

A REVALIDATION OF THE EFFECTIVENESS OF THE HOTS PROGRAM

Prepared for

Review by the PEP committee of the National Diffusion Network

by

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ABSTRACT

The Title I Higher Order Thinking Skills (HOTS) Project is an alternative approach to Title I for Grades 4-6 in which the compensatory services consist solely of systematically designed higher order thinking activities. Traditional drill and practice activities and content instruction are eliminated. The two years of thinking activities are designed to generate the gains in basic skills expected from Title I programs, while also improving thinking ability and social confidence. By learning how to learn, students are able to learn content the first time it is taught in the classroom. The program is conducted in a computer lab, with a detailed curriculum and a teacher trained in Socratic dialogue techniques. The curriculum is designed in accordance with information processing theories of cognition.

HOTS has been a member of the National Diffusion network since 1988. During that time the approach has remained the same, but the methods have been refined as a result of additional experience and research. In addition, newer technology has been incorporated.

Students in HOTS do better than control students on standardized tests, both in reading and math, on Spring to Spring comparisons. In the best study, fourth grade HOTS students gained 12.78 NCEs in reading comprehension while control students gained 2.95. Fifth grade HOTS students gained 14.12 NCEs, while control students declined 2.24 NCEs. On other comparisons HOTS students generally made approximately twice the gains in reading and (with one exception) math.

The growth in basic skills is also reflected in dramatically increased percentages of Title I students passing the Texas required Texas Assessment of Academic Skills (TAAS) test after the introduction of the HOTS program.

HOTS students also do better on a wide variety of measures of thinking skills, such as metacognition and general cognitive abilities. HOTS students also show significant growth on transfer to novel problem-solving tasks. Growth in thinking ability is also reflected by HOTS Title I students being placed in Gifted programs and making honor role.

HOTS students also do better in overall academic performance as measured by grade point average (GPA). In one study HOTS students made almost a whole letter grade gain in GPA in one year, while control students made little gain or actually declined. There are also indications from follow-up studies that there is a high retention rate for HOTS students and that they subsequently do well on innovative academic coursework. The cost of the program is no more expensive than traditional Title I programs which use an experienced teacher.

If anything, HOTS has become more effective and more flexible since the original submission. Additional types of gains have been documented, and it appears that the program helps additional types of students. Therefore, in addition to requesting revalidation for the original population of Title I students in grades 4-6, this submission requests that validation also be extended to grade 7, and to most Learning Disabled students (those whose verbal IQ is greater than 80).

A. BASIC INFORMATION

Project Title, Location, and contact people:

Chapter I Higher Order Thinking Skills Project, hereafter referred to as: (HOTS)
Higher Order Thinking Skills Program for Title I and Learning Disabled students.

Education Innovations
P.O. Box 42620
Tucson, AZ 85733

(520) 795-2143

Dr. Stanley Pogrow and Laurie Dagostino

Developer:

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Years of Development/Operation/Dissemination:

The first pilot to test the feasibility of the approach was established in 9/83. A more refined version of the first year of the model was tested during the period 9/85 to 6/87. Development of the second year of the curriculum was completed 10/88 when serious national dissemination proceeded. The original version of the curriculum was designed for the Apple IIe computer. Since then it was extended to also include the Apple IIGS and Macintosh computers. As new versions of the curriculum were developed to incorporate new computers, the curriculums were refined based on feedback from users and new research. The program currently supports the Macintosh and Power Mac computers, and will be available for IBM/clone computers this coming summer.

Dates of any evaluation:

Evaluation has been an ongoing process since schools have been required under Federal law to conduct annual evaluations. In addition, the HOTS project conducted its own summary evaluation of effects from randomly selected sites around the country. The most recent study has been to examine the effects of HOTS on overall cognitive development of educationally disadvantaged students by incorporating new types of measures into the evaluation process.

Date of last JDRP/PEP approval:

1989

Dates and amounts of dissemination funding by source:

National Diffusion Network from 1989-3/95

B. PROGRAM DESCRIPTORS--

1. Goals: The Title I Higher Order Thinking Skills Project replaces the traditional drill and practice approach to Title I programs in grades 4-6 with higher order thinking activities. The goal of the specially designed higher order thinking activities is to provide even better student performance on standardized tests of basic skills than traditional approaches, while also increasing thinking and social interaction abilities. The goal is to provide students with the conceptual skills needed to learn the more sophisticated content of the upper elementary grade levels the first time it is taught in the classroom.
2. Purposes and Needs Addressed: The Achilles heel of school reform has been the academic progress of educationally disadvantaged students in the upper elementary and middle school grades where the curriculum becomes more complex. Most widely used validated interventions such as Reading Recovery and Success for All are validated K-3 with little evidence of sustained gains later on. HOTS is one of the few national programs that produces significant growth in the tougher, later grade levels.

The fundamental reality at the upper elementary/early middle grade levels is that even as students are falling farther behind in basic skills, the thinking requirements of the curriculum are increasing. The students are faced with a double whammy. As a result, the primary need that the HOTS program addresses is to develop the more sophisticated thinking skills needed by the students for the greater integrative demands of the curriculum and for the increasingly sophisticated world of work. The second need addressed by the program is to give students the general types of learning skills needed so that they do not regress when they leave Title I. With respect to the latter need, the National Assessment Task Force speculated that: "...Title I students need help learning to learn. This hypothesis suggests that it may indeed be possible to provide a short-term supplementary service which will have a long-term impact. But the nature of that service would be quite different from what is now typically provided...In fact, under this hypothesis, Title I instruction which focuses on curriculum content will necessarily need to be repeated year after year, for it does not teach students how to learn from the regular program." (p.72 volume 2)

The first need is addressed by the use of a thinking skills development program that increases basic skills as a byproduct. This is a more equitable approach to preparing disadvantaged students to compete in the outside world. The second need is addressed by using the Title I service to make the students more sophisticated learners so that they can learn content the first time it is taught. By making students more sophisticated learners it is expected that they will not only be able to be more successful once they leave Title I, but will be better able to engage in academic work at the secondary school level.

3. Intended Audience: Title I students in grades 4-6. (It is now being proposed to extend the validation to grade 7, and to Learning Disabled students with verbal IQs greater than 80 in grades 4-7.) The same program is designed to help in both reading and math.
4. Background, Foundation, and Theoretical Framework: The program was originally developed because practitioners who were frustrated at the repeated failure of traditional approaches to Title I, and who believed that most Title I students were bright, asked this investigator to design an alternative approach that challenged the students intellectually.

The techniques used in this program evolved from information processing theories of cognition and related work in metacognition. The work of individuals such as Robert Sternberg, Ann Brown, Robert Siegler, Ellen Gagne, Joseph Campione, L.S. Vygotsky, and others was most influential. This branch of cognitive psychology emphasizes the importance of learning how to solve problems to the overall intelligence/learning capability of an individual. A complete

discussion of theoretical rationales is contained in: Pogrow, S. *HOTS: Using Computers to Develop Thinking Skills in Students At-Risk* (Scholastic Inc., NY) 1990.

5. Features—How the Program Operates: The program uses computers, together with specially designed curricular materials and Socratic teaching strategies. All drill and practice activities are replaced with the systematically designed higher order thinking activities. No workbooks or worksheets are used. Instead, Socratic dialogues are conducted around computer-use activities. Computers are used because of their ability to enhance motivation and to respond to student's ideas at the rate at which students think of them.

The first half of the period consists of teacher led discussion. The discussions are specified in a detailed curriculum. The discussions are designed to develop the thinking skills of: a) Metacognition, b) Inference from context, c) Decontextualization, and d) Information synthesis. These thinking skills are viewed as the key ones that underlie all learning and successful work. Teachers probe student responses in accordance with the Socratic techniques they are trained in.

After the discussion the students are given a challenge to work out on the computer for the rest of the period. The feedback generated by the computer provides a continuous flow of information for the student to process, which leads to improvements in comprehension and problem solving. Teachers constantly probe student to articulate their ideas, and explain how and why the computer is reacting to their strategies the way it is. Constantly pressing students to examine and explain their strategies and results increases the sophistication of their language use—both in terms of comprehension and articulation. This increased sophistication of language use enhances their ability to learn all content. That is why the same activities are able to produce substantial gains in both reading and math.

The program operates as a pullout. Students are in the program for 35 minutes a day, four days a week, for one to two years. In the first part of the period, the teacher engages students in sophisticated conversations. Students are then given a challenge which they go to the computer to try and solve. Students will later discuss their findings, approaches and how they know whether their strategy for solving the problem did, or did not, work.

The program requires a computer lab and a good teacher. A week-long workshop is provided to train the lab teachers how to shift from traditional teaching approaches of lecturing, refereeing and linear sequencing to the more open-ended, Socratic coaching techniques used in this program. It is also important to have competent instruction in the regular classroom.

Students proceed through the ungraded curriculum in a sequential fashion. Teacher judgment is used to determine the pacing. There is no management system and no grades. Success is demonstrated by the products generated by the student, their articulation of findings, and the results they record in their "lab notebook." These data are used by the students to determine whether a given strategy they have used is an optimal one. The only management activities are scheduling the pullout in accordance to recommended guidelines so as to minimize disruption to the regular classroom. The only formal evaluations are those required in the standard Title I reporting procedures. A number of teachers, however, have initiated an assessment process of providing reports to parents describing their childrens' activities in the program.

Most importantly, this is one of the few national programs with a consistent track record of producing gains in Title I students in grades 4-6. This program is the only thinking skills program designed specifically for Title I students, and that is designed to produce transfer to measurable gains in basic skills. It is also the only program nationally that treats Title I students as Gifted and which relies strictly on activities that challenge them intellectually.

There is no content remediation or worksheets. It is also the only Title I approach that views lack of experience in linking ideas and generalizing as the major deficiency as opposed to other programs which view a lack of content knowledge as the basic problem. In the view of HOTS, the shortage of content knowledge at the upper elementary grade level is a direct result of the student's lack of experience in engaging in the primary problem solving activities that the mind uses to retain and extend new information.

The curriculum organizes the computer activities in ways that parallel how the long term memory of the brain stores and retrieves information. The curriculum develops linkages and associations between and among concepts the student is already familiar with, and links the use of fundamental concepts across different software environments, contexts and symbol systems. Students also learn to work with larger chunks of information and to think more deeply about the information they use. Chunks of information are used to solve problems that require the development, testing and articulation of strategies.

Developing these general problem solving skills enables students to learn content the first time it is taught in the regular classroom, rather than always having to reteach the content in special programs to help them learn.

The general nature of the thinking skills activities means that the program can coexist with any textbook series, curriculum or instructional improvement technique in the classroom. Only occasional linkage to formal classroom content is needed.

The computer-use techniques and teacher training methodologies that have evolved in this program are state-of-the-art, and have broad implications for practice. While there are many computer drill and practice programs designed to improve basic skills, the Title I Higher Order Thinking Skills Project is the first to successfully use sophisticated computer tools to produce measurable transfer to basic and other academic skills. Rather than traditional CAI approaches to using computers, this project has resulted in a new methodology that has been termed 'Learning Dramas'. The curriculum and teaching techniques have been designed to create an environment where students are given the opportunity and responsibility to learn through discovery activities. A series of articles have already been published which describe the implications of these techniques for using computers with all students and at all grade levels. The most complete description of the techniques is in a book published in 1990 by Scholastic Inc. Articles describing Learning Dramas have appeared in the Feb. 90 issue of *Educational Leadership*, the Spring 94 issue of *Journal of Learning & Evaluation*, and a chapter in the forthcoming book *When Process is Content: Towards Renaissance Learning* to be published by Corwin Press.

In addition, the success of the HOTS program has resulted in some new knowledge about what the nature of the learning problems are for Title I and LD students, and why prior efforts have largely been unsuccessful after the third grade. Recent examples of such articles are: April 92 issue of *Phi Delta Kappan*, May 26, 1993 issue of *Education Week*, and the February 95 issue of *Educational Leadership*.

Finally, this is the only Title I program that generates reading and math gains from the same set of activities. Traditionally, separate pullouts and programs for reading and math. Indeed, recent evidence that will be discussed later is that HOTS simultaneously provides a wide variety of additional gains.

In summation, the Title I Higher Order Thinking Skills Project is the first program to put

together a replicable package of state-of-the-art curriculum and teaching techniques around the use of computers that simultaneously promotes basic and advanced types of learning gains. Indeed, the results indicate that this thinking skills program produces even greater basic skill gains than drill and practice approaches.

6. Recent Modifications:

HOTS has been adapted for the Macintosh and Power Mac computers. Work has started on adapting the program to the IBM platform.

A new form of weeklong training has been instituted for those teachers and schools for whom summer training is inconvenient. An internship form of training is now available wherein teachers are trained in the actual classroom settings of HOTS trainers. This gives trainees an opportunity to practice teaching HOTS lessons to actual Title I students.

Inservice training has also been instituted for existing HOTS teachers. Two day brushup trainings have been instituted to bring existing teachers up to date on the latest teaching techniques, and to share ideas.

The program has been experimenting with broadening the base of students it serves, primarily additional grade levels for Title I students and Learning Disabled (LD) students. Research has shown the program to be effective with Title I students in grade 7 (as well as the original grades 4-6), and for most Learning Disabled students (those with verbal IQ's greater than 80).

In keeping with the trends towards schoolwide models and site-based management, a few schools are experimenting with a schoolwide version of HOTS, and greater efforts are being made to increase contact with principals. In addition, a number of techniques are being developed to better link HOTS with other interventions to support overall school improvement.

As part of celebrating the intellectual development of HOTS students, the project started a national poetry contest two years ago. This past year over 100 submissions were received.

C. RELEVANT EVIDENCE

1. Evidence of success in dissemination

(a & b) HOTS generally trains one teacher per adopting school and perhaps one paraprofessional. Some schools train a backup teacher, and some schools have a sufficiently large population, or use the program on a schoolwide basis, to operate 2-3 labs with 2-3 lead teachers.

The table on the next page shows the growth of new schools and teachers. (We have not kept track of the number of paraprofessionals trained.)

HOTS GROWTH DATA

| Year | Number of New Schools | Number of New Teachers |
|----------|-----------------------|------------------------|
| Pre-1986 | 14 | 14 |
| 1987-88 | 30 | 48 |
| 1988-89 | 106 | 124 |
| 1989-90 | 186 | 264 |
| 1990-91 | 403 | 553 |
| 1991-92 | 492 | 669 |
| 1992-93 | 468 | 618 |
| 1993-94 | 290 | 397 |

The decline in the number of new schools and teachers trained in 1993-94 is a result of changes in funding allocations and a national movement towards schoolwide models as opposed to specialized programs and pullouts. However, preliminary indications are that the numbers of new trainees has stabilized as it now appears that the number of new schools and teachers trained in 1994-95 period was about the same as for last year. In 1994-95, 47 training workshops were conducted in 23 states.

The number of new sites will probably stay constant for another year and then start up again as people start to realize that the students have specific special needs that cannot be addressed as well through schoolwide models as compared to a specialized program such as the Higher Order Thinking Skills Program.

- (c) The major components of the dissemination process are: a) presentations about HOTS at national and regional conferences, b) mailings of awareness materials, c) operating booths at key national conventions, and d) articles written by Dr. Pogrow in major national journals.

The following is a summary of the number of presentations and mailings:

October 1, 1989 - January 31, 1990

| | | |
|--------------------------|-----|----------------------------------|
| Awareness presentations | 14+ | Attended by approx. 1,782 people |
| Conference presentations | 10+ | Attended by approx. 1,100 people |
| Awareness materials sent | 345 | Districts |

February 1, 1990 - January 31, 1991

| | | |
|--------------------------|-------|----------------------------------|
| Awareness presentations | 14+ | Attended by approx. 1,077 people |
| Conference presentations | 12+ | Attended by approx. 1,800 people |
| Awareness materials sent | 1,397 | Districts |

February 1, 1991 - January 31, 1992

| | | |
|--------------------------|-------|----------------------------------|
| Awareness presentations | 39+ | Attended by approx. 3,170 people |
| Conference presentations | 6+ | Attended by approx. 650 people |
| Awareness materials sent | 1,116 | Districts |

February 1, 1992 - September 30, 1993

| | | |
|--------------------------|-------|----------------------------------|
| Awareness presentations | 37+ | Attended by approx. 3,000 people |
| Conference presentations | 7+ | Attended by approx. 700 people |
| Awareness materials sent | 1,617 | Districts |

October 1, 1993 - September 30, 1994

| | | |
|--------------------------|-----|----------------------------------|
| Awareness presentations | 23+ | Attended by approx. 2,300 people |
| Conference presentations | 23+ | Attended by approx. 400 people |
| Awareness materials sent | 912 | Districts |

We are currently distributing nationally close to 10,000 copies of our brochure each year.

The project is currently in the process of expanding its dissemination. In prior years booths have been set up in the vendor's area for the national conventions of the Association For Supervision and Curriculum Development and the International Reading Association (IRA). For the 1995-96 school year, HOTS booths are being expanded to also include the national conventions of the National Association of Elementary School Principals, and the Title I auditors conference. In addition, booths will be maintained at regional IRA conventions.

HOTS teachers and coordinators are encouraged to do local and regional presentations through our national newsletter. The project provides some expense support to those who make such presentations.

We also plan to do a mailing to all the principals of Title I schools to let them know about HOTS. Finally, we are starting to explore the use of Internet to communicate about HOTS.

Over the past three years Dr. Pogrow has made 29 speeches about HOTS in 22 states. During this same period Dr. Pogrow has had nine articles/book chapters that were either directly about HOTS, or related to knowledge generated from HOTS. Three of them were published in the widely read *Phi Delta Kappan* and *Educational Leadership* journals. A new article about HOTS will be appearing in the March 96 issue of *Principal Journal*, and another one is being considered by *Phi Delta Kappan* for publication in Spring 96, which will summarize the knowledge generated by the HOTS program.

- (d) Curriculum materials are updated each year based on feedback from sites. A free 800 phone line support number is given to all sites. The calls coming in over this support line indicate problem areas as well as areas where there is confusion. These calls, as well as other types of correspondence, are used as the basis for updating the curriculum.

The training is updated annually based on feedback from trainers, as well as based on misconceptions that surface from the calls to the 800 phone line.

We have also improved our quality control mechanisms. In order for a school to adopt the program, an adoption agreement specifying how the program will be implemented and used must be signed by the Title I coordinator, principal, and designated teacher. This has dramatically cut down on the number of trainees who come to the training not knowing what the program is about, or where the school has not made adequate preparation for implementing the program in terms of proper scheduling or equipment purchasing. It has also served to increase the overall quality of teachers that schools recruit to be HOTS teachers.

We have also expanded the kinds of support provided to the schools that adopt the program. HOTS teachers receive training and materials for training the classroom teachers in their school on how to use some key HOTS techniques with all students in the regular classroom. In addition, a two-day brushup training for existing HOTS teachers has been instituted.

Finally, the materials have been extended to the Macintosh computer, and will soon be available for IBM computers.

- (e) Improving the academic performance of educationally disadvantaged students remains a high priority at the national and local levels of government. There is also increased recognition that basic skills are no longer sufficient for preparing students for the world of work in a global economy. HOTS responds to both needs in exemplary fashion. In addition, even as there is a shift away from traditional pullouts in favor of classroom wide approaches, schools and states are recognizing the need for research based, highly effective non-traditional pullouts such as HOTS and Reading Recovery. Some states such as Pennsylvania and Michigan are encouraging schools to adopt both programs in their new regulations. In addition, the national director of Title I, Mary Jean Letendre, has indicated that there is no intent in the new law to eliminate research based pullouts.

Specialized programs such as HOTS and Reading Recovery remain critical as schools adjust to the new Title I regulations, and their emphasis on schoolwide models of improvement. While some are defining schoolwide to mean that schools should offer the same help to all students, others are defining schoolwide to mean providing the specialized types of help needed by all students. Evidence will be presented in later sections of this proposal that HOTS is uniquely effective at the grade levels that it serves, and appears to be more effective for Title I students than general classroom improvement strategies. As a result, HOTS remains a critical component in overall, schoolwide improvement. Indeed, if our research is correct, HOTS is critical since it functions as a catalyst—enabling the students it serves to benefit from all the other good classroom practices offered in a school the same as all other students. In other words, HOTS is part of a schoolwide improvement approach.

Another indicator of current interest in HOTS is that articles about the program have been accepted for publication in Spring 96 by *Principal* and *Phi Delta Kappan* journals. In addition, Dr. Pogrow has had a profile of his work done by *Teacher* (October 92) and *Executive Educator* (June 94) journals. The emphases of these newer articles is about how HOTS is critical for schoolwide improvement.

2. Evidence of success in program implementation and retention

The Socratic method of teaching requires high ability teachers. The quality of teacher is probably the single most important factor in establishing an effective program. A great deal of effort is made in the dissemination process to communicate the need for very high quality teachers. New HOTS teachers are rated at the end of the training session by the trainer. The results of such evaluations are contained in the following table.

| Year | # of new HOTS teachers rated | # and % rated Outstanding | # and % rated Very Good | # and % rated Good | # and % rated Fair | # and % rated Weak |
|------|------------------------------|---------------------------|-------------------------|--------------------|--------------------|--------------------|
| 1993 | 358 | 22 (6.1%) | 143 (40%) | 145 (40.5%) | 40 (11.2%) | 8 (2.2%) |

| | | | | | | |
|------|-----|-----------|-------------|-------------|---------|----------|
| 1994 | 278 | 19 (6.8%) | 106 (38.1%) | 122 (43.9%) | 25 (9%) | 6 (2.2%) |
|------|-----|-----------|-------------|-------------|---------|----------|

While such data were not collected in earlier years, informal feedback from trainers in the early years of the program suggests that as many as half of the trainees were not considered of high quality. Currently, only 11% of the new teachers being trained are considered not up to the task of teaching HOTS. In many of these cases we urge administrators to consider assigning someone else to the program in the future. Generally, after a district has established HOTS in a few schools it develops a better sense of how to select teachers. Indeed, HOTS has been effective in drawing many high quality teachers into Title I.

In addition, our dissemination efforts have improved to the point that everyone arriving for training knows about the program and why they are there. Because of this greater knowledge we have over time been able to substantially reduce the amount of time spent in the training workshop on describing the nature of the program and its rationale, and spend more time on teaching skills.

There appears to be a high level of longevity. Of the 186 schools who implemented the program in 1989, *at least* 149 were still using the program in 1993 (the last time the database was *completely* updated) as were 286 of the 403 sites trained in 1990. Most of the sites who subsequently dropped the program did so because of a loss of Title I funds as funding formulas changed in the early 90's.

Ratings of workshop

On a scale of 1-5, with 1 being outstanding, workshops are consistently receive an average rating of 1.2 across all categories.

The only criticisms are that: 1) More time was needed to fully absorb everything, and 2) Some of the training videos need to be improved.

Long-Term support

The following are some sites and individuals who have been involved with the program over an extended period of time, during which they have continued to expand the program based on demonstrated results:

Detroit Public Schools, contact Corliss Williams, HOTS Coordinator, 313-596-3534
 Northeast School District in Texas, Gabby Holstein, HOTS teacher, National trainer,
 210-344-1011

Francis Hensley, NDN state facilitator, Georgia, 706-542-4038

The following are some examples of contact individuals who have been expanding the use of the program over a shorter period based on demonstrated results:

John Connelly, Assistant Supt. for instruction, 914-858-3179

Maria Laboy, Title I coordinator, Vineland NJ, 609-794-6735

3. Evidence of program effectiveness

(a) Summary of highlights of the original program

Effectiveness in the original program was measured in terms of larger gains in basic skills

and thinking skills than control groups. There were also indications of transfer effects. In addition, the program won a number of significant awards.

- i. Basic skills: HOTS students made substantial gains on a variety of standardized tests in both reading and math, as well as on Detroit's criterion reference test. The standardized test gains exceeded national averages and were significantly greater than comparison groups ($p < .05$). All gains exceeded the .2 sd criterion of educational importance.

On the more valid Spring to Spring measures, experimental students gained 7.2 percentiles (4.7 NCE's) in reading as compared to the national average of 5 percentiles (3.1 NCE's), and 11.0 percentiles (8.1 NCE's) in math as compared to 6.6 percentiles (3.9 NCE's). Gains continued into the second year.

Close to three quarters of the HOTS students made basic skill gains.

- ii. Higher Order Thinking Skills: Experimental students did better on the measures of thinking skills. Scale VI of the ROSS test and an Inference from Context measure were used to measure thinking skills. Experimental students consistently did better on the ROSS measure of thinking skills. For example, in Plymouth MA, Control students ($n=29$) went from the 55th to the 54th percentile during the year, while HOTS students ($n=24$) went from the 51st to the 66th percentile. Statistical tests of significance were not conducted, but the differences are obviously significant, as well as substantial.
- iii. Transfer: The anticipated transfer effects of the program to improved content learning and thinking skills were supported by the: a) substantial math gains produced with little or no supplementary math activities, and b) results from the thinking skills measures.

There were also indications of the existence of transfer effects from the program to the classroom from teacher reports about HOTS students: a) being placed in Gifted programs, b) making the school's honor role, c) increasing articulation, and d) gaining in self-confidence.

For example, Detroit conducted a survey of classroom teachers reactions to the experimental students on the following dimensions: Verbalization, recognizing similarities/differences, solve problems, written expression, team problem solving, independent problem solving, organizing data, and class participation. At the beginning of the year, teachers rated 61.3% of the students as 'needing improvement', and only 4% as 'excellent'. By the end of the year, the number of students labeled as 'Needing Improvement' dropped to 16%, while the percentage rated as excellent increased to 18%. This shift shows a dramatic improvement in the perceptions of the regular classroom teachers about the capabilities of their students over the course of the year.

- iv. Special awards: One HOTS site was selected as the most innovative K-8 program in California (an award which rarely goes to a categorical program), and an Arizona site was designated an exemplary Title I program by the U.S. Department of Education.

- (b) Current claims are that the same effects observed earlier are still occurring for students the program was originally validated for; Title I students in grades 4-6. There is some indication that as the program has improved that reading gains are even larger, and there

is even stronger evidence that transfer is occurring. There is also evidence on more varied instruments that HOTS students are making significant gains in thinking.

A new claim is that HOTS is also effective for Title I students in grade 7, and LD students in grades 4-7.

(c &d) This 'results' section will be organized around a series of different studies.

i. Elvira Elementary in Tucson:

The best, and most comprehensive, study conducted to date of the benefits of the HOTS program has been a recently completed dissertation at the University of Arizona by Dr. Mary Ann Darmer (Darmer, 1995). Dr. Darmer is a HOTS teacher in a local school, Elvira Elementary. Elvira is a very low SES school in an urban setting. The students are primarily Native American and Hispanic. What is unique about this study is that it was the first to use a wide variety of measures of cognitive development to more accurately and comprehensively assess how widespread the benefits of the HOTS program are. Previously, most studies had collected data primarily on standardized test scores.

Dr. Darmer studied the effects of HOTS training on the following outcomes: a) Metacognition, b) reading comprehension, c) grade point average, d) general intelligence, e) writing, and f) novel problem solving tasks. Metacognition was measured using the questionnaire developed by Lee Swanson (internal consistency of .92). Reading comprehension was measured using the Nelson Reading Comprehension Test. General intelligence was measured using five selected scales from the Woodcock Johnson Cognitive Abilities Test. Writing was measured using student writing samples (holistic scoring with an inter-rater reliability of .93). Novel problem tasks were developed by the researcher (Pre and Post test).

The following table summarizes the scales and methodology used in this study.

| Instrument | Measure/Scale | Group Tested | Type of Measurement |
|------------------------------|---|------------------------|---|
| Metacognition | Knowledge of: Problem solving Person Variables Reading Strategies Task Awareness | Experimental & Control | Post test only (Spring) |
| Nelson Reading Comprehension | Reading Comprehension | Experimental & Control | Pre and Post test (Spring to spring) |
| Grades | GPA | Experimental & Control | Pre and Post (Spring to Spring) |
| Woodcock Johnson | Listening Comprehension Concept Formation Verbal Analogies Spatial Relations Analysis-Synthesis | Experimental | Pre & Post test (Fall to spring) |

| | | | |
|---------------------|--|--------------|---------------------------------------|
| Novel problem tasks | Transfer Schema Usage Strategy Development | Experimental | Pre and Post test (Fall to spring) |
| Writing | Writing | Experimental | Pre and Post test (Fall to Spring) |

The result was a total of 15 scales, and 30 group comparisons (4th and 5th grade was compared separately).

Sample:

The experimental group consisted of Title I eligible students that was funded with Johnson O'Malley Funds. As a result, first priority was given to selecting Native American students. The remaining slots were filled by random selection from the remaining pool of eligible students.

The control group consisted primarily of Hispanic Title I eligible students whose services were funded out of Title I funds. Control students were pulled out once a week and received the balance of their service in the classroom.

The experimental group consisted of 28 fourth graders and 25 fifth graders. The control group consisted of 24 fourth graders and 25 fifth graders. There was no statistical difference in the pre-test reading scores of the two groups.

Results:

Results were compiled for the period Spring 93 to Spring 94.

First year HOTS students increased substantially and significantly in all 22 pre-post comparisons. HOTS students significantly and substantially outperformed the control Title I students in all 12 comparisons between the groups.

While space does not permit reporting all the data, the following two tables illustrate the significant differences between the groups:

A COMPARISON OF THE GROWTH IN READING COMPREHENSION

| Grade | Group | n | Pre | Post | Gain (NCE) | SD | t (post-test) * | p |
|--------|---------|----|-------|-------|--------------|-------|--------------------|-------|
| Fourth | HOTS | 28 | 33.93 | 46.71 | 12.78 | 17.59 | | |
| | Control | 25 | 31.42 | 34.37 | 2.95 | 17.47 | 2.78 | .0078 |
| Fifth | HOTS | 24 | 30.60 | 44.72 | 14.12 | 12.39 | | |
| | Control | 25 | 30.08 | 27.84 | -2.24 | 7.02 | 4.73 | .0001 |

* There was no statistical difference on the pretest

The gains for the HOTS students are substantially larger than in the original study. In addition, gains for the HOTS students are noteworthy given the fact that the scores of fifth graders in the same school are declining.

A COMPARISON OF THE GROWTH IN GPA *

| Grade | Group | n | Pre | Post | Gain | SD | t | p |
|--------|---------|----|-------|-------|-------------|------|------|--------|
| Fourth | HOTS | 28 | 77.43 | 86.86 | 9.43 | 6.50 | | |
| | Control | 25 | 74.70 | 74.17 | -.53 | 6.53 | 7.0 | <.0001 |
| Fifth | HOTS | 24 | 68.90 | 76.93 | 8.03 | 5.63 | | |
| | Control | 25 | 71.96 | 71.20 | -.76 | 7.94 | 3.64 | <.0007 |

* A gain of 10 points equals a gain of one letter grade

Grade Point Average is an excellent measure of transfer for a pullout program. Control students spent more time in the classroom than HOTS students, yet are declining in GPA. The decline in control students mirrors conventional wisdom about how the longer students are in Title I the worse they seem to do. yet, HOTS students are defying conventional wisdom and are benefitting from additional service. Why are HOTS students improving almost a whole letter grade? This phenomenon appears to validate Dr. Pogrow's belief that after the third grade the major inhibitor of learning is not prior content knowledge, but rather, an inability to process the more cognitively difficult tasks that occur after the third grade. That is why the development of general thinking skills through a program such as HOTS has more payoff to the learning of classroom content than increased exposure to the content. The increased thinking skills allow students to learn content the first time it is taught.

The gains in GPA for HOTS students are substantial. Indeed, by the end of the year, 18 of the HOTS students (35%) made honor roll. In addition, 23 of the students entered the school's science contest.

The thinking skill appear to translate directly into improved academic skills. For example, while the first year curriculum has students do some writing, writing is not emphasized to any great extent. At the same time, the table below shows that HOTS students showed significant improvement in writing (based on a rating rubric of 0-4).

GROWTH OF THE HOTS STUDENTS IN WRITING

| Grade | Group | n | Pre | Post | Gain | SD | t | p |
|--------|-------|----|-------|-------|--------------|------|-------|---------|
| Fourth | HOTS | 28 | 1.082 | 2.457 | 1.375 | .571 | 12.74 | p<.0001 |
| Fifth | HOTS | 24 | 1.06 | 2.52 | 1.460 | .406 | 17.97 | p<.0001 |

The transfer of the thinking skills into improved academic performance seems to be a result of overall intellectual development. There is evidence of a general cognitive development transfer effect. The table below shows the growth of HOTS students on solving novel problem solving tasks. (The tasks on the post-test were different than those on the pre-test.)

GROWTH OF THE HOTS STUDENTS ON NOVEL PROBLEM SOLVING TASKS

| Grade | Group | n | Pre | Post | Gain | SD | t | p |
|--------|-------|----|-------|-------|--------------|--------|-------|--------|
| Fourth | HOTS | 28 | 64.64 | 97.10 | 32.54 | 16.022 | 10.72 | <.0001 |

| | | | | | | | | |
|-------|------|----|-------|-------|--------------|--------|-------|--------|
| Fifth | HOTS | 24 | 52.56 | 92.32 | 39.76 | 18.075 | 11.00 | <.0001 |
|-------|------|----|-------|-------|--------------|--------|-------|--------|

And it does appear that HOTS students make a variety of intellectual development gains. For example, the table below shows the growth for the Woodcock-Johnson scale of Synthesis-Analysis:

GROWTH OF THE HOTS STUDENTS ON THE COGNITIVE ABILITY SCALE OF SYNTHESIS-ANALYSIS

| Grade | Group | n | Pre | Post | Gain | t | p |
|--------|-------|----|-------|--------|--------------|------|--------|
| Fourth | HOTS | 28 | 90.67 | 107.99 | 17.32 | 8.37 | <.0001 |
| Fifth | HOTS | 24 | 88.80 | 107.60 | 18.80 | 8.37 | <.0001 |

This pattern of significant growth was consistent across all the other four Woodcock-Johnson scales of cognitive ability used in this study.

This growth in general thinking ability is also mirrored, for example, in the relative performance of the groups in the metacognition scales of the instrument developed by Lee Swanson. For example, in the Knowledge of Task Awareness scale, The table below indicates that the HOTS students had significantly higher post-test scores than the control students.

A COMPARISON OF STUDENTS ON THE METACOGNITIVE SCALE OF KNOWLEDGE OF TASK AWARENESS

| Grade | Group | n | Post | SD | t | p |
|--------|---------|----|--------------|-------|------|--------|
| Fourth | HOTS | 28 | 81.21 | 9.34 | | |
| | Control | 24 | 62.50 | 11.70 | 6.46 | <.0001 |
| Fifth | HOTS | 24 | 79.52 | 7.48 | | |
| | Control | 25 | 57.00 | 12.00 | 7.91 | <.0001 |

This pattern of relative performance of HOTS versus control students on the three other scales of metacognition is the same as in the above table, with a substantial and significant advantage for the HOTS students.

Dr. Darmer has begun analysis of a second year of data that includes a new cohort of first year students, and the second year performance of the original cohort of students. Preliminary results show that HOTS students continue to make progress in the second year, although at a much slower rate of growth, while control students continue to decline. In addition, the preliminary analysis of results from the second cohort of first year students appear very similar to those of the first group reported in this study.

This study shows that HOTS provides a major advantage on a wide variety of measures, and consistently produces a wide variety of substantial gains. The gains in GPA, performance on novel problem-solving tasks, and in writing make a convincing case that HOTS activities produce a powerful form of transfer.

ii. Mann Middle School in San Diego:

Mann Middle School is one of the lowest SES schools in San Diego Unified School District and has 80% free and reduced lunch. Results from this school confirm the effects of HOTS on transferring to academic gains. In 1992-93, 14% of the 65 seventh graders in the second year of HOTS had an A average, 49% had a B average or better, and 83% had a C average or better. 15% made the honor roll. Only one of the students was failing.

The results were even better in 1993-94. 21% of the first year students (sixth grade) had an A average, and 33% made honor roll. 23% of the second year (seventh grade) HOTS students had an A average, and 29% made honor roll. In addition, 16 students were recommended for being tested to determine their eligibility for placement into the Gifted program, and 4 HOTS Title I students were placed in Gifted programs.

iii. Detroit Public Schools:

Detroit Public Schools was represented in the original validation study. Detroit continues to have a large number of schools using the HOTS program. The Detroit office of research conducted a study of the effectiveness of the HOTS program in 1992-93. The study is based on results from the California Achievement Test from Spring 92 to Spring 93. (The control group had statistically significantly higher pre-test scores in both reading and math.)

A COMPARISON OF THE GROWTH OF STUDENTS IN DETROIT IN READING AND MATH

| SUBJECT | GRADE | n | | GROWTH (In Grade Mean Equivalents) | |
|---------|-------|------|---------|---------------------------------------|---------|
| | | HOTS | Control | HOTS | Control |
| Reading | 4 | 245 | 107 | .9 | .5 |
| | 5 | 123 | 68 | 1.6 | .9 |
| Math | 4 | 245 | 107 | 1.2 | .7 |
| | 5 | 123 | 68 | 1.3 | 1.3 |

HOTS students consistently made significantly greater progress, almost twice as much growth, except for fifth grade math where both groups made substantial gains. (If reading comprehension had been reported separately, the difference in reading growth in favor of the HOTS students would probably have been even greater.)

It is impossible to compare the amount of gains for HOTS students in this study as compared to the Detroit study in the original validation study since the earlier study used a criterion referenced test instead of the current norm-referenced test. However, the percentage difference in favor of HOTS students in reading in this study on a norm-referenced test is consistent with the overall findings from the original study (i.e., approximately twice the gain).

(There is an apparent national trend for math results tend to be more inconsistent than reading results. Given that there are almost no math activities in HOTS, math gains are pure transfer and depend heavily on the quality of regular classroom math instruction.)

The Detroit study also found that interviewed teachers felt that the thinking skills of the HOTS students had definitely improved. The conclusion of the study was that the HOTS program "...should be continued and expanded."

iv. Kenai Peninsula Borough School District in Soldotna, Alaska:

About as far away from Detroit, both geographically and culturally, is the Kenai Peninsula Borough School District in Soldotna Alaska. The following results are for Spring to Spring gains on the ITBS test.

A COMPARISON OF THE GROWTH OF STUDENTS IN SOLDOTNA ALASKA IN READING AND MATH (1990-92)

| SUBJECT | GRADE | n | | GAINS (NCEs) | |
|---------|-------|------|---------|--------------|---------|
| | | HOTS | Control | HOTS | Control |
| Reading | 5 | 17 | 17 | 8.22 | 4.41 |
| | 6 | 13 | 12 | 6.15 | 2.25 |
| Math | 5 | 8 | 27 | 12.12 | 7.67 |
| | 6 | 7 | 9 | 10.85 | 5.45 |

Once again HOTS students are making approximately twice the growth of control Title I students.

v. Gains on the Texas state TAAS Test:

HOTS not only produces gains on nationally normed tests, but also on the TAAS test which is required statewide in Texas, and used to determine promotion and graduation. Williams Elementary is in Georgetown TX, a small rural community. Results were compiled as to the percentage of fifth grade Title I students passing the statewide TAAS assessment in reading and math in 94, prior to HOTS, and the percentage of HOTS students passing in 1995 (n=49).

A COMPARISON OF FIFTH GRADERS PASSING THE TEXAS TAAS TEST IN WILLIAMS ELEMENTARY SCHOOL BEFORE AND AFTER HOTS

| | 1994 Percent passing | 1995 (HOTS) Percent passing |
|---------|-------------------------|--------------------------------|
| Reading | 8 | 47 |
| Math | 38 | 61 |

In addition, teachers felt that approximately 80% of HOTS students had made improvement in the classroom over the course of the year.

A confirmation of a high percentage of students in rural Texas district's passing the TAAS test was submitted by McGaha Elementary in Wichita Falls Texas. In 1995, the percentage of HOTS students passing both reading and math by grade level were: Grade 4 —75%, Grade 5—88%, and Grade 6—70%.

v. Dan Mills Elementary

Dan Mills Elementary is representative of the type of report the HOTS project receives wherein HOTS schools produce gains much larger than average. For example, Dan Mills Elementary finished first out of 27 elementary schools in the size of gains for their Title I students in grades 3-6 based on performance of the reading section of the CTBS test from Spring 91 to Spring 92. The overall gain for 68 HOTS students in grades 4-6 was 12.95 NCEs.

vi. Finally, informal tabulation indicates that between 10-15% of the HOTS Title I students are making honor roll nationally.

Followup studies:

There have been constant anecdotal reports of students' being successful in later schooling. Such reports include a wide range testimonials include: Obtaining honors at later levels, high levels of participation in academic courses, graduating high school, and entering college. There have also been reports of HOTS students graduating college and becoming teachers.

Since a key goal of HOTS is to develop the sense of understanding so that students can perform at higher levels in exemplary content, the focus of followup research by the HOTS project itself has not been on simply following students later on in their school careers, but rather, how they do in high quality curricula. To this end Dr. Pogrow developed an innovative pre-algebra course called SUPERMATH. Research is just beginning on how HOTS students do subsequently when placed into SUPERMATH in a heterogeneous environment. The first school to establish such a transition from HOTS to SUPERMATH was Morey Middle School in Denver Public Schools.

The table below shows the results for Morey Middle School in Denver for a class composed of regular students and Title I students who had been in HOTS for a year:

OVERALL CLASS GAIN IN MATH IN MOREY MIDDLE SCHOOL

| | Pre | Post | NCE Gain |
|-----------------|------|------|----------|
| Problem Solving | 46.7 | 56.7 | 9.9 |
| Total Math | 46.8 | 51.5 | 4.7 |

The above table indicates that students in SUPERMATH made substantial gains in math, with more of the gain coming in the problem solving section of the test, probably reflecting the problem solving nature of the curriculum. The important question, however, for the purpose of this proposal is how the students whose pre-test scores were below 15 NCE, who were primarily HOTS students, did relative to the other students. The relative performance is described in the following table:

A COMPARISON OF THE PERFORMANCE OF HIGH AND LOW PRETEST SCORING STUDENTS IN MATH

| | Total Class NCE Gain | NCE Gain of low pretest students |
|--|----------------------|----------------------------------|
| | | |

| | | |
|-----------------|-----|-----|
| N | 22 | 10 |
| Problem Solving | 9.9 | 9.1 |
| Total Math | 4.7 | 5.6 |

The above table indicates that low pretest scoring HOTS students at Morey made substantial gains in problem solving and total math, and gained approximately as much as the 'regular' students. This indicates that HOTS enables Title I students to subsequently do well in academic content curricula that incorporate the use of thinking and technology.

Denver Public Schools also conducted a follow-up study of 41 seventh grade Title I students in HOTS in 90-91 who were still in school in 93-94 as high school students. Of the 41, only two had dropped out for sure. (The study was unable to locate a third student.) Thirty eight were still in school, either in Denver or other school districts. This is a retention rate three years later of 95 or 93% (depending on what happened with the other student. (No comparable data were provided for other Title I students in the district.) This low dropout rate during the duration of the study is, of course, no guarantee that the students will graduate.

Another piece of evidence on the long term success of HOTS students comes from a dissertation in progress by Robert Landry (1995). Mr. Landry, who is not affiliated with the HOTS program, studied the effects of an alternative program on high school at-risk students in a school in his district. He studied 10 randomly selected students out of a population of 64 tenth grade at-risk students involved in the program. The study found that poor performance in math vocational math courses was a major detriment to academic self-esteem. The exception to poor performance in vocational math was three female students who had been in HOTS in prior years in the junior high school. These students said that they felt good doing math problems, and the "...math teacher said that these students assisted other students in math." (p. 86) "The students having been placed in the Higher Order Thinking Skills program at one junior high school appeared more successful." (p. 88) "These three female students were successful in the mathematics course." (p. 124) *This study recommends HOTS as an important background factor for students being able to take advantage of innovative high school programs.*

Tucson Unified School District did a followup study of the subsequent performance of HOTS students on the ITBS/TAP standardized tests. The table below indicates how students who had been in HOTS in the year indicated were performing in 1994-95. The results are contained on the next page.

The Tucson followup data are difficult to interpret given the attrition that has occurred over the years. The data seem to suggest that students who remain in the district continue to make some progress in comprehension and problem solving after HOTS. At the very least, there is no reason to believe that they follow a general pattern of ongoing decline in upper grade levels that seems to befall many educationally disadvantaged students.

FOLLOWUP RESULTS FROM TUCSON UNIFIED SCHOOL DISTRICT

| | |
|----------------------------|------------------------|
| HOTS Post-Test Score (NCE) | Score in 1994-95 (NCE) |
|----------------------------|------------------------|

| Year in HOTS | READING Comprehension | MATH Problem Solving | READING Comprehension | MATH Problem Solving |
|--------------|--------------------------|-------------------------|--------------------------|-------------------------|
| | Mean Score (n) | Mean Score (n) | Mean Score (n) | Mean Score (n) |
| 1989-90 | 28.1 (299) | 31.1 (290) | 31.5 (56) | 33.0 (44) |
| 1990-91 | 27.1 (467) | 31.2 (475) | 30.4 (139) | 33.8 (116) |
| 1991-92 | 29.7 (123) | 33.0 (125) | 32.2 (172) | 37.3 (147) |
| 1992-93 | 27.5 (271) | 32.6 (265) | 34.4 (148) | 38.2 (137) |

At the same time, HOTS students do not seem to make ongoing dramatic progress after they leave the program. However, that is to be expected. Dr. Pogrow has speculated that fully developing intellectual potential is a two stage process. Stage one is the initial nurturing of general thinking skills in HOTS. Stage two is experiences in innovative academic curricula wherein students have the opportunity and interest to apply their thinking skills to formal academic content—e.g., the results reported above for Morey Middle School. HOTS students who subsequently do not have access to innovative curricula will not continue to make measurable progress. Unfortunately, there was no effort in this district to subsequently build on the potential developed in HOTS.

At the same time, HOTS provides an enabling capability such that when students are subsequently placed in innovative curricula they are able to perform at high levels—e.g., the above study by Landry.

Awards

The HOTS program continues to win awards. For example:

- 1995 West Avenue Elementary school, a HOTS site in the Northeast School District in Texas, was recognized by the U.S. Department of Education as an exemplary Title I program. In addition, three other HOTS schools in the district received state recognition in 1994 for having at least 70% of the Title I students pass the TAAS test.
- 1994 South Elementary, a HOTS sites in Mission, South Dakota on the Rosebud reservation, was recognized by the U.S. Department of Education as an exemplary schoolwide Title I program.
- 1991 Three of the 105 exemplary Chapter 1 awards from the U.S. Department of Education nationwide went to HOTS sites in the following districts: Tucson Unified School District (AZ), Luddington Area Schools (MI), Wyomissing Area School District (PA)

In addition to school awards, we constantly receive notices from teachers about regional awards and recognition won by their HOTS students.

Extending HOTS to seventh graders and LD students:

Over time teachers began to experiment with using HOTS with populations other than those the program was originally validated for whenever their instincts said that the program would work. As the project became aware of such experiments it began to

systematically collect data and share it over the HOTS network.

The two new populations for whom HOTS has been effective are Seventh graders and LD students.

(a) LD students:

In 1993 a study was done of 30 schools around the country using HOTS with LD students. Feedback showed that the program was working with a majority of the LD students but not all of them. Follow-up research was done to determine the conditions under which HOTS worked for LD students. Teachers, coordinators, and counselors were asked to try and identify what the distinguishing features were between LD students who benefited from HOTS and those that did not. The conclusion of the study was that HOTS consistently benefited those LD students who were above 80 verbal IQ.

Results have shown HOTS to be consistently effective with LD students above 80 verbal IQ, regardless of whether the students were self-contained or mixed in with Title I students.

The following specific results are from Randolph and Drew Model Elementary Schools in Arlington VA, on the Degree of Reading Power test. The results are fall-fall.

GAINS FOR LD STUDENTS in RANDOLPH SCHOOL

| Year | Grade | Years in HOTS | n | Average Gain for all Students | Mean Gain for HOTS |
|---------|-------|---------------|---|-------------------------------|--------------------|
| 1994-95 | 4 | One | 4 | 4 | 6.8 |
| | 5 | One | 2 | 4 | 8.0 |
| | 5 | Two | 1 | 8 | 13.0 |
| 1993-94 | 4 | One | 3 | 4 | 8.0 |
| | 5 | One | 1 | 4 | 10.0 |
| | 5 | Two | 2 | 8 | 9.5 |

GAINS FOR LD STUDENTS in DREW MODEL ELEMENTARY SCHOOL

| Year | Grade | Years in HOTS | n | Average Gain for all Students | Mean Gain for HOTS |
|---------|-------|---------------|---|-------------------------------|--------------------|
| 1993-94 | 4 | One | 7 | 4 | 13.3 |

The HOTS LD students made larger gains on this tests than the overall national sample. (Presumably, the gains expected for just for LD students on this test would be less than 4 points per year, further enhancing the significance of the progress HOTS LD students made.)

The overall national study combined with the specific results from the above two schools indicate that HOTS is extremely effective for LD students above verbal IQ is above 80, which comprises the vast majority of LD students.

The conclusion that HOTS helps most LD students is consistent with the work of researchers, such as Candace Bos of the University of Arizona, who have concluded that much of the learning problems of LD students results from problems with metacognition skills. The effects of HOTS would validate this theory.

Seventh graders:

Seventh graders did so well as second year students in HOTS, that teachers began to start seventh graders in HOTS. Our research shows that HOTS works very well for those students, especially if they have not been previously retained (i.e., that they are the appropriate age for that grade level.)

Landis Intermediate School, in Vineland NJ, is one of the schools that submitted results for students starting the program in the seventh grade. The results are for Spring 93 to Spring 94 on the MAT 7 test.

GAINS FOR SEVENTH GRADE HOTS STUDENTS AT LANDIS INTERMEDIATE SCHOOL

| SUBJECT | PRE | POST | GAIN (NCEs) |
|---------|------|------|-------------|
| Reading | 36.7 | 43.3 | 6.6 |
| Math | 35.8 | 41.5 | 5.7 |
| Writing | 30.0 | 44.7 | 14.7 |

The above gains in reading are larger than those in the original study, but lower in math. The very large gains in writing suggest that transfer is occurring, and that the lower gains in math are probably a reflection of the quality of classroom math instruction.

Seventh grade students were also included in the results cited above from Mann Middle School in San Diego. In 1992-93, 14% of the 65 seventh graders in the second year of HOTS had an A average, 49% had a B average or better, and 83% had a C average or better. 15% made the honor roll. Only one of the students was failing. In 1993-94, results were even better for seventh graders. 23% of the seventh grade HOTS students had an A average, 60 % had an average of B or above, and 29% made honor roll.

These results demonstrate that HOTS also generates a wide variety of substantial gains for seventh graders.

(e) Interpretation and Discussion of Results:

The data in this report shows that HOTS is even more flexible than originally thought in producing substantial growth at the key grade levels of 4-7, and that it works for LD (above 80 verbal IQ) as well as for Title I students. The research cited above strengthens the basic premise of the HOTS program, i.e., that the best way to develop basic skills in grades 4-7 is as a byproduct of developing thinking skills.

The research cited here confirms the basic skill gains reported in the first study, while

breaking new ground in term of demonstrating a wide variety of other associated benefits that occur simultaneously. If anything, the absolute size of the gains in reading and the comparative advantage for HOTS students in reading, appear to be larger than in the original submission. In the original submission HOTS students did 80% better in reading on Spring to Spring measures. In this study HOTS students generally did at least twice as well. The studies also continued to also show substantial gains in math, and (with one exception) an advantage for HOTS students. The HOTS students also did very well on a new standardized measure, the Texas TAAS test.

The approach to measuring thinking skills was new to this study, and much more comprehensive than the original study. The single ROSS test scale used in the original study was not reused since it was only appropriate for the fourth grade, and the other measure had no reliability or validity. The Metacognition and general cognitive ability scales that were used instead consistently confirmed the superior performance of the HOTS students in general measures of thinking and/or the growth of the HOTS students. (The sensitivity of the Woodcock-Johnson scales had previously been established in an earlier Master's thesis at the University of Arizona by Sharon Keown. Ms. Keown found that HOTS students made substantial growth on the cognitive ability Woodcock-Johnson scales.) The gains on these tests were confirmed by the researcher developed measure on transfer to novel problem solving tasks.

The demonstration of gains in writing and GPA were new. In both cases the gains and performance were substantial. These gains, combined with the gains in math and novel problem-solving tasks suggest even more strongly that transfer is occurring, and that HOTS truly enables students to be successful on a wide range of academic tasks.

This submission also provides some evidence that the HOTS program translates into gains in subsequent innovative academic coursework. When innovative coursework is not available HOTS students seem to cope and survive—as opposed to subsequently declining.

The documentation of these new types of gains also means that the basic skill gains are not a result of some artifact such as regression to the mean. Such artifacts cannot account for the consistent gains in classroom performance measures, such as GPA and honor roll. In addition, the study by Dr. Darmer showed that at least on some measures control students were declining—ruling out regression effects.

Nor do the gains seem to be merely a result of having good teachers or using computers. Rather, there appears to be a general cognitive enhancement effect. First, good teaching might account for the reading gains, but not for the GPA or thinking skill gains, since there are no formal classroom content activities in the HOTS curriculum materials. In addition, both HOTS and control students in the Darmer study were from the same classrooms and received the same regular instruction. Indeed, the Darmer study is probably the best evidence to date as to how dramatic a difference the approach to Title I students makes.

There is a great deal of educational significance to the findings. First, HOTS remains one of the few national interventions that have been successful at grade 4-7. Second, HOTS accommodates student diversity. It is effective for all races and ethnicities it has been used with. Third, by being able to serve both the majority of Title I and LD students, HOTS provides a way to simplify the process of providing a highly progressive specialized program to educationally disadvantaged students, while increasing the effectiveness of such services.

Most importantly, the success of HOTS provides a way to leverage the effectiveness of all other interventions and reforms in a school and make schoolwide improvement an obtainable goal. Since HOTS students are able to benefit from sophisticated forms of instruction, it becomes more practical for classroom teachers to raise the bar of the overall demands and expectations for their entire class. When they do, the HOTS Title I and LD students become some of the best students, and the educational process goes from mere physical inclusion to academic inclusion. ('Academic Inclusion' is a term coined by Dr. Pogrow to describe educationally disadvantaged students doing as well academically in heterogeneous settings as the 'regular' students.) In a sense, HOTS is the missing link and catalyst for making schoolwide change effective.

HOTS remains one of the most significant national interventions for helping educationally disadvantaged students. It has succeeded in demonstrating: a) the tremendous intellectual potential that these students have—regardless of race, ethnicity, or SES level, and b) that it is possible to design a highly progressive approach to education that can also produce high levels of basic skill gains on a large scale. National interest in the program remains high on the part of both practitioners, editors, and the academic community. As HOTS goes into its 15th year, the new priorities are to link it to other reforms as part of using it as an instrument of schoolwide reform.

References

Darmer, M.A. Developing Transfer and Metacognition in Educationally Disadvantaged Students: Effects of the Higher Order Thinking Skills (HOTS) Program. Unpublished dissertation University of Arizona, 1995.

Landry, R.J. An Alternative approach for Increasing Academic and Social Esteem in At-Risk Students in a High School. Dissertation in Progress. 1995.