DOCUMENT RESUME

ED 353 157 SE 053 204

AUTHOR Mitchell, Mathew
TITLE Situational Interest: Its Multifaceted Structure in the Secondary Mathematics Classroom.
PUB DATE Apr 92
NOTE 28p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, CA, April 22, 1992).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Affective Behavior; Classroom Research; Cognitive Measurement; Cognitive Structures; *Context Effect; Correlation; Factor Analysis; High Schools; High School Students; Interest Inventories; Interest Research; Interviews; Mathematics Achievement; Mathematics Education; *Mathematics Instruction; *Models; Qualitative Research; School Surveys; Secondary School Mathematics; *Student Interests; *Student Motivation
IDENTIFIERS LISREL Analysis; *Model Development

ABSTRACT

Classroom boredom in the secondary mathematics classroom is a problem that can be addressed from knowledge of the intrinsic motivational variable of "interestingness." The lack of a theoretical model of interest is an obstacle in research that investigates this variable. This paper describes the three stages in the development of a model of interest. The first stage involved the development of a preliminary model according to the current research literature on interest. Working from the social ecological research orientation of (R. H.) Moos (1976, 1979) that emphasizes the importance of social perceptions as the key to manipulating an environment, the second stage included an elaboration on the initial model using naturalistic techniques to better understand student perceptions of interest in the mathematics classroom. In the third stage, a survey instrument was developed. Data was collected and quantitatively analyzed to assess the tenability of the model developed through stages one and two. Participants in the study consisted of 350 high school students from 3 different high schools in the Santa Barbara (California) area. The sample was composed of 147 boys and 188 girls, 30% of whom were not Anglo-American. Students responded to a Likert-type survey consisting of 45 items representing 7 different scales identified as the following: personal interest; situational interest; meaningfulness; involvement; group work; puzzles; and computers. Factor analysis, LISREL analysis, and correlational analysis were applied to the data. Results of the various analyses identified two general scales for personal interest and situational interest (SI) and five subscales for SI. In addition, the correlational analyses lent support to the conceptual distinction made between catching and holding interest. (Contains over 60 references.) (MDH)

SITUATIONAL INTEREST:

Its Multifaceted Structure in the Secondary Mathematics Classroom

by Mathew Mitchell

Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, California, April 20-24, 1992).

SITUATIONAL INTEREST:
Its Multifaceted Structure in the Secondary Mathematics Classroom

Classroom boredom has been well documented in the research literature for several decades (e.g.: Buxton, 1973; Csikszentmihalyi & Larson, 1984; Jackson, 1968)--especially in the high school mathematics classroom (Kline, 1977; Papert, 1980; Whitehead, 1912). As Sarason observed, ". . . schools are not very interesting places for most of the people in them. That is indisputably the case for high and middle or junior high schools." (Sarason, 1983, p.64)

Classroom boredom, though, may really be an indication of a bigger schooling problem, namely the lack of motivation to learn. Since disinterest in learning is one primary manifestation of this, one way to attack classroom boredom is from the perspective of an intrinsic motivational variable called interestingness (Hidi, 1990; Schank, 1979). The present study attempts to tackle a specific hurdle which continues to plague the research on interest--the lack of a adequate theoretical model of interest. This study proposed and empirically assessed the tenability of a hypothetical construct of interest. The study focused on mathematics in the secondary mathematics classroom because it seems to be the source both of much boredom *and* low achievement at the secondary level (Carpenter, Lindquist, Matthews, & Silver, 1983; Putnam, Lampert, & Peterson, 1990). Indeed, as the recent report *Everybody Counts* (National Research Council, 1989) noted: "Mathematics is the worst curricular villain in driving students to failure in school. When mathematics acts as a filter, it not only filters students out of careers, but frequently out of school itself." Understanding how to enhance interest in the mathematics classroom may prove be one of the most direct and effective ways to approach the problem of effective mathematics instruction.

Interest is a hypothetical construct whose usefulness must be demonstrated by investigations into its construct validity (Shavelson, Hubner, & Stanton, 1976). The first step in construct validity is the identification of theoretically consistent and distinguishable facets of interest (within-network studies). The next step is the study of how these interest facets are related to other constructs (between-network studies). Within-network studies focus on the development of theoretical models of the construct and of measurement instruments that are consistent with these models. Because the research on interest is at a relatively early stage (Hidi, 1990), this particular study will focus only on this within-network aspect of construct validation.

Definition of Interest

Dewey provided three key characteristics for a working definition of interest: identification, absorption, and activity. He wrote: "Genuine interest . . . simply means that a person has identified himself with, or has found himself in, a certain course of action. Consequently he is identified with whatever objects and forms of skill are involved in the successful prosecution of that course." (1913, p.43) Later Dewey stated: "Interest is not some one thing: it is a name for the fact that a course of action, an occupation, or pursuit absorbs the powers of an individual in a thorough-going way." (p.65) In these passages Dewey illuminated two of the key factors of interest: *identification* and *absorption.* Dewey argued further that the word interest always implies an *active process*--i.e. it is never passive or indifferent.

Schiefele (1991) recently proposed some additional features of interest. Schiefele's proposals are important in that they direct further research on interest towards specific content domains, rather than treating interest as a relatively general construct. In particular, Schiefele proposed:

1. Interest is a content-specific concept. It is always related to specific topics, tasks, or activities.
2. When understood as a content-specific concept, interest fits well with modern cognitive theories of knowledge acquisition, in that new information is always acquired in particular domains.
3. Subject-matter-specific interest is probably more amenable to instructional influence that are general motives or motivational orientations. (1991, p.301)

The term interest as used in this paper refers to an interest *directly* tied to the content of instruction. Too often educators do try to make their classes more interesting, but their ". . . appeal is simply made to the child's love of something else." (Dewey, 1913, p.12) For instance, the research on seductive details (Garner, Gillingham, & White, 1989; Garner, Alexander, Gillingham, Kulikowich, & Brown, 1991) indicates that text material can be made more interesting, but if one is not careful, the enhanced interest will have little to do with the particular content being taught. As an example, Garner et. al. (1991) found that text written about Stephen Hawking which included details about his personal life was rated as more interesting than text which excluded this material. However, when subjects read the "personal-life" text, they recalled fewer of the important ideas contained in the text than those who had read the regular text.

DEVELOPMENT OF THE MODEL OF INTEREST

In developing a model of interest three stages of development were undertaken--each of which will be described in detail below. The first stage involved the development of a preliminary model according the the current research literature on interest. The next two stages of development adopted the social ecological research orientation of Moos (1976, 1979) who emphasized the importance of social perceptions as the key to manipulating an environment. Thus these two stages proceeded under the assumption that student *perceptions* of interest was the key factor to assess. In particular, the second stage involved elaborating on the initial model by using naturalistic, or qualitative, techniques to better understand student perceptions of interest in their mathematics classrooms. Finally, the third stage developed a survey instrument and collected data which was quantitatively analyzed to assess the tenability of the model developed through the first two stages. The anticipated result of these three stages of development was that psychological theory and the qualitative results could be brought together to develop and test the viability of an extended conceptual framework of interest in the mathematics classroom via a survey instrument.

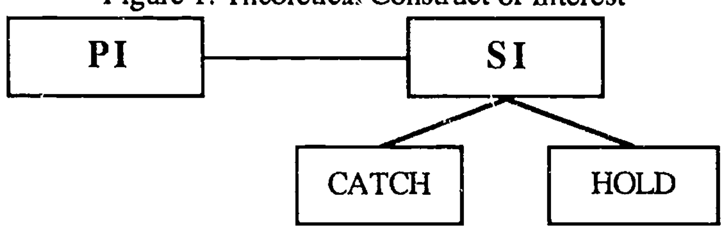
Stage 1--Theoretical Underpinnings of the Model

This paper builds upon previous research in constructing a model of interest and empirically testing that model in the secondary mathematics classroom. The primary distinction made about the structure of interest was put forth by Krapp (1989) who distinguished between personal and situational interest. A personal interest (or PI) refers to an interest that people bring to some environment or 'context.' For example, typically some students will come to a mathematics classroom already interested (or disinterested) in the subject. On the other hand, situational interest (or SI) refers to an interest that people acquire by participating in an environment or 'context.' Thus, the PI approach emphasizes working with individual differences, while the SI approach emphasizes the importance of creating an appropriate environmental setting.

From an educational point of view, situational interest is the real topic of concern since teachers have no influence over student's *incoming* PIs. It should be noted that while Krapp has proposed this fundamental distinction between PI and SI, there is at present no research which directly speaks to the tenability of this proposal. While PI and SI can be thought of as distinct, they are also hypothesized to be related. In particular, from an educational perspective one would hope that if a classroom is high in SI, then that environment would change an individual's PI level regarding the subject over time. In other words, while a teacher may have no control over students' incoming PIs, that same teacher may be capable of having a noticeable influence on the students' *outgoing* PIs by the end of the school year.

Concentrating on SI, it is next proposed that situational interest itself is multifaceted. Figure 1 presents the hypothesized multifaceted model of SI proposed in this study.

Figure 1: Theoretical Construct of Interest



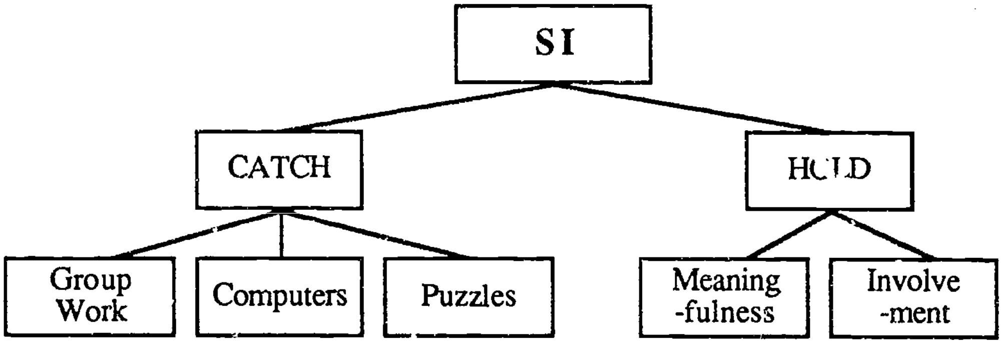
The second level of the model distinguishes between 'Catching' and 'Holding' interest. As Hidi and Baird noted: ". . . interest has a durational aspect--there are triggering conditions and there are conditions which ensure the continuation of interest." (1986, p. 191) Indeed, Malone & Lepper (1987) point out that it is relatively simple to design computer programs with technical gimmicks which will attract students' interest, but many of those same programs fail to maintain the user's interest over time. It is hypothesized that a Hold SI facet will be more strongly related to overall SI than any Catch facet since a Hold facet is a condition which maintains interest over a period of time. In particular it is posited that conditions which hold interest over the course of a high school semester will have a deeper impact upon students than conditions which simply catch or trigger interest.

Stage 2--Naturalistic Development of the Model

The next stage in model development came from the results of focus groups and open-ended questionnaires used with high school mathematics students. (Mitchell, 1992) A focus group consists of a small number of participants (usually 5-9 people). In essence, focus groups are group interviews (Krueger, 1988; Morgan, 1988). Focus groups were conducted with a small number of randomly selected volunteer students from five different classes in December, 1991. Next, open-ended questionnaires were used to gather information from all the classes used in the study in early January, 1992. In the open-ended questionnaire, students would list aspects of their class that were interesting (or boring) and then state *why* each aspect was interesting (boring) to them. The qualitative data was subsequently analyzed according to guidelines proposed by Krueger (1988).

The expanded model built up from these two sources of qualitative data is shown in Figure 2. Three specific Catch facets and two specific Hold facets were identified. The Catch facets proposed are computers, group work, and puzzles. A Catch facet implies that a particular instructional 'tool' seems to be effective for getting the interest of students, but that the Catch facet in-and-of-itself would likely not be successful in holding that interest. The expanded model also proposes two different Hold facets: meaningfulness and involvement. The reason each of these proposed facets was put under the Hold category is that they seemed to be effective tools for not only getting interest, but maintaining it as well. The rationale for including each facet in the model is described below.

Figure 2: Hypothesized Construct of SI in the Mathematics Classroom



The benefits of small group work has been well documented in the research literature (Johnson & Johnson, 1975; Noddings, 1985; Slavin, 1980) and the students' comments reaffirmed many of the conclusions of this research base. The data indicated that when group work was used in mathematics classes, students found this to add to the interestingness of the classroom environment primarily because they could discuss problems with one another. This process of communication seems to be crucial. For instance, the new *Mathematics Framework for California Public Schools* (California Mathematics Framework Committee, 1992) consistently emphasizes the importance of mathematical communication--and group work appears to provide a direct way to accomplish this goal. Secondly, students noted that they were much more willing to ask questions of other students rather than risking looking dumb when asking questions to the teacher in front of the whole class. Students also related that their fellow students were often able to explain concepts better than the teacher because these students talked in a 'language' they could readily understand.

In the research literature, Lepper & Malone (1987) provide an excellent overview of many of the ways in which computers effectively catch the interest of students (as well as providing examples of cases where computer programs held that interest). The qualitative data indicated that computers served as a valuable way to catch student interest. Computers seemed to be perceived as interesting primarily because students could explore and test conjectures--for example by using the program *Geometric Supposer* (Yarushalna & Chazan, 1990). It was the exploratory use of computers that seemed to be of primary interest to students because they could more readily learn things on their own. However, it should be noted that not all classes which used computers did so in an exploratory fashion. Some classes simply had students go through prescribed steps in an activity sheet. Nonetheless, even in these cases computer use stood out because it offered a different way of learning the material and created some variety in the classroom.

The general idea of puzzles as a tool for sparking curiosity has a rather lengthy history in the research literature starting with Berlyne (1960, 1966) and continuing into the present with the research of such people as Lepper (1988), Malone (1981), and Voss & Keller (1983). Indeed, the qualitative data indicated that students perceived the use of puzzles as making their classes more alive. Puzzles is a generic name used to cover a variety of tools used for getting students' curiosity. These puzzles were referred to as either logic puzzles, mind-teasers or starters. In general, these puzzles were not perceived as being 'regular' mathematics, but rather as being 'weird' or 'unusual' problems which demanded that students think more clearly or creatively. Interestingly, a number of students noted how these puzzles made them really use their brains--apparently something that rarely happened when studying regular mathematics.

The role of meaningfulness, particularly in mathematics education, is receiving increasing attention from policy reports (California Mathematics Framework Committee, 1992; National Research Council, 1989) as well as researchers (Anderson, Shirey, Wilson, & Fielding, 1987; Kaput, 1989; Lepper & Malone, 1987; Mellin-Olsen, 1987; Papert, 1980; Schank, 1979). Although these documents use slightly different vocabulary, they all complement the basic point made by Papert (1980) that a good mathematical curriculum is one which allows the learner to perform meaningful projects which make cultural sense, or 'fit', within the larger culture the student lives in. Meaningfulness simply refers to students perceiving that the topics under study in their math class were meaningful to them in their present lives. In point of fact, the data indicate that many students made statements about the *meaninglessness* of much of their work. Typically many students did not see the content of mathematics as important or related to their daily lives.

The notion of involvement fits nicely with some of the research implications of constructivism (e.g. see Carey, 1985; Mellin-Olsen, 1988; NCTM, 1991; Schoenfeld, 1987) as well as with the importance Dewey put on activity (Dewey, 1938). Involvement refers to the degree to which students felt they are active participants in the learning process. The data indicate that involvement seems to have a strong inverse relationship with lecturing. The more a particular teacher tended to lecture, by default the less opportunities students felt they had to actually learn the material themselves. Basically students felt involved when they got to *do* activities to learn new material, rather than sitting and listening. Doing in this context does not refer to mechanical work such as drill and practice. Instead, it refers to a process in which students are being active participants in the learning of new material.

The initial, qualitative development of the multifaceted model of SI seems to mirror many of the important features of the latest statewide document attempting to influence the direction of future mathematics instruction. The *Mathematics Framework for California Public Schools* (California Mathematics Framework Committee, 1992) in particular emphasizes both the importance of meaningful mathematics and involvement. The *California Framework* tacitly recognizes these issues when it states that, "Students construct their understanding of mathematics by learning to use mathematics to *make sense* of their own experiences; this understanding of mathematics becomes more powerful when students use it to *achieve purposes* that are meaningful to them." The *California Framework* also addresses the value of computers, puzzles, and group work in the mathematics classroom.

Stage 3--Survey Development and Data Analysis

The third stage represents the core of the study. A survey, named the Situational Interest Survey (SIS), was developed, pilot tested, and given to a sample of high school mathematics students. The resulting data were then analyzed to test the feasibility of the model of interest that had been developed through the first two stages. The details of the sample used, instrument development, and analysis strategy are present in the Method section.

METHOD

Sample and Procedure

The sample consisted of 350 high school students from three different high schools in the Santa Barbara, California area. The sample was composed of 147 boys and 188 girls (with 15 non-responses to the gender item). Approximately 30% of the sample were not Anglo-American. The students were all attending college preparatory classes in either algebra or geometry. Thirteen different classes were sampled, incorporating seven different teachers, all of whom are 'master' teachers in their school district. Two classes from each teacher were surveyed, except for one teacher who only taught one of the target subject courses.

The students were administered the SIS instrument by the author for 20 minutes within a scheduled 50-minute mathematics class session in January, 1992.

Measurement Instrument

The SIS is a measure of adolescent interest in the mathematics classroom designed to measure two general areas of interest (personal and situational) and five specific components of SI: meaningfulness, involvement, computers, groups, and puzzles. Because of the study's emphasis on student perceptions, the SIS was a self-report survey format. The stems used in the survey were taken from statements made by a student either in a focus group or the open-ended questionnaire. Students responded on a 6-point Likert scale, the response options varying from "1-Strongly Disagree" to "6-Strongly Agree."

An initial bank of 77 items was pilot tested. These items represented items from seven scales (PI, SI, Meaningfulness, Involvement, Group Work, Computers, Puzzles). The first stage of pilot testing involved having two students do the survey with a talk-aloud protocol. Items which were clearly ambiguous or difficult to understand were dropped at this point. The second stage of pilot testing involved using the remaining items for in-class pilot testing using two classes. The internal consistency of the items within each scale was conducted, and weak items were dropped. The final resulting survey had 45 items representing the seven different scales. The results from the two pilot classrooms were included in the final analysis since no new items were subsequently included in the final survey. Each of the scales on the final survey were represented by either 5 or 7 items.

Analysis Strategy

Responses to negatively worded items were reversed so that for all items a response of 6 represented the highest possible positive rating of an item. There were a few missing responses (less than 2%) to any SIS item. The missing responses were replaced by the mean response for that individual to other items on the same scale. A preliminary item analysis of responses for each scale indicated that no item in any scale was a negative discriminator In fact all 45 items had 'corrected item-total correlations' (see Norusis, 1990) of at least 0.30.

The analysis strategy consisted of seven steps. First, the internal consistency of the scales was checked. Any weak items were to be dropped from the scales at this point. Second, a factor analysis was conducted between the remaining PI and SI items. As Harris & Harris (1971) suggested, it is prudent to check for invariance of results across different extraction and rotation techniques. For the factor analysis three extraction methods were used: principal components analysis, principal axis factoring, and maximum likelihood. For the two 'true' extraction techniques (principal axis and maximum likelihood) two different rotations were also used: orthogonal and oblique (with delta set to 0). If there were any items which did not clearly load onto either factor, it was dropped from the scale, and the resultant new scale reanalyzed for its reliability. The third step was a factor analysis conducted on the items representing the five SI component scales. This procedure was conducted in the same way as the second step.

Once the first three steps were completed, the fourth step was to make sure each final scale had an even number of items since item-pairing was to be used for the subsequent factor and LISREL analyses. The procedure of using 19 item-pairs instead of 38 single items was preferable for the following reasons: (a) the ratio of the number of subjects to the number of variables is increased (a minimum ratio of 10:1 was desired), (b) each item-pair variable is more reliable than a single-item variable and should have a smaller unique component; (c) the factor loadings should be less affected by the idiosyncratic working of individual items. The major disadvantages of this procedure are that: (a) information about individual items is lost, (b) items must be reasonably homogeneous with respect to the dimension that they were designed to measure, so that it is important to perform a preliminary item analysis such as the one described above before this procedure is used, and (c) the parameter estimates and the factor scores resulting from the factor analysis are likely to vary somewhat, depending upon the particular pairing of items that are used. The practical effects of each of these possible disadvantages was subsequently assessed in the study. If a single item needed to be dropped at this point, the item with had the lowest item-total correlation was excluded. Since each scale started with an odd number of items (either 5 or 7), one item was dropped from each of the seven scales somewhere during the first three steps. The resulting scale was then divided into 2 (or 3) item-pairs.

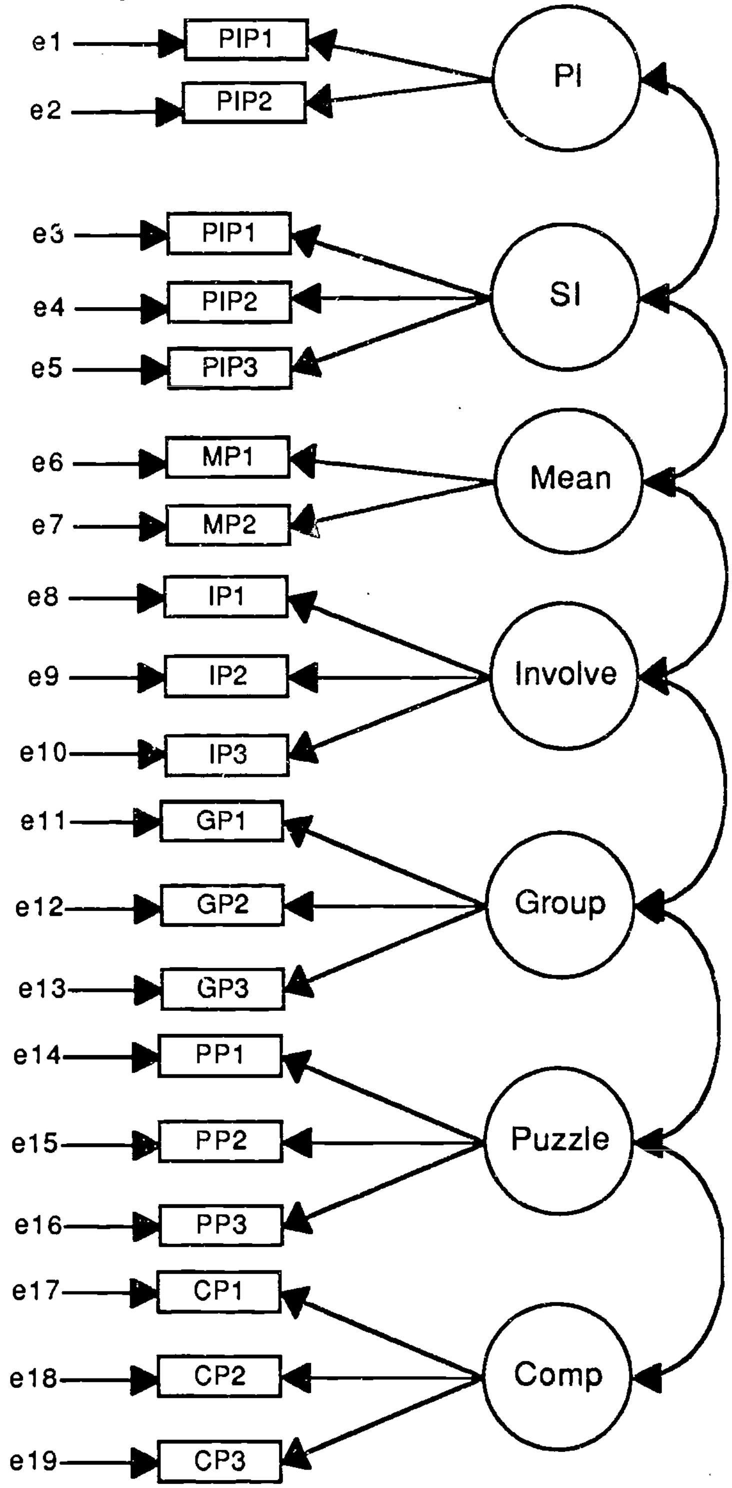
Factor analysis and a set of LISREL analyses were used to assess the hypothesis of a multifaceted structure to interest. The item pairing was done such that the first 2 items in a scale were assigned to the first pair, the next 2 items to the second, and so forth. The factor analyses were then redone using these item-pairs. To check for variability in results due to a particular item-pairing, another set of factor analyses was conducted with a second set of random item-pairs. Next a LISREL analysis was conducted--this step is described in detail below. The final step was to assess the correlational relationships of the latent variables from the LISREL analysis. The primary purpose of this analysis was to assess the tenability of the distinction between the Catch and Hold facets of SI.

Evaluation of Alternative Models

An analysis of the covariance structure of the data, using LISREL 7.15 (Joreskog & Sorbom, 1989), was conducted to examine the multi-faceted structure of SI. Figure 3 (below) gives one diagram of how a LISREL model was conceptualized before an analysis was run. The boxes in Figure 3 represent the observed measurements--in this study each item-pair represented one such measurement, thus giving us 19 total boxes. The circles represent the unobserved constructs underlying the measurements and the e's represent residuals (or errors) that are estimated in the data analysis. Notice that the straight arrows indicate that both the underlying constructs and errors give rise to the performance observed on the measurements. Also, as Figure 3 indicates, each observed measurement is expected to load on only one facet of self-concept (all other possible loadings for a particular measurement are constrained to zero). The curved arrows indicate that the facets of SI are correlated; these correlations are estimated in the data analysis.

Covariance structure analysis has traditionally relied on a chi-square significance test to determine the degree to which a proposed model fits the observed data. However, as many researchers have pointed out (e.g. Bentler and Bonnett, 1980; Byrne, 1989; Marsh, Balla, & McDonald, 1988), chi-square goodness of fit tests are often inadequate for model evaluation because they are contingent on sample size. Various alternatives have been proposed. The two indices used in the current study include the CFI (or comparative fit index) and the RNI (or relative noncentrality index) (Bentler, 1990; McDonald & Marsh, 1990). Currently, these two measures seem to offer the best indications of fit without being unduly affected by sample size. Both scales give results on a scale between 0 and 1. As a rule-of-thumb, any model with an index of less than .90 needs improvement. Ratios greater than .90 are considered adequate; and, as one gets closer to 1, the more impressive the fit.

Figure 3: LISREL Path Diagram for Model 5[1]



1 For clarity not all curved arrows between all latent variables have been drawn. However, in the LISREL models used, the program was allowed to find covariances between all possible pairs of the latent variables. Also, the abbreviations used in the boxes always indicate a particular item-pair. For instance, PIP1 indicates personal interest pair 1. The first one (or two) letters (e.g. PI) indicate the construct the item-pair is hypothesized to load on. The last two symbols (e.g. P2) simply indicates which item pair the box represents.

RESULTS AND DISCUSSION

Reliability

Table 1 presents the internal consistency coefficients (Cronbach's alphas) for each scale. For purposes of a psychometric instrument, one would desire alpha coefficients of at least .70 (Nunnally, 1978). As Table 1 indicates, all of the scales have a more than satisfactory coefficient. In addition, item-pairing is not advisable if the reliability of the scales is not satisfactory. However, the data in this study indicate that all the individual items within a scale are 'reasonably homogeneous,' indicating the item-pairing would be appropriate to conduct in subsequent analyses.

Table 1. Reliability of SIS Scales

Scale	# Items	Alpha
PI	4	0.92
SI	6	0.90
Meaningfulness	4	0.77
Involvement	6	0.86
Groups	6	0.93
Puzzles	6	0.88
Computer	6	0.92

Factor Analysis of the SIS Responses

The factor analyses conducted on item-pairs (see Table 2 and Table 3) identified the two general interest factors and the five SI subfactors with great clarity. The results presented are based on a factor analysis using maximum likelihood extraction technique with an oblique rotation. The same pattern of results were obtained for a principal components analysis, a principal axis extraction using both orthogonal and oblique rotations, and a maximum likelihood extraction with an orthogonal rotation. In assessing a best solution for a factor analysis, the rule-of-thumb used was to retain factors with eigenvalues greater than 1. For the factor analysis in Table 2, the 2nd eigenvalue was 1.19 and the 3rd was 0.30, indicating that a 2-factor solution is reasonable. Similarly, for the factor analysis in Table 3, the 5th eigenvalue was 1.09 and the 6th was 0.41, indicating that the 5-factor solution was optimal. The parsimony postulate (Kim & Mueller, 1978) for factor analysis states that if both an N factor and an N-1 factor solution are consistent with the data then we would accept the N-1 model as more accurate due to its greater parsimony. Thus factor analyses were also conducted with less than 2 (or 5) rotated factors. For the solutions with less than the targeted number of factors, at least one of the SIS factors was not adequately represented in that the variables designed to measure it did not load substantially on any factor. Therefore, the original 2 (and 5) factor solutions were interpreted to be the most parsimonious solutions.

Table 2. FA of the SI & PI Item-pairs

Item-Pair	Factor 1	Factor 2	*Comm*
PIP1	**0.98**	-0.06	*0.91*
PIP2	**0.85**	0.08	*0.79*
SIP2	-0.09	**0.97**	*0.88*
SIP1	0.03	**0.86**	*0.77*
SIP3	0.08	**0.77**	*0.65*

Table 3. FA of the SI Subfacet Item-pairs

Item Pair	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	*Comm*
MP2	**1.02**	0.02	0.00	0.02	-0.06	*0.99*
MP1	**0.66**	-0.01	0.00	-0.01	0.06	*0.46*
CP2	-0.03	**0.94**	0.00	-0.01	0.05	*0.91*
CP1	0.02	**0.87**	-0.03	-0.09	0.10	*0.82*
CP3	0.01	**0.82**	0.02	0.08	-0.07	*0.66*
GP3	-0.01	-0.03	**0.96**	0.00	-0.03	*0.88*
GP1	-0.02	-0.03	**0.88**	-0.02	0.03	*0.76*
GP2	0.04	0.07	**0.82**	0.04	0.04	*0.76*
PP2	0.04	0.04	0.06	**0.89**	-0.08	*0.82*
PP3	-0.02	0.07	0.03	**0.85**	-0.01	*0.73*
PP1	0.00	-0.12	-0.06	**0.79**	0.15	*0.69*
IP3	0.08	-0.05	0.02	-0.01	**0.87**	*0.80*
IP1	-0.03	0.06	0.01	0.08	**0.78**	*0.68*
IP2	0.00	0.04	0.02	-0.02	**0.74**	*0.58*

A factor analysis of items from all seven scales indicated that the Involvement items loaded on the same factor as the general SI items. The rest of the items, however, loaded onto factors representing the separate scales which they represented. At this point, however, it was unclear whether or not it would be more sensible to think of Involvement and Situational Interest as one factor (implying involvement was synonymous with SI). The LISREL analysis (below) was used to help assess this possibility.

LISREL Analysis

With a conventional factor analysis, a particular structure cannot be statistically tested against alternative structures (Byrne, 1989). In addition, the structure of the model cannot be controlled (beyond setting the number of factors and the level of correlation between factors). For both of these reasons, a LISREL analysis was performed. The main objective of using LISREL was to compare the viability of a variety of different models to explain the observed measures. Construct validity often proceeds by disconfirming alternative models. Thus it was hoped that the primary model (based on seven scales) would describe the data substantially better than any reasonable counter-model. A nested set of six models was examined: (0) a 'null' model of complete independence of all observed measurements--this provides a measure of the total covariation in the data; (1) a single-facet, general interest model; (2) a two-facet, personal and situational interest model, (3) a four-facet model including personal and situational interest with 'catch' and 'hold' subfacets of SI, (4) a six-facet model including PI and SI* (with the Involvement items loading onto the SI latent variable) and the four other subfacets of SI (meaningfulness, puzzles, group work, and computer subfacets of SI), and (5) a seven-facet model which added the Involvement subfacet of SI to the fourth model.

The results of fitting each of the six models to the data collected is presented in Table 4. We interpret the data in Table 4 to mean that the multifaceted model (Model 5) provides the best fit to the data. Each indicator of goodness-of-fit shows that Model 5 is better than Model 4, and that Model 4 is better than Model 3, and so on. Tests of statistical significance, although not discussed, showed that the differences between each of these models are statistically significant ($p < .01$). While Model 4 does provide an adequate model for describing the data, Model 5 describes the data better both statistically and substantively. Substantively, the theory predicts Involvement to be a subfacet of SI. In addition, it is more helpful for educators to know that increasing student involvement is a key tool for enhancing situational interest.

Table 4. LISREL Results

Model	df	$\chi 2$	CFI	RNI	Model Description
Null	171.00	4995.00	-	-	Total covariation
1	152.00	2943.00	0.42	0.42	General Interest only
2	151.00	2552.00	0.50	0.51	PI & SI only
3	146.00	1878.00	0.64	0.64	PI, SI, Catch & Hold
4	140.00	496.00	0.93	0.93	PI, SI*, Meaning, + 3 Catch facets
5	131.00	326.00	0.96	0.96	Full hypothesized model

Correlational Analysis

Although the LISREL analysis provided further evidence that the hypothesized multifaceted structure of SI was reasonable, as of yet we have little evidence to support the distinction made between those facets which Catch and those which Hold SI. Towards this end, an analysis was conducted using the LISREL latent variable correlation matrix . The results are presented in Table 5. This data supports the conceptual distinction made between catching and holding. For instance, the two hypothesized hold facets, meaningfulness and involvement, both have strong correlations with SI. The other three facets, however, all have moderate correlations with SI, and all are either weakly or moderately correlated with the hold facets.

An alternative way to assess these results is to conduct a multiple regression analysis. The results of this analysis are presented in Table 6. This analysis was conducted by using the resultant scales for SI and it's facets. Each of the Catch facets was forced into the equation one at a time. The final two steps forced the entry of the Meaningfulness scale and the Involvement scale. The important findings in this table are that even when Meaningfulness and Involvement are forced into the equation after the three Catch facets, they still explain a noticeable additional amount of the variance.

Table 5. LISREL Correlations between Latent Variables

Measure	SI	Meaning	Involve	Group	Computer	Puzzle
SI	1.00					
Meaning	0.55	1.00				
Involve	0.86	0.46	1.00			
Group	0.34	0.15	0.36	1.00		
Computer	0.32	0.11	0.37	0.20	1.00	
Puzzle	0.39	0.27	0.40	0.40	0.08	1.00

Table 6. Multiple Regression Table

Variable	R^2	$R^2_{increase}$
Computer	.08	.08*
Group	.16	.08*
Puzzles	.22	.07*
Meaning	.41	.18*
Involvement	.64	.23*
TOTAL	.64*	

* $p<.01$

SUMMARY AND CONCLUSION

The purpose of this study was to assess the tenability of a hypothesized multi-faceted construct of situational interest (SI) within the secondary mathematics classroom. The study had three major components: (1) to assess if the distinction between personal interest and situational interest was reasonable, (2) to assess if the SI structure was multifaceted, and (3) to assess the general distinction made between Catch and Hold facets within SI. The results of the various analyses clearly identified two general scales (for PI and SI) and five sub-scales for SI. In addition, the correlational analyses lent support to the conceptual distinction made between catching and holding interest.

One potential limitation to this study was the use of item-pairs rather than single items. However, since each scale was very homogeneous ($\alpha \geq .77$) and since a second random pairing of items provided an identical pattern of results, item-pairing seemed reasonable for the purposes of this study. However, a further check was conducted using single items in the factor analyses which led, once again, to a similar pattern of results. In addition, although the study developed an instrument which meets some valued construct validity criteria, the SIS instrument needs to be used in a variety of other settings (including different locations, using non-college-prep classes, using student populations with different ethnic mixtures, etc.). Nonetheless, despite this limitation, the SIS has a well-developed factor structure, and measures dimensions that are reliable and based upon a theoretical model. At this point in time, one of the major weaknesses of research into interest is the lack of instruments used to measure it. Although at a preliminary stage, further development of the SIS would seem to offer a measurement tool of great practicality for further research purposes.

The results of this study have important implications for further theoretical work in interest research. Previously interest has been treated as a general concept. Although important distinctions have been made between personal and situational interest, and also between catching and holding interest, little empirical evidence has been gathered to support these theoretical distinctions. This study has provided quantitative evidence for the tenability of these distinctions.

In addition, it is only with Schiefele's recent work (1991) that a focus has been put on interest as a subject-matter-specific construct. The present study has made particular headway into developing a model of situational interest as it relates to the secondary mathematics classroom. The results indicate that we can usefully think of SI as being composed of five facets--each of which contribute significantly to enhancing the SI of high school mathematics classroom.

This study also contributes to a potentially powerful approach to improving mathematics education. As Dewey put it succinctly, "Teaching may be compared to selling commodities. No one can sell unless someone buys." (1933, p.35) Clearly, in many mathematics classrooms students have not been 'buying.' Recent studies note that as students get older, fewer of them report liking math (McKnight, Crosswhite, Dossey, Kifer, Swafford, & Travers, 1987; Stodolsky, Salk, & Glaessner, 1991). In addition it appears that as our students get older their performance in mathematics gets "worser and worser" (Kantrowitz & Wingert, 1991). However, enhancing classroom interest may offer the most direct way to improve this educational morass. As Csikszentmihalyi put it, ". . . if intrigued by the opportunities of the domain, most students will make sure to develop the skills they need to operate within it." (1990, p.126). The results of this study begin to define a conceptual model of how to practically enhance classroom environments.

To appreciate the potential usefulness of the SI approach in mathematics education, it is important to emphasize the state of affairs in most high school classrooms today. For instance, Weiss (1990) found that only 31% of secondary math teachers state they give a 'heavy' emphasis to getting students more interested in mathematics. One reason for this lack of emphasis from practitioners may be a lack of knowledge about how to systematically develop SI within their classrooms. Although each of the Catch facets seems to offer relatively simple insights into how to enhance the classroom, it is likely that few current classrooms use any of these facets. For example, consider a recent survey of eleventh grade students (Dossey, Mullis, Lindquist, & Chambers, 1988) in which it was found that 59% of the students stated that they *never* worked on math problems in small groups, 82% reported *never* doing math laboratory activities, and 87% reported *never* making reports or doing projects in their mathematics class. Although the categories used by Dossey et. al. do not strictly conform to the three Catch facets, their results nonetheless make it clear that implementation of the Catch facets is probably a relatively rare phenomenon in many high school mathematics classes.

The Hold facets in this study are likely implemented less frequently than even the Catch ones. Yet both the *NCTM Standards* (1989) and the *California Framework* (1992) emphasize the need for students to do meaningful mathematical activities and to be involved in the learning process. Kaput (1989) recently summed up the thoughts of many educators concerned with mathematics instruction when he wrote:

> "Few now deny that school mathematics as experienced by most students is compartmentalized into meaningless pieces that are isolated from one another and from the students' wider world. . . . This *experienced meaninglessness* of school mathematics devastates the motivation to learn or use mathematics . . . " (p.99)

The results concerning the Hold facets indicate that if we really want to enhance the situational interest of our mathematics classrooms we need to radically rethink how we typically conduct mathematics lessons. In particular, Involvement stood out as the facet with the strongest relationship with overall SI. This result is not that surprising given the work of Stodolsky, Salk, & Glaessner (1991) who concluded that, ". . . the usual instructional pattern in math classes establishes an expectation on the part of students that they will be 'told' math." (1991, p.111) The 'telling' of math is a deeply ingrained instructional orientation. However, as the study's results clearly indicate, the more students perceive themselves as active learners rather than passive absorbers of knowledge, the more interesting a classroom environment seems to be to them.

BIBLIOGRAPHY

Anderson, R. C., Shirey, L. L., Wilson, P. T., & Fielding, L. G. (1987). *Interestingness of children's reading material*. In R. E. Snow, & M. J. Marr (Eds.), Aptitude, learning and instruction: Vol. 3, (pp. 287-299). Hillsdale, NJ: Lawrence Erlbaum.

Bentler, P. M. (1990). Comparative fit indices in structural models. *Psychological Bulletin*, 107, 238-246.

Bentler, P. M., & Bonnett, D. G. (1980). Significance tests and goodness-of-fit in the analysis of covariance structures. *Psychological Bulletin*, 88, 588-606.

Berlyne, D. E. (1960). *Conflict, arousal, and curiosity*. New York: McGraw-Hill.

Berlyne, D. E. (1966). Curiosity and exploration. *Science*, 153, 25-33.

Buxton, C. (1973). *Adolescents in schools*. New Haven: Yale University Press.

Byrne, B. (1989). *A primer of LISREL*. New York: Springer-Verlag.

California Mathematics Framework Committee (1992). *Mathematics framework for California public schools*. Sacramento, CA: California State Department of Education.

Carey, S. (1985). *Conceptual change in childhood*. Cambridge, MA: MIT Press.

Carpenter, T., Lindquist, M., Matthews, W., & Silver, E. (1983). Results of the third NAEP mathematics assessment: Secondary schools. *Mathematics Teacher*, 76(9), 652-659.

Csikszentmihalyi, M. (1990). Literacy and intrinsic motivation. *Daedalus*, 119, 115-140.

Csikszentmihalyi, M., & Larson, R. (1984). *Being Adolescent*. New York: Basic Books.

Dewey, J. (1913). *Interest and effort in education*. Cambridge, MA: Riverside Press.

Dewey, J. (1933). *How we think (revised edition)*. New York: D.C. Heath.

Dewey, J. (1938). *Experience and education*. New York: Macmillan Co.

Dossey, J. S., Mullis, I. V. S., Lindquist, M. M., & Chambers, D. L. (1988). *The mathematics report card: Are we measuring up?* Princeton,NJ: National Assessment of Educational Progress at Educational Testing Service.

Garner, R., Alexander, P. A., Gillingham, M. G., Kulikowich, J. M., & Brown, R. (1991). Interest and learning from text. *American Educational Research Journal*, 28(3), 643-659.

Garner, R., Gillingham, M. G., & White, C. S. (1989). Effects of "seductive details" on macroprocessing and microprocessing in adults and children. *Cognition and Instruction*, 6, 41-57.

Harris, C., & Harris, M. (1971). A factor analytic interpretation strategy. *Educational and Psychological Measurement*, 31(3), 589-606.

Hidi, S. (1990). Interest and its contribution as a mental resource for learning. *Review of Educational Research*, 60(4), 549-571.

Hidi, S., & Baird, W. (1986). Interestingness: A neglected variable in discourse processing. *Cognitive Science*, 10, 179-194.

Jackson, P. W. (1968). *Life in classrooms*. New York: Holt, Rinehart and Winston.

Johnson, D., & Johnson, R. (1975). *Learning together and alone*. Englewood Cliffs, NJ: Prentice-Hall.

Joreskog, K. J., & Sorbom, D. (1989). *LISREL: Analysis of linear structural relationships by the method of maximum likelihood*. Mooresville, IN: Scientific Software Inc.

Kantrowitz, B., & Wingert, P. (June 17, 1991). A dismal report card. Newsweek, 64-66.

Kaput, J. J. (1989). *Information technologies and affect in mathematical experience*. In D. B. McLeod, & V. M. Adams (Eds.), Affect and mathematical problem solving, (pp. 89-103). New York: Springer-Verlag.

Kim, J., & Mueller, C. W. (1978). *Factor analysis: Statistical methods and practical issues*. Beverly Hills, CA: Sage.

Kline, M. (1977). *Why the professor can't teach*. New York: St. Martin's Press.

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.

Krueger, R. A. (1988). *Focus groups: A practical guide for applied research*. Newbury Park, CA: Sage.
Lepper, M. L. (1988). Motivational considerations in the study of instruction. *Cognition and instruction*, 5, 289-309.
Lepper, M. L., & Malone, T. W. (1987). *Intrinsic motivation and instructional effectiveness in computer-based education*. In R. E. Snow, & M. J. Farr (Eds.), Aptitudes, learning, and instruction, Vol 3(pp. 255-286). Hillsdale, NJ: Lawrence Erlbaum.
Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science*, 4, 333-369.
Malone, T. W., & Lepper, M. L. (1987). *Making learning fun: A taxonomy of intrinsic motivations for learning*. In R. E. Snow, & M. J. Farr (Eds.), Aptitudes, learning, and instruction, Vol 3: Conative and affective process analyses(pp. 223-254). Hillsdale, N.J.: Erlbaum.
Marsh, H. W., Balla, J. R., & McDonald, R. P. (1988). Goodness-of-fit indexes in confirmatory factor analysis: The effect of sample size. *Psychological Bulletin*, 103, 391-410.
McDonald, R. P., & Marsh, H. W. (1990). Choosing a multivariate model: Noncentrality and goodness-of-fit. *Psychological Bulletin*, 107, 247-255.
McKnight, C., Crosswhite, F., Dossey, J. A., Kifer, E., Swafford, J. O., Travers, K. J., & Cooney, T. J. (1987). *The underachieving curriculum: Assessing U.S. school mathematics from an international perspective*. Champaign, IL: Stipes.
Mellin-Olsen, S. (1987). *The politics of mathematics education*. Dordrecht: D. Reidel Publishing
Mitchell, M. (1992). *A multifaceted model of situational interest in the secondary mathematics classroom*. Unpublished doctoral dissertation, University of California at Santa Barbara, Santa Barbara, CA.
Moos, R. H. (1976). *The human context: Environmental determinants of behavior*. New York: John Wiley & Sons.
Moos, R. H. (1979). *Evaluating educational environments*. San Francisco: Jossey-Bass.
Morgan, D. L. (1988). *Focus groups as qualitative research*. Newbury Park, CA: Sage.
National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.
National Council of Teachers of Mathematics (1991). *Professional standards for teaching mathematics*. Reston, VA: Author.
National Research Council (1989). *Everybody Counts: A report to the nation on the future of mathematics education*. Washington, D.C.: National Academy Press.
Noddings, N. (1985). *Small groups as a setting for research on mathematical problem solving*. In E. Silver (Ed.), Teaching and learning mathematical problem solving: Multiple research perspectives, (pp. 345-360). Hillsdale, NJ: Lawrence Erlbaum.
Norusis, M. J. (1990). *SPSS base system user's guide*. Chicago: SPSS Inc.
Nunnally, J. C. (1978). *Psychometric theory (2nd Ed.)*. New York: McGraw-Hill.
Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York: Basic Books.
Putnam, R., Lampert, M., & Peterson, P. (1990). Alternative perspectives on knowing mathematics in elementary schools. *Review of Research in Education*, 16, 57-152.
Sarason, S. (1983). *Schooling in America: Scapegoat and salvation*. New York: The Free Press.
Schank, R. C. (1979). Interestingness: Controlling inferences. *Artificial Intelligence*, 12, 273-297.
Schiefele, U. (1991). Interest, learning, and motivation. *Educational Psychologist*, 26(3), 299-323.
Schoenfeld, A. H. (1987). *Cognitive science and mathematics education: An overview*. In A. H. Schoenfeld (Ed.), Cognitive science and mathematics education, (pp. 1-31). Hillsdale, NJ: Lawrence Erlbaum.
Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research*, 46(3), 407-441.
Slavin, R. (1980). Cooperative learning. *Review of Educational Research*, 50, 315-42.

Stodolsky, S. S., Salk, S., & Glaessner, B. (1991). Student views about learning math and social studies. *American Educational Research Journal*, 28(1), 89-116.
Voss, H. G., & Keller, H. (1983). *Curiosity and exploration: Theories and results*. New York: Academic Press.
Weiss, I. (1990). Mathematics teachers in the United States. *International Journal of Educational Research*, 14, 139-155.
Whitehead, A. N. (1912). *The aims of education*. London.
Yerushalmy, M., & Chazan, D. (1990). Overcoming visual obstacles with the aid of the Supposer. *Educational Studies in Mathematics*, 21(3), 199-219.

APPENDIX A -- ITEMS USED IN THE FINAL SURVEY

Notes on the Survey Format

* All the personal interest (PI) items were put together as one group of items at the beginning of the survey. These items were prefaced with the statement: *For the first 5 questions, think about how you felt about mathematics before the school year began.*

* All of the other items were randomly mixed in the rest of the survey. Before students began the rest of the survey they answered the following question: *For all the following questions, think about how you felt about your first semester math class this school year (NOT including the student teacher, if you had one).*

Teacher 1st Semester: ____________________ Math Period: __________

* All of the items had the following response format:

1. Our class is fun.
   strongly agree   agree   slightly agree   slightly disagree   disagree   strongly disagree

---

Personal Interest (PI)

1. Mathematics is enjoyable to me.
2. I have always enjoyed studying mathematics in school.
3. Compared to other subjects, I feel relaxed studying mathematics.
4. Compared to other subjects, mathematics is exciting to me.

Situational Interest (SI)

1. Our class is fun.
2. I actually look forward to going to math class this year.
3. Our math class is dull.
4. This year I like math.
5. I don't find anything interesting about math this year.
6. My other classes are more interesting than math.

Meaningfulness

1. The stuff we learn in this class will never be used in real life.
2. Class would be better if the math problems were more related to life problems.
3. I see the math we've learned as important in life.
4. I will never use the info in this class again, so I don't need it.

Involvement

1. Our teacher has fun activities to learn the stuff that we need to know.
2. We just come in, take notes, go home, do homework, and it's the same thing every day.
3. We learn the material ourselves instead of being preached at.
4. We usually sit and listen to the teacher talk.
5. We often <u>do</u> something instead of the teacher just talking.
6. We often hear long, long explanations and I quickly lose interest.

Group Work

1. I like the groups in our class because learning is more fun when things can be discussed.
2. I like working in groups because I can ask one of the people in the group and they'll explain things on a level I can understand.
3. When we work in groups we exchange ideas.
4. When we do group work it's like working as a team.
5. The groups we use in class make work easier.
6. Working in groups makes our class more enjoyable.

Puzzles

1. I enjoy doing starters or mind-teasers.
2. We do starters which warm me up and get my head going.
3. I like how we do logic puzzles which exercise my brain.
4. It's good to have a starter in math to get us thinking.
5. The mind-teasers or logic puzzles we do are fun.
6. The mind-teasers or logic puzzles we do make me think

Computers

1. We try to discover things on the computer in our class.
2. We use computers which let me experiment with what's being taught.
3. In our class we often work on computers where I discover things on my own.
4. We work on computers to actually put problems together ourselves and see them in reality.
5. We work on computers more than in a book.
6. Using computers in our class is fun.