills (ITBS), a standardized, norm-referenced achievement test (The University of Iowa College of Education, 2010). It is expected that there will be a positive correlation between the teacher identification scores and the students' Iowa Math test scores, both for the overall scale composite and for each item of the questionnaire.

The ITBS has extensive psychometric evidence regarding its reliability and validity, and has a long history of use in school systems in the country. A reviewer of the

ITBS reported that internal consistency estimates for the subtests of the ITBS typically fall in the 0.80s and 0.90s across both Forms A and B of the test (Lane, 2007).

Equivalent-forms reliability was also determined for the ITBS, with the lower correlation estimates in the 0.70s and 0.80s occurring for the lower age groups. Higher equivalent-forms reliability was found for upper levels of the test designed for older students, with coefficients ranging from 0.811 to 0.942 (Lane, 2007).

Evidence for the validity of the ITBS also has an extensive history. Lane (2007) reported sufficient content validity for the ITBS based on the process that was followed in developing the test specifications, the individual test items and also the test forms. Validity of the ITBS was further evidenced by the test's correspondence with instructional goals of schools across the country, making it representative of what students are being taught in school. Correlations were examined for the ITBS composite scores as well as individual subtest scores, with correlations being in the moderate to high range (Lane, 2007).

Results

Data were collected from six elementary schools in the Warren County, KY area for students in grades two through six. However, for the purpose of this project, only the data for grades three through five was included in the data analysis. The second grade data was excluded because there were no reported Iowa Tests of Basic Skills (ITBS) Math scores for students in that grade level, and therefore there was nothing against which to compare the data. Only three schools reported teacher interest questionnaire scores for their sixth grade students, thus making the data set for that grade level incomplete. This could be because the teachers were aware that the questionnaire was going to be used for identification purposes and that the sixth grade students would not have the opportunity to participate in the advanced GEMS project the following year. One school reported data for two third grade and two fourth grade classrooms, while every other school only provided data for one grade per school. Because some schools use ability grouping for their classes and others do not, specific instructions about which teachers should fill out the questionnaire and for which classes were given on the attached cover sheet. For example, for schools that use ability grouping, only the teacher for the upper ability group was instructed to complete the form. If the school had mixed ability level classes with multiple teachers, then each teacher was instructed to complete the form for only the students in their classroom.

As indicated in the instructions to the questionnaire, teachers were supposed to list students who were accelerated in their class, meaning that the students were actually enrolled in lower grades but were in the teacher's math class as an advanced placement for the student. One third grade teacher, however, listed four students as being

accelerated in her class, although they were all actually enrolled in the third grade and not accelerated as defined by the questionnaire. These four students were still given scores of “5” across all items as if they really were accelerated, because it was unclear what the teacher had meant when she listed them as being accelerated, and I didn’t want these students to not be given credit on the questionnaire due to the teacher’s error. The instructions to the questionnaire were further modified to ensure clarity of when students are considered accelerated for the purposes of this questionnaire.

The data for the remaining grades (three through five) was broken down by grade level for the purpose of data analysis for several reasons. First, the standard scores reported by the ITBS differ according to grade level, making it difficult to compare scores across grades when each grade has a different score range. Also, each grade takes a different form of the ITBS, so that students in grades three through five all took different tests. Finally, the construct of students’ interest in mathematics may be more discernable in some grades than others. In other words, teachers may be better able to identify students with high interest levels in mathematics in higher grades than in earlier grades.

A frequency count with data from all grades was performed, and a logical sequence emerged from the data. While it would be ideal for the frequency counts to be identical across the items and grades, this was not the case because some teachers did not fill out all five blanks provided for each item. Also, accelerated students who were given scores of “5” across all items made the corresponding frequency count for scores of “5” appear inflated. For example, in the fourth grade on item number one, there were eight scores of “5,” seven scores of “4,” seven scores of “3,” six scores of “2,” and six scores

of “1.” Here is it important to keep in mind that one school reported two sets of data for their third and fourth grades. The scores can thus be interpreted in that across the six schools on item one, seven teachers identified a top student, and one additional student was given a score of “5” due to enrollment in an accelerated class for math. The same seven teachers were then able to identify students ranked as number two and three, receiving scores of “4,” and “3,” respectively. Then, only six teachers identified students ranked in the fourth and fifth places on item one. This logical sequence of highest frequencies for scores of “5” and lower or equal frequencies for the lower scores indicates that the teachers filled out the forms correctly and the data is consistent with the structure and instructions of the questionnaire.

Table 3 below shows the average levels and variance for ITBS math scores for students based on grade level. According to the ITBS website, standard scores reported by the test represent a student’s achievement level along a continuum, and have to be interpreted in reference to other students’ scores in the same grade. ITBS also reports that the standard score scale was developed by assigning a score of 200 to the median performance of fourth grade students, and a score of 250 to the median performance of eighth graders (The University of Iowa College of Education, 2010).

Table 3

Students’ ITBS Math Scores

Grade	Mean	Median	Std. Deviation	Minimum	Maximum
3	168.4	167.0	13.8	139	222
4	176.6	176.0	16.8	140	223
5	194.7	193.0	18.8	152	247

In the following tables (Tables 4, 5, and 6), two types of correlations are presented for individual questionnaire items. Corrected item-correlation refers to how well each individual item relates to the composite of the other six items. Cronbach's alpha if item deleted shows what the internal consistency estimate for the remaining six items would be if that item in particular were to be removed. The tables are divided by grade level for the reasons outlined previously.

Table 4

Third Grade Item Analysis Statistics

Item Number	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1	.845	.918
2	.820	.920
3	.750	.927
4	.732	.928
5	.704	.931
6	.843	.918
7	.808	.921

Each item correlation with the item total composite for the third grade data ranged from .704 to .845, indicating relatively high consistency among items. When all items were included, the overall Cronbach's alpha was .934 for the third grade data. A Cronbach's alpha this high indicates that, for third grade students, the questionnaire was a reliable measure of student interest in mathematics. Comparing the Cronbach's alpha if item deleted column to the overall third grade alpha of .934 shows that the omission of

any of the seven items would not increase the overall alpha to any higher than its current value. Therefore, all seven items are providing a significant contribution to the questionnaire's internal consistency and none needed to be deleted.

Table 5

Fourth Grade Item Analysis Statistics

Item Number	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1	.709	.919
2	.860	.903
3	.568	.931
4	.801	.909
5	.769	.912
6	.861	.903
7	.775	.912

The corrected item-total correlations for fourth grade students ranged from .568 to .861, a much larger range than with the third grade data. Most of the correlations were relatively high (.700's to .800's), indicating high consistency among the seven items. However, the correlation from item three (.568) was much lower than the other items, and should thus be interpreted with a degree of caution.

When considering a composite score including all items for fourth grade students, the Cronbach's alpha was .925, indicating that overall, the seven items together on the questionnaire were reliable for the intended purpose. All but one of the alpha if item deleted values were less than the fourth grade composite alpha (.925), indicating that six

of the items were significantly contributing to the questionnaire's internal consistency for fourth grade data. The alpha if item deleted for item number three (.931) was higher than the composite alpha, indicating that item three did introduce some variability among the items. However, this item was kept in the questionnaire due to its higher consistency values for grades three and five and the relatively small increase from the fourth grade overall alpha to its alpha value if it had been removed.

Table 6

Fifth Grade Item Analysis Statistics

Item Number	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1	.726	.885
2	.719	.885
3	.669	.891
4	.751	.882
5	.660	.892
6	.726	.885
7	.709	.887

The range of corrected item-total correlations for the fifth grade was from .660 to .751. These correlations were similar across items, and all were in the mid to high range, indicating consistency among items. The overall Cronbach's alpha for the fifth grade was .901, indicating that the questionnaire was a reliable measure of student interest for fifth grade students. All seven Cronbach's alpha if item deleted values were less than the overall fifth grade alpha (.901), and therefore none of the items were removed.

Even though the item analyses providing the best information have come from dividing the data by grades, it is still useful to examine the overall Cronbach's alpha for grades two through five. This statistic provides an overall description of the reliability of the teacher questionnaire form including all seven items for the grades which had full participation in the identification form. This Cronbach's alpha was found to be .926, indicating high reliability for the form as a whole for students in grades two through five.

Results from the test-retest reliability study of the teacher identification form are as follows. The correlations between the teachers' ratings in October 2009 and May 2010 were .464 for third grade, .567 for fourth grade, and .671 for fifth grade. While these are all moderate correlations, they are still significant at the 0.01 level using a two-tailed test.

Table 7

Individual Item Correlations with ITBS Math Scores

Item Number	Grade 3	Grade 4	Grade 5
1	.338	.290	.312
2	.400	.372	.380
3	.275	.324	.386
4	.333	.323	.393
5	.261	.325	.325
6	.348	.352	.392
7	.320	.365	.383

Table 7 displays the correlations between each individual item from the teacher questionnaire with the students' ITBS math scores, by grade. All correlations in the above table were found to be significant at the 0.01 level using a two-tailed test, and all correlations across grades were similar in magnitude. Interestingly, the range of correlations was narrower for higher grades (.312 to .393 for fifth grade) than for lower grades (.261 to .400 for third grade).

A composite score for the teacher ratings was generated, which included the data from all seven items on the questionnaire. The composite score was then correlated with the students' ITBS math scores for each grade to obtain an overall depiction of how well the teacher rating questionnaire correlated with math achievement on the ITBS. For the third grade, the correlation between the teacher ratings composite and the ITBS math scores was .379. Fourth grade data revealed a correlation of .417, and the correlation for the fifth grade data was found to be .460. All three of these overall teacher ratings composites correlated with the ITBS math portion at the 0.01 level using a two-tailed test. Although the data collected from the sixth grade was incomplete, a teacher rating composite was calculated based on the information that was returned, and its correlation with ITBS math scores was .300. Although this correlation was lower than the three correlations from grades three through five, it was still significant at the 0.01 level.

Discussion

The purpose of this project was to develop a reliable and valid teacher identification form that can be used to assist in the identification of students with high levels of individual interest in mathematics. This form was developed as part of a larger project in which students were identified as being gifted in math in order to participate in an accelerated program for math instruction. Therefore, students who were identified by their teachers as having high levels of individual interest using this form would be considered, along with other factors, for inclusion in the accelerated program. The construct of interest was chosen for this project primarily based on past literature showing the relationship between student interest, motivation and academic achievement (Koller et al., 2001; Schiefele et al., 1992).

Some difficulties were encountered in the development of the form, such as teachers filling out the form incorrectly and misunderstanding instructions such as what to do in situations where there are students enrolled in an advanced math class. Because of this, many revisions had to be made along the way to both the instructions and the actual teacher identification form itself. The final version of the cover letter including the instructions for the form, and the teacher identification form are attached.

The teacher identification form that was developed for this project served its intended purpose in that it was found to be both a reliable and valid measure of student individual interest in mathematics. The reliability of the form was examined through item analyses such as corrected item-correlations and Cronbach's alpha if item deleted for each item on the questionnaire in each grade level. The relatively high item correlations indicated high levels of consistency among the items on the form. When

examining the Cronbach's alpha including all seven questionnaire items for each grade, I found an alpha of 0.934 for third grade, 0.925 for fourth grade, and 0.901 for fifth grade students. Although the grades were analyzed separately for reasons including different ITBS standard score ranges among grades, no ITBS scores for second graders, and the lack of responses from sixth grade teachers, there is still some value in looking at an overall Cronbach's alpha for grades two through five for the purposes of determining reliability. The Cronbach's alpha indicating the rate of consistency and reliability among the seven items on the questionnaire for grades two through five is 0.926. These high Cronbach's alpha for each grade and for grades two through five combined indicate that the teacher identification form is a reliable and consistent measure of student interest for these grades.

Results from the test-retest data analysis spark some questions about whether that statistical method was in fact the most appropriate statistic to use in this case. While the correlations (.464, .567, and .671) were all moderate and significant, they were still not as high as one would hope. One potential explanation for these results could be that the students' interests are in fact changing over the course of the school year. Some students who were initially rated in October of 2009 may not have displayed as many signs of individual interest as in May of 2010, after they had been exposed to much more mathematics curriculum. Another plausible explanation may be that the students themselves are not changing as much, but that the teachers are more aware of their students' talents and characteristics in May than in October. This would lead to the teachers providing more accurate ratings of their students' individual interests at the second rating than at the first rating. It is also worth noting here, that the test-retest

correlations increased with each increasing grade through fifth, indicating that the teacher identification form produced more stable results for older students than for younger students. This could be due to more stable individual interests of students as they get older, or the teachers being better able to identify such interests when students are older.

Validity of the teacher identification form was determined by examining the correlations between scores on the form and the students' most recent performance on the Iowa Tests of Basic Skills (ITBS) math section. Individual item correlations with the ITBS math scores were all significant at the .01 level. There was a narrower range of these correlations for higher grades (0.312 to 0.393 for fifth grade) than for lower grades (.261 to .400 for third grade). The correlations between ITBS scores and teacher identification form composite scores are as follows: 0.379 for third grade, 0.417 for fourth grade, and 0.460 for fifth grade.

It is interesting to note that, along with more narrow ranges of correlations in higher grades, the overall correlations were highest for fifth grade, next highest for fourth grade, and lowest for third grade. Thus, teachers' responses on the identification form were most highly correlated with students' ITBS math scores when the students were in fifth grade. Also, there was the least amount of variability in teacher responses when the students were in the fifth grade compared to third and fourth grade. While all of the correlations were relatively high, indicating adequate construct validity via math achievement, this is again evidence that teachers are better able to identify students with high levels of individual interest in higher grades. Students in higher grades may also have further developed and more stable individual interests, which may be easier for teachers to identify in the classroom.

Literature on the development of self-concept also provides reasoning for why older students tend to have more developed and stable individual interests in mathematics. Although there are exceptions, theorists generally agree that as children and adolescents grow and develop, their self-concepts also develop and become more stable. Authors Cole et al. (2001) explain that, while young children in grades kindergarten through third grade often have inflated self-concepts and are usually overconfident in their abilities, from third grade on their self-concepts tend to become more realistic as they become aware of their own strengths and weaknesses compared to their peers. Thus, not only would students tend to develop more stable interests over time as their self-concepts become more stable, but their own perceptions of their strengths and possibly their individual interests would become more realistic as well.

Findings from the development of this teacher identification form are consistent with results from similar past studies. In Schiefele et al.'s (1992) meta-analysis of research, a 0.32 correlation was found between student interest in mathematics and their academic achievement in the subject. Koller et al. (2001) explained the interest-achievement relationship in a more indirect way, in that students with high levels of interest were more likely to choose an advanced course in mathematics when given the option, thereby increasing their knowledge in mathematics through advanced courses. The current results also support this interest-achievement relationship through the high correlations between identification results and achievement on the ITBS math section. The development of this teacher identification form has also contributed to interest literature by providing a measure on which to gauge student interest, which has been empirically shown to be both a reliable and valid measure of the construct.

Other strengths of this teacher identification form include its unique design in that it is completed by teachers and not by the students. It was previously mentioned that one of the weaknesses of self-report measures, especially for younger children, is that children may lack awareness of their own states of interest and therefore may not be very accurate reporters of their own interest. While it is still the case that even this teacher form may be more useful with older children than younger children, it still may compensate in areas in which self-report forms lack. One recommendation in the identification of student interest is that both self-report and teacher identification methods be used together in order to provide the most accurate representation of students' true states of interest.

Limitations of the current design include the potential lack of generalizability for the teacher identification form. In its pilot study as well as in its main use in identification, this instrument has only been used with students in a small geographical region of Kentucky. Future research needs to look into using this form in different geographical areas to determine whether the form would be just as reliable and valid in other locations and with other populations. Future research may also examine whether the form is reliable and valid with other age groups in school. The current project was only able to provide complete data for grades three through five, and it would be worthwhile to determine whether the current trends in results would continue with students in higher and lower grades.

Other future research that would be a significant contribution to interest and achievement literature as well as the establishment of the psychometric properties of the teacher identification form would involve further validation and reliability studies of the

instrument. One such validation study might involve having a math teacher complete the identification form, and at the same time having all of the students in the classroom fill out a self-report measure of individual interest in math. Calculating a correlation between the teacher's results and the students' results would provide an interesting estimate of the form's validity in terms of how the teacher's perceptions of the students' individual interests match up with the students' own perceptions. This validation study would be optimally conducted with a wide age range of students, to determine whether this form of validity differs depending on the grade level of the students.

Other such studies might involve developing a parent/guardian form which would be completed regarding the level of individual interest for each child. This would be similar to the self-report form for students in that there would be a separate form for each student, except that the parent/guardian would complete the form while thinking about whether or not their child displays the characteristics of individual interest included in the form. While getting all parents involved in such a project to complete the form accurately would be a challenge, being able to correlate the results from the parent version with the teacher identification form would provide intriguing information about students' individual interest in math from the perspective of adults at home and at school.

Other ways to validate the teacher identification form further could involve studies of predictive validity. To do this one might have a math teacher complete the form at a given time, such as at the end of the fourth grade, and then a few years later track those same students' achievement levels in math by analyzing improvements in their math grades compared to peers and their improvements on standardized math tests such as the ITBS.

A potential study to investigate further the reliability of the form might involve having another adult who is present in the mathematics classroom on a consistent basis and familiar with the students, such as a teacher's aid or a parent volunteer, fill out the teacher identification form to provide a second set of data using the same group of students. The results from this second rater could then be correlated with results from the identification form as completed by the classroom mathematics teachers to establish the level of inter-rater reliability for the form. The completion of such reliability and validity studies would assist in further establishing the psychometric soundness of the teacher identification form as well as contribute to the literature regarding the construct of interest and how it relates to student academic achievement.

References

- Cole, D., Maxwell, S., Martin, J., Peeke, L., Seroczynski, A., Tram, J., Hoffman, K., Ruiz, M., Jacquez, F., & Maschman, T. (2001). The development of multiple domains of child and adolescent self-concept: A cohort sequential longitudinal design. *Child Development, 72*, 1723-1746.
- Dewey, J. (1913). *Interest and effort in education*. Boston: Riverside.
- Hidi, S. (2001). Interest, reading, and learning: Theoretical and practical considerations. *Educational Psychology Review, 13*, 191-209.
- Hidi, S. & Renninger, K. (2006). The four-phase model of interest development. *Educational Psychologist, 41*, 111-127.
- James, W. (1890). *The principles of psychology*. (2 vols.) New York: Henry Holt & Co.
- Krapp, A. (1989). *Interest, learning, and academic achievement*. In P. Nenniger (Chair.), Task motivation by interest, Symposium conducted at the meeting of the Third European Conference of Learning and Instruction (EARLI): Madrid, Spain.
- Krapp, A., Hidi, S., & Renninger, K. (1992). Interest, learning, and development. In K. A. Renninger, S. Hidi, & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 183-212). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Koller, O., Baumert, J., & Schnabel, K. (2001). Does interest matter? The relationship between academic interest and achievement in mathematics. *Journal for Research in Mathematics Education, 32*, 448-470.
- Lane, S. (2007). Iowa Tests of Basic Skills (r), Forms A and B. In K. Geisinger, R. Spies, J. Carlson & B. Plake (Eds.), *Mental Measurements Yearbook, 17th edition*. Lincoln, NB: The University of Nebraska Press.

- Mitchell, M. (1993). Situational interest: Its multifaceted structure in the secondary school mathematics classroom. *Journal of Educational Psychology*, 85, 424-436.
- Mitchell, M., & Gilson, J. (1997, March). *Interest and anxiety in mathematics*. Paper presented at American Educational Research Association, Chicago, IL.
- National Center for Education Statistics. (2007). Trends in international mathematics and science study (TIMSS). <http://nces.ed.gov/timss/results07.asp>.
- Organisation for Economic Co-Operation and Development. (2006). Programme for international student assessment (PISA). <http://www.pisa.oecd.org/>.
- Renninger, K.A. (1992). Individual interest and development implications for theory and practice. In K. A. Renninger, S. Hidi, & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 183-212). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Roberts, J. (2008). Project GEMS (gifted education in math and science). Unpublished manuscript, Western Kentucky University: Bowling Green.
- Schiefele, U. (1991). Interest, learning, and motivation. *Educational Psychologist*, 26, 299-323.
- Schiefele, U., Krapp, A., & Winteler, A. (1992). Interest as a predictor of academic achievement: A meta-analysis of research. In K. A. Renninger, S. Hidi, & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 183-212). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Schunk, D., Pintrich, D., & Meece, J. (2008). *Motivation in education: Theory, research and applications* (Third ed.). Upper Saddle River, New Jersey: Pearson.

- Singh, K., Granville, M., & Dika, S. (2002). Mathematics and science achievement: Effects of motivation, interest, and academic engagement. *The Journal of Educational Research, 95*, 323-332.
- Stevens, T. & Olivárez, A. (2005) Development and evaluation of the Mathematics Interest Inventory. *Measurement and Evaluation in Counseling and Development, 38*, 141-152.
- Tobias, S. (1994). Interest, prior knowledge, and learning. *Review of Educational Research, 64*, 37-54.
- The University of Iowa College of Education. (2010). *The Iowa Tests of Basic Skills*.
<http://www.education.uiowa.edu/itp/itbs/>.
- Winger, S. (2008). Characteristics of interest. Unpublished manuscript.

APPENDIX A

Cover Letter

Dear Teacher:

The attached forms are part of the identification process for the GEMS project.

For the questions on the attached form, please list in order no more than the top 5 students from your class(es). Only include students who are currently enrolled in the grade you teach. If you have any accelerated students in your class from lower grades (e.g., you teach 4th grade math and you have two third graders who come to your class for math) please list their names at the bottom of this form; do **not** include them in identification questions 1-7.

Please be as objective as possible. Try not to allow any positive or negative biases you may hold for specific students to interfere with your evaluations. If you are unable to answer a question please indicate with **UTA**, rather than guessing or putting names just to complete the question.

Grouping scenarios and how to use the identification forms:

- 1) If your school uses ability grouping to assign students to classes, then only the teacher for the upper ability group class should complete the form(s).
- 2) If your school has heterogeneous (mixed ability) classes but one teacher teaches all of students in a specific grade, then only that teacher should complete the form. In addition, this teacher should only complete one form considering all students in a specific grade.
- 3) If your school has heterogeneous classes and multiple teachers teach the classes, then each teacher should complete a form considering all of the students they teach that subject to in that specific grade.

Your willingness to complete this form indicates your implied consent.

Your time and participation is appreciated!

Steve Winger, Ph.D.
GEMS Evaluator

List accelerated students in your class from lower grades (e.g., 3rd grader taking 4th grade class):

	Circle subject(s) for acceleration
_____	Math Science

APPENDIX B

Teacher Identification Form

Student Identification Form: Math

1) Which students demonstrate the most positive affect (enjoyment or excitement) towards Math?

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

2) Which students know the most about Math?

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

3) Which students value learning about Math most (the importance or usefulness of)?

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

4) Which students are most confident in their Math abilities?

- 1. _____
- 2. _____
- 3. _____

4. _____

5. _____

5) Which students demonstrate the most curiosity about Math?

- 1. _____
- 2. _____
- 3. _____
- 4. _____

5. _____

6) Which students demonstrate the most advanced learning/problem-solving strategies for Math?

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

7) When confronted with difficulties (i.e. challenging problems), which students are most likely to continue working on the Math problem?

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

