DOCUMENT RESUME

ED 374 984 SE 054 940

AUTHOR Mitchell, Mathew
TITLE Enhancing Situational Interest in the Mathematics Classroom.
PUB DATE 5 Apr 94
NOTE 34p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 4-8, 1994).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *College Students; Diagrams; Environmental Education; Grade 9; Higher Education; High Schools; *High School Students; Interest Research; *Mathematics Instruction; Models; *Student Interests; Student Motivation

ABSTRACT

Interest may be conceptualized as a variable which affects both motivational and cognitive activity. The purpose of this study was to systematically apply a theoretical model of interest to a classroom setting and explore whether students' interest in mathematics could be increased. The theoretical model of interest is presented and followed by the rationale used for developing the interest treatment. A study of (n=15) college students (Study 1) and (n=68) high school freshmen (Study 2) was conducted using a curriculum developed for the study called Mathematics of the Environment (MOE). In the MOE experience, students work in groups to assess the environmental health of selected world countries. The final student outcome is to find and propose a solution for resolving environmental problems in their chosen nation. An interest survey was given at the beginning and end of Study 1 and at the end of Study 2. The results of the studies were mixed. Study 1 indicated great success of the curriculum in enhancing students' motivation towards the subject, but Study 2 indicated no difference between students' attitudes in the MOE classroom relative to student attitudes in other mathematics classrooms taught by other master teachers. Two differences in the two studies were the teachers and the age of the students. Contains 30 references. (MKR)

Enhancing Situational Interest in the Mathematics Classroom

Mathew Mitchell
University of San Francisco

April 5, 1994

A Paper presented at the Division C Symposium titled:
Interest Research in Mathematics and Science Education
at the Annual Meeting of the
American Educational Research Association
in New Orleans, LA

Correspondence concerning this paper should be addressed to:
Mathew Mitchell, School of Education, University of San Francisco,
2130 Fulton Street, San Francisco, CA 94117

Enhancing Situational Interest in the Mathematics Classroom

April 5, 1994

Many students find their high school mathematics classrooms boring, meaningless, and uninvolving (Mitchell, 1993). This lack of motivational factors, in addition to cognitive variables, most likely contributes to the low level of student competence in the subject. The report Everybody Counts: A Report to the Nation on the Future of Mathematics Education (National Research Council, 1989) stated, "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" (p. 7). If a primary manifestation of boredom is a lack of interest in learning (Hidi, 1990), then one potential way to combat classroom boredom is to manipulate the motivational variable called "interestingness" (Hidi, 1990; Schank, 1979).

Interest may be conceptualized as a variable which effects both motivational and cognitive activity. Hidi's (1990) review of interest research concluded that interest has a "profound effect on cognitive functioning and the facilitation of learning." (p. 565). The obvious explanation is that interested students spend more time on learning tasks. Yet research studies indicate that interested students do not consistently spend more (or less) time than other students on an instructional activity (Hidi, 1990). Instead, the key factor affected by interest appears to be *depth* of cognitive processing (Pintrich, 1989; Pintrich & Garcia, 1991; Pokay & Blumenfeld, 1990; Schiefele, 1991, 1992). It appears that students who report that their courses are more interesting are also more likely to employ deeper cognitive processing. Depth of processing behaviors reported in these studies included cognitive elaboration strategies, metacognitive control strategies, and engagement in critical thinking. These results suggest the hypothesis that if we can effectively raise the level of interest in the classroom then we may also increase the level of academic achievement for many high school students.

The purpose of the present study was to systematically apply a theoretical model of interest to a classroom setting and explore if students' interest in mathematics could be increased. The theoretical model of interest is presented first, followed by the rationale used for developing the interest treatment.

A Theoretical Model of Interest

The term interest, as used in this study, has three key characteristics: (1) it is defined by a person-environment interaction, (2) it develops due to both knowledge and value, and (3) within the school context, it refers to an interest directly tied to the goals of instruction. This definition of interest has been further elaborated elsewhere (see Renninger, Hidi, & Krapp, 1992). This study focuses on the multifaceted structure of interest first proposed by Hidi & Baird (1986, 1988) and Krapp (1989) and later elaborated by Mitchell (1993).

Figure 1 provides an overview of the multifaceted model of interest used as the basis for this study. This model initially distinguishes between personal interest and situational interest. Personal interest (PI) describes the "person" component of the person-environment characteristic of interest. Personal interest is defined as the interest that a person brings to some environment or context. For instance, some students will come to a mathematics classroom already interested (or uninterested) in the subject--this represents a personal interest.

Personal interest is generally conceptualized as being both a disposition and an actualized state (Krapp, Hidi, & Renninger; 1992). Disposition means interests that are enduring. Thus personal interests are generally assumed to endure over long periods of time. The "actualized state" means that personal interest becomes "actualized" or demonstrated in such behaviors as highly focused attention, displays of pleasure, and a high degree of persistence at a task.

Insert Figure 1 about here

Situational interest (SI) describes the "environment" component of the person-environment interaction. Situational interest is defined as an interest that "is generated primarily by certain conditions and/or concrete objects (e.g. texts, film) in the environment" (Krapp, Hidi, & Renninger; 1992, p. 8). For example, if a classroom activity is developed that a student finds interesting (given there was no pre-existing PI in the activity), this represents a situational interest. Situational interest is thought to have two key characteristics. First, the initial environmental context that elicited the interest (e.g. a text or a presentation) will be present only for a short time. So once the interaction with the environmental context is gone, so is the situational interest (Hidi, 1990). Second, while PI is an individual interest, SI represents an interest which the majority of people in an environment experience.

PI and SI are hypothesized to be related (Hidi & Anderson, 1992). While researchers have not studied whether PIs enhance SI, they have theorized that SI enhances PI. It has been suggested (Hidi & Anderson, 1992) that if an individual is consistently exposed to a high SI environment, then that individual will likely develop a PI in the content of that environment. Hidi and Anderson think that PIs develop slowly. This means that extended exposure to a high SI environment is needed to affect a person's PI. For example, teachers have no influence on their students' PI level in a subject at the beginning of a school year. However, a consistently high SI classroom may cause a noticeable increase in the students' PIs by the end of the school year.

Classroom interventions aimed at increasing student learning and motivation can focus either on using established student PIs or on creating an environment which is high in SI. Settings in which a teacher works with a small number of students may lend themselves better to the PI orientation. For example, the elementary school teacher who has 15 students or less can reasonably assign student reading projects to each individual student's interests. But, in many educational settings the teacher-to-student ratio is too high to use the PI approach. The typical high school teacher will see over 150 students per day. When the PI approach is not possible, teachers need to maximize SI. Enhancing student interest in most high school classrooms means finding ways of systematically increasing SI in those classrooms.

SI is a multifaceted construct. In a recent study, Mitchell (1993) found evidence to support this multifaceted structure of SI in the secondary mathematics classroom. While we do not completely understand the structure of SI, there is an initial theoretical model to build from. Hidi & Baird (1986) first distinguished between "catching" and "holding" SI. "... Interest has a durational aspect--there are triggering conditions and there are conditions which ensure the continuation of interest." (Hidi & Baird, 1986, p. 191). Mitchell (1993) proposed that the importance of *catching* lies in finding various ways to stimulate students, and the importance of *holding* lies in finding variables that empower students.

A stimulant is commonly defined as a variable that temporarily increases the activity of an organism. The works of Berlyne (1960, 1966) and Malone and Lepper (1987) both provide a rationale for determining the kinds of variables that should be particularly effective for catching interest. Malone and Lepper proposed that there are at least two kinds of stimulation: cognitive and sensory. They defined sensory stimulation as "the attention-attracting value of variations and changes in the light, sound, or other sensory stimuli of an environment" (Malone & Lepper, 1987, p. 235). Cognitive stimulation was defined as occurring when "people have a cognitive drive to bring 'good form' to their cognitive structures and that instructional environments can stimulate curiosity by making people believe that their existing knowledge structures are not well formed" (p. 236). Cognitive or sensory stimulation as the underlying variable in *catching* interest may explain why some environmental variables may be particularly good catalysts for initially seizing a student's interest. In Mitchell's study (1993) three types of stimulation were found in the high school mathematics classroom: puzzles, computers, and group work.

Holding interest is effective when a variable is used that empowers the student. The term empower refers to the bestowing of power for an end or purpose. For instance, making the content of learning meaningful for students tend to empower them because it gives students greater ability to achieve their personal ends. Variables that empower students will hold interest because the student will find the subject empowering to them even when the source of empowerment is removed. For example, if reading *per se* is perceived as empowering to a student, then his/her interest in reading is likely to remain ("hold") for an entire classroom reading session. In Mitchell's study (1993) two types of empowerment were found in the high school mathematics classroom: meaningfulness and involvement. Figure 2 provides a visual overview of the "lasting power" of the *catching* and *holding* aspects of SI relative to PI.

Insert Figure 2 about here

Since the purpose of this research is to find ways to hold students' interest, it is important to take a closer look at these two hold variables. *Meaningfulness* appeared effective because content that is perceived as being personally meaningful to students is a direct way to empower them and thus hold their interest. *Meaningfulness* refers to students' perception that the topics under study in the mathematics classes were meaningful to them in their present lives. Initial data indicate that most high school mathematics students find much of their work meaningless (Mitchell, 1993). For elementary-level students meaningfulness seems to be synonymous with their ability to "do" mathematics (Stipek, 1993). However, for high school students the capacity only to "do" does not make a subject meaningful for them.

Involvement appears to be effective because it makes the *process* of learning absorbing to the individual. Involvement refers to the degree to which students feel they are active participants in the learning process. Involvement has a strong inverse relationship with lecturing. The more a particular teacher tends to lecture, the fewer opportunities students have to interact with the material themselves. Students feel involved when they get to do activities in order to learn new material, rather than sitting and listening (Mitchell, 1993). 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.

Theoretical Basis for Enhancing Situational Interest

The study first created and then implemented a high school mathematics curriculum based on the model of interest presented above. In developing a curriculum intended to be high in SI, the author focused on using the SI Hold variables: meaningfulness and involvement. In the previous study (Mitchell, 1993) no teachers were found who created mathematics classrooms which were high in terms of perceived meaningfulness. Some teachers were found who organized their classrooms so that students consistently perceived the learning process to be highly involving for them. The initial goal of curriculum development in this study was to create a model to practically infuse meaningfulness into the mathematics content.

Two parallel approaches were used for implementing meaningfulness: (1) real-world problem based and (2) theme-based. Real-world problems are perceived as interesting to many students. For instance, environmental issues, future jobs creation, controversies involving race relations or abortion, and how to create a national health care system all represent potential topics that are current real-world problems. Some issues may be attractive to students because they deal with students' present or imminent futures. Other issues are probably attractive simply because they are controversial and call into question societal values.

There are many real-world issues which will likely be interesting to students and lend themselves to academic study. Classrooms investigating real-world problems should be perceived as meaningful because the real-world problems draw on personal interests that students already have. The key is that the classroom serves as a focus for expanding that personal interest by linking it with a subject (e.g. mathematics) that students do not usually associate with the issue.

Another approach for creating meaningfulness in the classroom lies in a theme-based approach. Jones (1968) proposed that specific imaginal themes dominate each stage of human development. In particular, Jones suggests that the themes of justice, revolution, reformation, and utopias predominate in the minds of teenagers. All people have general imagination themes which intrigue them at various stages of life and could be worthy of investigation. Within the high school classroom, teachers may be able to develop projects and activities which take advantage of students' desire to change things (e.g. to correct the mess that adults have made of the world).

Meaningfulness is also to a valuable *cognitive* variable. For example, the Cognition and Technology Group at Vanderbilt (1990) have developed their concept of *anchored instruction* based on a theoretical framework that emphasizes the importance of anchoring instruction in meaningful, problem-solving contexts. This approach addresses the inert knowledge problem where a student may have the necessary knowledge, but does not use that knowledge when in a real-problem situation . Anchored instruction is used to create contexts where students learn information not as facts but as tools. The Cognition and Technology Group hypothesizes that the educational contexts that lend themselves most readily to learning "knowledge as a tool" are those which are both meaningful to students and which have problem-solving situations embedded in them.

The second variable important for empowering students is involvement. Involvement as a motivational variable nicely parallels the call for activity-oriented instruction (California State Framework, 1992; NCTM, 1989). Involvement also fits with the research orientation of constructivism (e.g. Carey, 1985; Mellin-Olsen, 1987; NCTM, 1991; Schoenfeld, 1987). Cognitively, involvement is important because it reflects how people most effectively learn by actively interacting with their environment. From a motivational perspective, involvement is a powerful variable because it provides students with greater control of the learning process (Deci & Ryan, 1985) and allows them more opportunities for engaging in a "learning loop" in which they act, receive feedback, reflect, and act again.

METHODOLOGY

Treatment

The curriculum developed is called Mathematics of the Environment (MOE) (Mitchell, Prion, Baab, & Campbell-Lavoie, 1993). This curriculum is a "mathematical adventure" in which students learn important mathematical skills and student interest in mathematics is enhanced. The topic of the environment was chosen since environmental issues seem to be of concern to many adolescents.

MOE is designed to cover approximately a ten week period in first-year high school mathematics. In the MOE instructional experience, students work in groups to assess the environmental health of selected world countries. Each student group is responsible for investigating a different country. The final student outcome is to find and propose a solution for resolving an environmental problem in their chosen nation. In order to accomplish this outcome, students need the specific mathematical skills learned in the course. For instance, students learn to make comparisons using ratios and percentages, evaluate environmental trends by calculating compound interest, make sense of data and prepare a rational argument by using logical thinking skills, and display data in a visually powerful manner using graphs. It is important to note that this configuration of mathematical topics is unusual. They do not fit into the usual first-year algebra course. On the other hand, they do represent a *cohesive* set of topics and skills which assist students in developing the competence to accomplish the final curricular outcome.

MOE includes a special section on ECO-LOGIC®. This unit helps students practice important logical thinking skills that are not well developed in most mathematics curriculums. Mathematically, the 1992 California Framework in Mathematics points out that students need more than just a background in geometric proofs when it comes to the topic of deductive logic. For environmental issues, people need to be able to apply deductive thinking skills to real-world problems. For example, environmental analysts often will work with "best," "medium," and "worst" case-scenarios. Each scenario starts with a set of assumptions and then uses impeccable deductive logic to analyze what the status of the world would be at a future date based on those assumptions. Environmental analysts also need to develop solid logical arguments to support their positions. In order to accomplish these tasks, environmental analysts need to have sound applied deductive logic skills.

Figure 3 presents a visual overview of the structure of MOE. The top box in the figure represents the final outcome, while boxes below it represent the hierarchy of subordinate outcomes. Students are given guidelines about the components needed to be included in their final presentation. These guidelines include how students should incorporate ratios, compound interest, logic and solution chains from the ECO-LOGIC® unit, graphs, and presentation skills.

Insert Figure 3 about here

Despite a clear final outcome about the *form* which group presentations should have, it leaves the matter of *content* open-ended. Practically speaking, this means that if three different groups were studying Brazil, then the class may well see three presentations all using the same format but with large variances in content depending on how each group assessed and 'solved' a Brazilian environmental problem.

Sample

The research project was divided into three studies. Study 1 was conducted using 15 students at a college in Southern California during the Summer of 1993. Information from this study was used to revise and enhance the curriculum. Study 2 was conducted using 68 freshman students in 4 classes at a high school in the San Francisco Bay Area during the Fall of 1993. The same teacher was used in all four classes. This teacher then instructed two other teachers in the same high school about the curriculum and how to use it. Study 3 is currently being conducted using approximately 150 freshman students in 8 classes from the same high school used in Study 2. Implementation of the curriculum will be completed in late April, 1994. The teachers have organized their use of the curriculum so that student presentations will coincide with Earth Day 1994. This paper reports on the results from Studies 1 and 2 only.

Study 1 was an intensive implementation of the MOE curriculum conducted during the summer of 1993. The class met each day for 3 hours for 5 days a week over a 3 week period of time. Although the students were all college students, they were also students who avowed to "dislike" mathematics. The course formally fulfilled the mathematics general education requirement at the college. This course was the one and only mathematics course these students would take during their undergraduate career.

Study 2 was a moderately-intensive implementation of the MOE curriculum implemented during the Fall of 1993. The class met each day for approximately 1.5 hours for 5 days a week over a 6 week period of time. The students were mixed in terms of ethnicity and academic ability. Caucasian students represented less than 20% of the sample, with the rest of the sample comprised of Asian, African-American, and Latino students. The high school did not put students into different "tracks" of mathematics classes. All students at the same age level were involved with the MOE curriculum.

Instrument and Procedure

The intent of the study was to determine if the MOE curriculum would be effective in increasing SI within the mathematics classroom. The instrument used for measuring students perceptions was the Interest Survey (or IS). The reliability and basic construct validity of the instrument had been assessed in a previous study (Mitchell, 1993). The instrument contained five scales which were used to assess the effectiveness of the MOE intervention. These scales measured: (1) PI in mathematics (PIM), (2) PI in environmental issues (PIE), (3) situational interest of the classroom (SI), (4) meaningfulness, and (5) involvement.

The items in the IS were constructed using a Likert scale. Students responded to a 6-point Likert scale ranging from strongly disagree (1) to strongly agree (6). Each of the scales was composed of 5 to 7 items with approximately half positively worded, half negatively worded. The pre-IS instrument was given the beginning of the first day of class in Study 1. This version contained items measuring PIM and PIE only. Due to a change in scheduling, it was not possible to give the pre-IS to the Study 2 students. The post-version of the IS was given at the end of both Study 1 and Study 2.

For purposes of evaluation the study used a quasi-control group. This group consisted of high school students' perceptions from two previous research studies. Study A (Mitchell, 1993) consisted of 350 high school students enrolled in either first-year algebra or second-year geometry courses. This study used 7 teachers at 3 high schools in a suburban Southern California community. The students were primarily Caucasian (75% +). Study B consisted of 185 students enrolled in a "Discovering Geometry" approach to second-year geometry. This second study used 3 teachers at 1 high school in an urban Northern California city. The students used in Study B were primarily non-Caucasian (70%+ non-white).

In both studies the teachers used were considered master teachers, roughly indicating that these teachers were among the top 40% of mathematics teachers in their school district. Teachers in the participating school districts were given "master" status if (a) they had been observed and requested as a mentor for a student teacher by the subject-matter teacher education supervisor at the local university and (b) the principal of the high school also thought the teacher was accomplished enough to serve as a mentor for a student teacher.

RESULTS AND DISCUSSION

Reliability of Measures

The reliability of the 5 scales used in the two studies (N=83) was assessed by calculating the internal consistency coefficients (Cronbach's alphas) for each scale. The coefficients ranged from .79 to .93 (specifically, .90 for personal interest in mathematics, .93 for personal interest in environmental issues, .89 for situational interest, .80 for meaningfulness, and .79 for involvement). For purposes of a psychometric instrument, alpha coefficients of at least .70 would be desired (Nunally, 1978). As the results indicate, all of the scales have a more than satisfactory coefficient.

All further analyses using the items were done by creating scales for each of the 5 constructs. Each scale was created by calculating the average response per item in the scale. Thus all results are presented with 1 representing the minimum score, 6 the maximum score, and 3.5 the midpoint.

Differences Between Groups

Table 1 provides a descriptive overview of the major results of the two non-MOE groups (Studies A and B) and the two MOE groups (Studies 1 and 2). One-way analysis of variance tests were conducted to see if there were statistically significant differences between student perceptions across the four groups. If there were significant differences, post hoc pairwise tests using Tukey's HSD were calculated using a harmonic mean since the sample sizes of the four groups varied greatly. Notice that Table 1 is broken down by study and by teacher. Studies A and B used multiple teachers resulting in clear variations between teachers. In particular, it is useful to examine Teacher 7 from Study A. This teacher's classes had the highest ratings of any classrooms surveyed in Study A or B in terms of SI and Involvement. An informal challenge for the MOE curriculum in Studies 1 and 2 would have been to duplicate the results of Teacher 7's classrooms in terms of SI and Involvement, while surpassing that teacher's classroom scores in terms of Meaningfulness.

Insert Table 1 about here

Omnibus F-tests with post-hoc contrasts revealed that there were significant differences between studies in terms of PI ($F=2.85$, $MSe = 1.52$, $p < .05$) but that the only significant pairwise difference was between Study 1 and Study B. In short, the PIs of students across groups were equal except for the Study 1 students who seemed to have more negative attitudes towards math than the Study B students. On the other hand, the F-test for SI revealed a significant different between studies ($F=8.49$, $MSe=1.21$, $p < .01$) wherein the Study 1 classroom had a significantly higher rating than either of the other 3 studies classrooms based on pair-wise contrasts.

An analysis of the two key SI variables, Meaningfulness and Involvement, led to a similar pattern of results. The F-test revealed overall significant differences for both Meaningfulness ($F=13.71$, $MSe=.98$, $p < .01$) and Involvement ($F=7.70$, $MSe=.95$, $p < .01$). The Tukey HSD pair-wise contrasts showed that the significant differences in both cases were the Study 1 classroom that was rated significantly higher than the other three groups in terms of Meaningfulness and Involvement.

These results provide both encouraging and disappointing news. Study 1 shows that MOE appears to have been very successful in terms of creating a high SI classroom which students perceived as both meaningful and involving. On the other hand, the four classrooms used in Study 2 reveal no significant differences from the motivational effectiveness of other high school classrooms conducted by master teache

The Role of Personal Interest in Studies 1 and 2

Study 1 and 2 collected additional information *not* collected in Studies A and B: (1) pre- and post-measures of personal interest in mathematics (PIM) and personal interest in environmental issues (PIE). It was theorized that MOE would be effective in part due to its ability to connect mathematical knowledge to an interest students already had in the environment. Table 2 presents the results for these PI measures.

Insert Table 2 about here

This information is revealing and indicates that Study 1 students had a high personal interest in environmental issues. More importantly, Study 1 students' PI in mathematics greatly increased between the start and end of the course. On the other hand, Study 2 indicates that the participating students had neither a high PI in environmental studies nor mathematics. Thus the theoretical motivational "lever" that PI in environmental issues was supposed to provide was not present in Study 2.

The study also conducted a correlational analysis between the two PI variables. In Study 1 the Pearson correlation coefficient between PIM and PIE was -.14 and non-significant. In Study 2 the PIM and PIE correlation measure was .11 and non-significant. Both of these figures indicate there is no association between personal interest in mathematics and personal interest in environmental issues.

SUMMARY AND CONCLUSION

The purpose of this study was to assess if a curriculum designed to be high in SI would, in fact, be perceived that way by students. The Mathematics of the Environment curriculum was developed using a theoretical framework which suggested that the most effective way to build high-SI classroom environments was to systematically incorporate meaningfulness and involvement. The results of the study are mixed. Study 1 indicated great success of the curriculum in enhancing student motivation towards the subject. Study 2 indicated no difference between student attitudes in the MOE classroom relative to student attitudes in other mathematics classrooms taught by master teachers. Study 3 is currently being conducted and data from its implementation are not available yet.

There were some key differences between Study 1 and Study 2 that are worth exploring. First, there were differences in the teachers. It is important to note that teachers received some background on the purpose and structure of

MOE, but no detailed teacher training was provided. This has proven to be a weakness in the MOE curriculum project. For instance, the Study 1 teacher was well known to being committed to getting students involved in the learning process. It was an orientation she carried into all of her courses. This may have helped her to implement MOE in an involving manner. While the teacher in Study 2 was quite enthusiastic about the curriculum, he seems to have relied more on lecture presentations for the curriculum's units. This, of course, would have diminished student involvement in the learning process.

A second difference in the two studies were the student populations. Although in Study 1 the students were older, they were mathematically equivalent to the high school students used in Study 2. A key difference, however, was likely their attitude towards learning in general. The students in Study 1 were all successful college undergraduates and had clear academic interests (but not in mathematics!). The students in Study 2 represented a wide range of ability and motivation towards both mathematics and learning in general. Unlike most high schools, this high school placed all students of the same age level into the same mathematics class. Students were not divided up into a first-year algebra class and a remedial mathematics class. This meant that the academic preparedness of the students in Study 2 was probably lower than that of students in any of the previous studies in which interest data had been collected. This implies that it will be harder to catch and hold the interest of students at the MOE high school when mixed groups are used. Nonetheless, the mixed classroom setting is the future for many California high schools. If MOE (and similar curriculums) are to be effective, then they must find ways to catch and hold classes comprised of mixed groups.

An interesting finding was that PIM and PIE have no relationship. In Study 1 it appears that MOE was partially effective because it took advantage of the high PIE that students have. Of course, in Study 2 the level of PIE was no higher than their PIM. In the second study there was not an environmental interest base to build upon. However, it does appear that even in the second study the range of students potentially interested in the MOE curriculum was enlarged. Approximately 13% of the students had a "high" interest in mathematics, while another 14% had a "high" interest in environmental issues. Because of the low correlation between the two, this resulted in 25% of the students with a high personal interest either in mathematics or environmental issues. The range of students who might be excited by the class was wider then if the class were "pure" mathematics.

There are two notable limitations to the research reported. First, part of the theoretical rationale underlying the development of MOE was to take advantage of "themes" which would hold the interest of adolescents. MOE was developed using the theme of students creating "change" in the world. While Jone's (1968) proposal of imaginal themes is intriguing, no research has been conducted to evaluate which themes do indeed attract high school students' interest. Furthermore, no survey measures have been created to assess student perceptions of how well a particular theme was implemented within a particular curriculum. Research into imaginal themes could be worthwhile given that such themes help address making the *process* of learning meaningful to them while target issues (such as the environment) may make the *content* of learning meaningful for them.

A second notable limitation to the study was that learning measures were not collected. In Study 1, 80% of the students received an "A" grade. In the instructor's evaluation of the course, the students learned a great deal. Unfortunately, at the time of Study 1 a solid measure of academic performance on the objectives in MOE had not been constructed. In Study 2 the students were at a high school where grades were not given, but rather students received credit for meeting pre-stated "competencies" that they were expected to master over the academic year. Thus, giving an academic test was not appropriate in this school. However, the teacher was very enthusiastic in his positive evaluation of students' learning progress during the MOE curriculum.

At this point in time we have some indications that the MOE curriculum can be successful with students to increase interest and academic performance. Two significant changes will be made to the MOE curriculum when revised this summer. First, activities will be rewritten so that they need to be implemented in a more involving manner. Second, future teachers who want to implement MOE will be required to undergo an intensive one week training program. We hope to upgrade the involvement level of the curriculum by having teachers more clearly understand and practice the student-action-oriented nature of the MOE activities. We also hope to upgrade the meaningfulness level of the curriculum by having participating MOE teachers become more familiar with the critical importance of environmental issues. If teachers are not clear about the crucial role understanding the environment has in creating a healthy future planet, then it is unlikely they will model that "meaningfulness" when they implement the curriculum.

The MOE curriculum project is still underway. Initial results have provided some encouraging news and feedback on how to improve and expand the curriculum. A second project, titled Statistics of the Environment (SOE), is currently being developed. SOE uses a local (rather than global) environmental theme to provide opportunities for more advanced mathematical problem solving.

The MOE projects the first in a series of studies attempting to bridge the gap between theory and practice. As more theoretical studies into the nature of interest (especially SI) are conducted, they will serve as informed models for developing practical implementations to test these evolving models of interest. On the other hand, curricular projects such as MOE may serve as informed practical models for re-conceptualizing our theoretical models of interest. The hope is that out of this "dialogue" between theory and practice we may be able to develop implementations of SI that increase students' motivation towards, and performance in, learning.

BIBLIOGRAPHY

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

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

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

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

Cognition and Technology Group at Vanderbilt. (1990). Anchored instruction and its relationship to situated cognition. Educational Researcher, 19(3), 2-10.

Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. New York: Plenum Press.

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

Hidi, S. & Anderson, V. (1992). Situational interest and its impact on reading and expository writing. In K. Renninger, S. Hidi & A. Krapp (Eds.), The role of interest in learning and development, (pp. 215-238). Hillsdale, NJ: Lawrence Erlbaum.

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

Hidi, S., & Baird, W. (1988). Strategies for increasing text-based interest and students' recall of expository texts. Reading Research Quarterly, 23, 465-483.

Jones, R. M. (1968). Fantasy and feeling in education. New York: University of London 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.

Krapp, A., Hidi, S., Renninger, K.A. (1992). Interest, learning and development. In K.A. Renninger, S. Hidi & A. Krapp (Eds.), The role of interest in learning and development, (pp. 3-26). Hillsdale, NJ: Lawrence Erlbaum.

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. Vol 3: Conative and affective process analyses, (pp. 223-254). Hillsdale, N.J.: Erlbaum.

Mitchell, M.T. (1993). Situational Interest: Its multifaceted structure in the secondary mathematics classroom. Journal of Educational Psychology, 85, 427-439.

Mitchell, M. T., Prion, S., Baab, B., & Campbell-Lavoie (1993). Mathematics of the environment manual: An integrated mathematics curricular approach. San Francisco: Integrative Curriculum Research Group.

Mellin-Olsen, S. (1987). The politics of mathematics education. Dordrecht: D. Reidel Publishing.

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.

Nunnally, J. C. (1978). Psychometric theory (2nd ed.),New York: McGraw-Hill.

Pintrich, P. R. (1989). The dynamic interplay of student motivation and cognition in the college classroom. In C. Ames & M. Maehr (Eds.), Advances in motivation and achievement: Motivation-enhancing environments (Vol. 6, pp. 117-160). Greenwich, CT: JAI Press.

Pintrich, P.R., & Garcia, T. (1991). Student goal orientation and self-regulation in the college classroom. In M. Maehr & P.R. Pintrich (Eds.), Advances in motivation and achievement: Goals and self-regulatory processes (Vol. 7, pp. 371-402). Greenwich, CT: JAI Press.

Pokay, P., & Blumenfeld, P.C. (1990). Predicting achievement early and late in the semester: The role of motivation and use of learning strategies. Journal of Educational Psychology, 82, 41-50.

Renninger, K., Hidi, S. & Krapp, A. (Eds.). (1992). The role of interest in learning and development. Hillsdale, NJ: Lawrence Erlbaum.

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.

Schiefele, U. (1992). Topic interest and levels of text comprehension. In K. Renninger, S. Hidi & A. Krapp (Eds.), The role of interest in learning and development, (pp. 151-182). Hillsdale, NJ: Lawrence Erlbaum.

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.

Stipek, D. (1993). Motivation to learn: From theory to practice (2nd edition). Boston: Allyn & Bacon.

Table 1. Descriptive Statistics for the Quasi-Control and MOE Groups

		PI		SI		Mean		Involve		N
Study	Teach	m	s	m	s	m	s	m	s	
Quasi-Control Groups										
A	1	3.44	1.27	3.72	0.96	3.49	0.82	4.10	0.84	47
A	2	3.36	1.08	3.33	1.05	3.34	1.09	3.47	0.89	60
A	3	3.34	1.16	3.41	1.13	3.41	0.99	3.05	0.97	63
A	4	3.03	1.38	3.12	1.19	3.74	1.06	3.07	1.04	53
A	5	2.86	1.08	3.18	1.15	3.30	1.14	3.21	0.98	20
A	6	3.18	1.31	4.07	1.01	3.84	1.00	4.00	0.83	50
A	7	3.37	1.42	4.50	0.86	3.82	0.99	4.80	0.71	57
	Ave.	**3.27**	**1.26**	**3.65**	**1.14**	**3.58**	**1.02**	**3.70**	**1.09**	**350**
B	8	3.43	1.17	3.47	0.89	3.81	0.93	3.80	0.68	59
B	9	3.44	1.16	3.51	0.99	3.92	0.77	3.85	0.82	56
B	10	3.65	1.27	3.60	1.23	4.20	1.11	3.47	0.88	70
	Ave.	**3.52**	**1.21**	**3.53**	**1.05**	**3.99**	**0.97**	**3.69**	**0.82**	**185**
Mathematics of the Environment										
1	**11**	**2.79**	**1.05**	**4.73**	**0.79**	**4.70**	**0.77**	**4.90**	**0.66**	**15**
2	**12**	**3.23**	**1.19**	**3.22**	**1.05**	**3.91**	**0.84**	**3.62**	**0.80**	**68**

Table 2. Pre- and post-measures of PI

		Pre		Post		Difference			N
Study	Var	m	s	m	s	t-test	p	Δ	
1	PIM	2.86	1.06	3.48	1.31	2.51	0.03	0.67	14
1	PIE	4.70	0.98	4.92	0.64	0.50	0.63	n.a.	14

Figure 1. Model of the Interest Construct

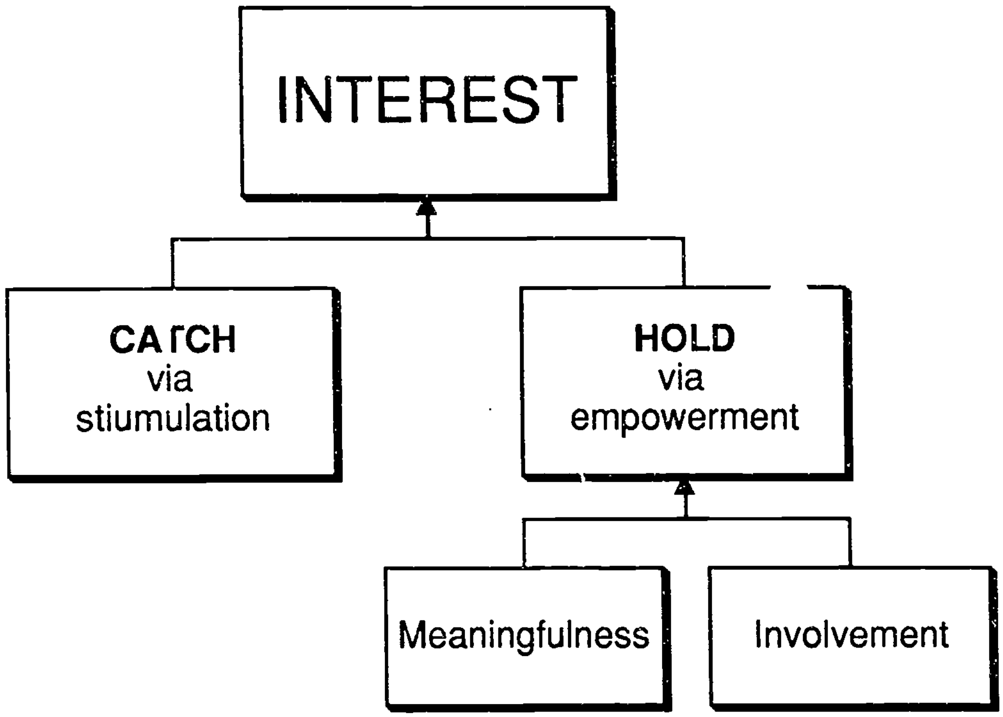

Figure 2. Visual Overview of the Hypothesized Relationship between PI, SI, and Time.

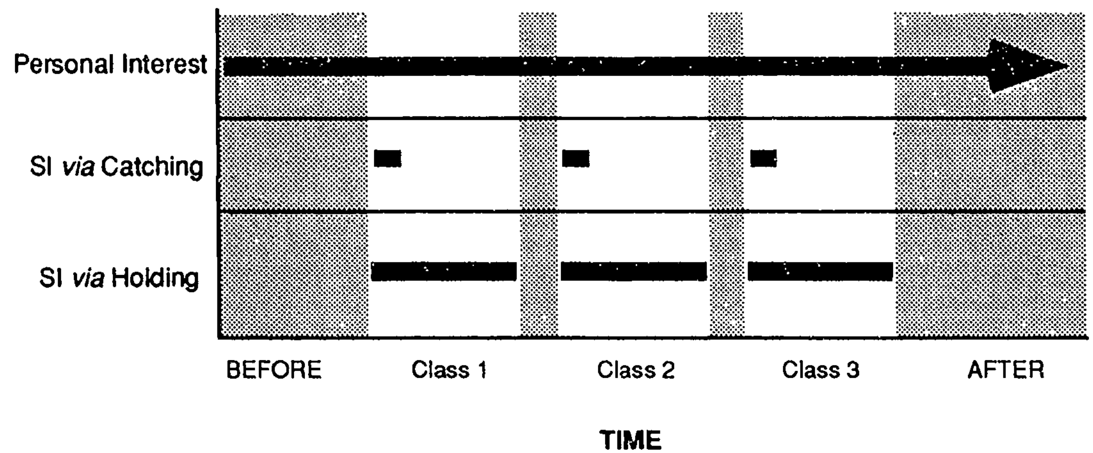

Figure 3. Visual Overview of the MOE Instructional Design