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ABSTRACT

The concept of aptitude is reviewed, and the uses and misuses of aptitude tests are considered. Many aptitude tests measure general ability plus certain more specialized abilities that are important for success in particular educational programs. Aptitude tests can be subdivided into: (1) group-administered aptitude tests, such as the Scholastic Aptitude Test; (2) multifactor aptitude tests, exemplified by the Differential Aptitude Test; (3) specific aptitude tests; and (4) individually administered aptitude tests (intelligence tests). Aptitude tests have three major uses: instructional purposes; administration; and guidance. Several potential misuses of aptitude tests can occur, particularly if results are interpreted as fixed or immutable. In considering the effects of schooling on results of ability measures, it is important to consider the many reasons for change in individual test scores. While it may not be possible to raise intelligence quotients permanently, habits can be taught that allow a child to make the most of natural ability. Raising achievement test scores and teaching test-taking skills are generally acceptable objectives. Improvement of academic aptitude may be possible through direct training in learning strategies and the development of executive learning skills, i.e., skills involved in planning, monitoring, and evaluating one's own thinking. A 35-item list of references is included. (SLD)

APTITUDE: WHAT IT IS, HOW TO USE IT, AND HOW TO AFFECT IT

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The terms aptitude, ability, intelligence and achievement are used interchangeably by many people, whereas most measurement experts would make distinctions between them. Tests are measures of these constructs. It is quite reasonable to feel unclear in regard to both the constructs and the measures since differences between them are subtle.

All of these constructs and the tests designed to measure these constructs sample intelligence, learned behavior and measure the probability of future learning or performance (Wesman, A.G., n.d.). In this sense. they are all the same! We need, however, to make distinctions between them in order to responsibly understand and use the data that the tests that measure them produce.

Let us initially group ability, aptitude and intelligence tests together and explore the difference between this group which we will call "aptitude tests" and achievement tests.

The differences between aptitude and achievement tests are as follows:

1. Aptitude tests cover a broader area than achievement tests and sample a wider range of experiences (Sattler, J.M., 1988).
2. Aptitude tests are less closely tied to particular school subjects and are less specific and culture bound (Mehrens, W.A., n.d.; Sattler, J.M., 1988).
3. Aptitude tests have higher heritability indices than achievement tests (Mehrens, W.A. and Lehmann, I.J., 1987).
4. Aptitude tests measure cumulated learning or learning for all time, achievement tests tend to measure recent learning (Mehrens, W.A., n.d.; Mehrens, W.A. and Lehmann, I.J., 1987).

5. Aptitude tests are more valid measures of future performance than achievement tests (Sattler, J.M., 1988).
6. Aptitude tests stress the ability to apply information in new and different ways while achievement tests are designed to measure mastery of facts (Sattler, J.M., 1988).

Aptitude tests have clear advantages if one is interested in predicting general academic performance and if one is interested in what a child is bringing to a task irrespective of the specific curriculum that the child has experienced. The difference between aptitude and achievement tests is sometimes a matter of degree and some aptitude and achievement tests look a lot alike (Mehrens, W.A. and Lehmann, I.J., 1987).

Aptitude tests take less time to administer and are more efficient. They are particularly useful when compared with achievement measures to show a difference between expected achievement and actual achievement. Such a comparison can be used as one measure of curricular or school effectiveness given proper precautions (Mehrens, W. A., n.d.; Mehrens, W.A. and Lehmann, I.J., 1987).

Ability, intelligence and aptitude are constructs that are more similar to each other than they are to achievement. Intelligence tests are considered the more global measures, aptitude the more specific measures (Mehrens, W. A. and Lehmann, I.J., 1989) Yet intelligence tests, cognitive ability tests and scholastic aptitude tests all measure a general ability factor (Jensen, A., 1981). Test publishers currently lean away from the terms intelligence and aptitude and prefer the term ability or school learning ability.

General ability tests measure overall average performance across a broad range of mental capabilities. These tests are called mental tests,

intelligence tests or IQ tests. They have broader predictive validity than any other type of psychological measurement. We can compare intelligence tests to aptitude tests which are more specialized. Many aptitude tests measure general ability plus certain more specialized abilities that are important for success in a particular educational program. Scholastic aptitude tests are primarily interested in general reasoning ability and specific verbal and numerical abilities because these are the most predictive of scholastic performance (Jensen, A. 1981).

Jerome Sattler views intelligence as a "broad concept that reflects an individual's information processing capabilities and possession of useful knowledge" (Sattler, J.M., 1988, pg. 78). Scores on an intelligence test are an important index of ability but should not be considered to thoroughly measure intelligence or measure all of an individual's intelligence.

> ...for many there is a 'mystique' surrounding the IQ: the misconcpetions are frequently so deeply ingrained that it might even require a complete college course on mental testing to dispel them (Jensen, A., 1981, pg. 237).

Definitions of intelligence, and there are many of them, emphasize adjustment or adaptation to the environment, the ability to learn or the ability to use abstract symbols or concepts. Current theories of intelligence posit a general factor at one level, several broad classes of abilities at the next level and primary factors at a third level (Sattler, J.M., 1988).

> ...intelligence can be seen as the most complex scientific issue of all time...There simple exists no more complex problem in science today (Reynolds, C.R., 1987, pg. 309).

Now that some subtle distinctions between intelligence, aptitude and achievement have been carefully spelled out, a question can be posed to check our understanding.

> If we used reading comprehension items on a test would we be measuring intelligence, aptitude or achievement?

Reading comprehension is more highly correlated with general ability or intelligence than is any other area of scholastic performance. It is more highly correlated with all other forms of achievement than is any other school subject. However, the answer depends on the age of the students that would take our test! If we tested elementary school students, our test would be measuring achievement. Students are learning to read. This is recent learning strongly effected by curricula and teaching. If we were to test high school juniors and seniors, however, we would be measuring general ability or intelligence as well as aptitude to do college level work. The exception would be those students with specific reading disabilities such as dyslexia. In the case of a student with dyslexia, reading comprehension would not reflect general ability or intelligence. Content of a test then is not adequate to identify it as an intelligence, aptitude or achievement test. In fact, the higher one goes in levels of education, the more the content of aptitude tests such as college entrance exams resemble achievement tests. This is because certain past knowledge is part of the aptitude predictive of success at advanced levels (Jensen, A., 1981).

Aptitude tests can be subdivided into four categories and students might have experience with all four. Those categories include group administered aptitude tests, multifactor aptitude tests, specific aptitude tests and individually administered aptitude tests.

The SAT is a good example of a group administered ability test. It is probably the best known and most widely used test. It is well designed. A question goes through more than a hundred steps before it is accepted and may take as long as two years before it is seen on a test (Feder, B., 1979). The SAT-Verbal aptitude test consists of reading comprehension, antonyms, verbal analogies, and sentence completion. The SAT-Mathematical aptitude test measures numerical ability and quantitative reasoning. An individual score should be thought of as the score plus or minus 32 points which is the standard error of measurement. The SAT-V is generally more predictive of overall college grades than the SAT-M. Predictive accuracy is improved by combining SAT-V and SAT-M with high school grades (Jensen, A., 1981).

Criticism of this type of aptitude test may relate to the fact that aptitude tests are used to parcel out the limited resources of society such as admission to select colleges and the tests are seen as closing doors to opportunity for success (Sattler, J.M., 1988). Studies show that actually the S.A.T. validly and reliably measures what it is intended to measure.

> For the last 63 years, the S.A.T. has functioned as a guarantor of fairness to students of every background in college admissions. It has been a messenger of clear national standards of academic achievement that help to keep high school grades from "intlating" beyond reason (Steward, D.M., 1989).

The Differential Aptitude Teat is a good example of a Multi-Factor Ability Test. The DAT has eight subtests: Verbal Reasoning (VR), Numerical Ability (NA). Abstract Reasoning (AR), Clerical Speed and Accuracy (CSA), Mechanical Reasoning (MR), Space Relations (SR), Spelling (Sp) and Language Usage (LU). The last two subtests are really achievement tests because they are so closely tied to the curriculum. The DAT is considered a multifactor Aptitude Test and fits under the category of multiple aptitudes. In practice, the differential validity of the DAT in predicting course grades is not any better than predicting grades from the combined VR and NA score which is a measure of general scholastic aptitude. Counselors like the DAT, however, especially when it is combined with a Career Planning Report. In general, however, the multifactor aptitude tests are not very good for differential prediction (Mehrens, W.A. and Lehmann, I. J., 1998).

Individual aptitude tests are also called intelligence tests, An individually administered ability test or IQ test allows the examiner to observe a student'sapproach to problem solving,his/herreaction to stress and his/hergeneral test taking patterns. The examiner can control the student's behavior and observe a child closely allowing more reliable measurement and a better understanding of the factors underlying the behavior observed (Mehrens, W.A. and Lehmann, I J., 1987). No other items of information that we can obtain about a child will predict overall learning ability and academic achievement better than recently obtained scores on an individually administered aptitude or ability test (Jensen, A., 1981).

Misconceptions about the ability tests we consider intelligence tests abound. A few statements can be made that may be helpful in disspelling some of those misconceptions.

1. Intelligence tests never measure innate intelligence exclusively.Scores on such tests are based on the student's interaction with the environment as well.

2. Intelligence tests absolutely do not measure capacity or potential!
3. Individual student's scores on intelligence tests can change significantly although for most children, measured intelligence remains relatively stable after five years of age.
4. Any test is but a sample of an individual's skills and abilities.

   Intelligence tests do not measure all we need to know about a person's abilities and certainly do not reflect a person's essential worth. High school seniors should not be allowed to think that they do.
5. All intelligence tests do not measure the same thing. The score on one test may not be interchangeable with a score on another test. (Sattler, J.M., 1988).

None of these statements is intended to diminish the value of individually administered intelligence tests. Properly chosen, administered and responsibly used, they are of considerable value in helping children.

> Many would, in fact, offer the intelligence test as the major achievement of psychology in guiding everyday practical affairs. (Weinberg, R.A., 1989, pg. 100).

What Is the Value of Ability Testing?

Educators have always been concerned with evaluating the progress of students. The goals of education are increasingly complex and the demand for accountability has grown. Tests of general ability measure skills that are important to learning in school.

There are considerable data on the usefulness or value of individually administered ability tests.

1. They are excellent predictors of scholastic achievement.
2. They provide ways of comparing a child's performance with that of other children observed in the same situations.

3. They provide a profile of strengths and weaknesses.
4. They measure a child's ability to compete in our society in ways that have economic and social consequences.
5. They assess individual, cultural and biological differences among individuals.
6. They have identified unsuspected talents in some children thereby improving their educational opportunities and are valuable tools in working with handicapped children (Sattler, J.M., 1988).

Group ability tests are administered most often as part of a group achievement test battery. Their advantage lies in quick administration to large numbers of students at reasonable costs. One of the values of group ability tests is to identify those children who obtain extreme scores so that they may be selected out for further attention. They are also of value in making program decisions, curricula decisions and for making instructional groupings although the latter should constitute a highly flexible use of such data. Some data shows that group administered ability tests predict achievement as well as individually administered tests (Wright, D. and Piersel, W.C., 1987). Others are cautious in their discussions of the uses of group administered tests of intelligence (Anastasi, A., 1982).

How Can We Use Aptitude Test Results?

In general, aptitude tests have three major uses: instructional, administrative and guidance. Aptitude tests are used for instructional purposes when they are used to adapt students to courses, or courses to students, or curriculum to student groupings, or to design assignments for students who differ widely in ability in the same class. Aptitude test scores can help teachers form realistic expectations of students. Knowing something about the ability level of students in a given class can help a teacher identify which students are not learning as much as could be predicted on the basis of ability scores. If a whole class were performing less

well than would be predicted from aptitude test scores than curriculum, objectives, effective teaching methods, or student characteristics might be investigated (Barlow, D.L., 1985; Mehrens, W.A. and Lehmann, I.J.,1987).

An interesting study was reported in 1987 in which effective teacher behavior was related to student ability. It was found that a teacher must behave differently to be effective with high-ability learners than to be effective with low ability learners. Also it was found that a teacher must behave differently to be effective with learners at either ability level when teaching arithmetic than when teaching reading. What constitutes" effective teaching" may vary depending on content and student ability (Lara, A.V. and Medley, D.M., 1987).

Some theorists feel that achievement is related to time on task. Aptitude impacts on this research as well. The amount of time a child should spend in learning depends on how much time is needed to reach the intended goal, the quality of instruction and the child's ability to understand that instruction. High aptitude children may not learn more with additional time on task as it isn't needed. Students do not have a uniform learning rate (Gettinger, M., 1989).

Studies which attempt to match instruction to learner characteristics are called 'aptitude times treatment interactions'. High and low aptitude students have been found to learn better in small group conditions than in large group conditions. Medium ability students do slightly better in large group conditions (Wagner, R.K. and Sternberg, R.J., 1984). Other studies have found sex differences in motivational patterns and behavior among high ability but not low ability students, especially in mathematics (Dweck, C.W., 1986).

Aptitude test scores are useful in educational, personal and vocational guidance. In vocational guidance,the educational requirements of some jobs require considerable general ability. In vocational and personal guidance,

the measurement of differential abilities may facilitate self-understanding. Students can be helped to understand themselves as individuals and as members of a group. They can be helped to set realistic goals and to make decisions with regard to the kinds of abilities and strengths and weaknesses they possess. (Barlow, D.L., 1985; Mehrens, W.A. and Lehmann, I.J., 1987).

Some uses of aptitude test scores fall under the category of administrative uses. Aptitude test results can be used to gain supplementary information for curricula planning and evaluation. An idea of the general ability level of a school is helpful in determining how much emphasis should be made on college preparatory programs. Aptitude tests could be used to help identify students for early admission to kindergarten or for acceleration at different grade levels. Aptitude tests can be used along with other data when grouping students. Recent meta-analyses on ability grouping, both in elementary and secondary schools, claim small positive achievement effects of between-class ability grouping. The effects depend on ability, however, with high achievers gaining the most. There is good evidence that regrouping students for reading across grades increases reading achievement. Within class grouping in upper elementary school in mathematics is effective (Slavin, R.E., 1987).

> Tests are far from perfect, but they are still a fairer way to select pupils than on teacher judgement...test scores, especially when there are several of them over time, are the most objective evidence parents can get about the school ability of their child (Boehm, A.E., 1982, pg. 162).

Although one would not advocate using only test data to group students, studies show that such a process would result in less separation of upper and lower SES students than if other factors in addition to test scores are used (Mehrens, W.A. and Lehmann, I.J., 1987). *

*SES refers to socioeconomic status

In addition to all of these ways in which ability tests are used, there is considerable potential for use of ability test data for research and employment. Using modern statistical tools researchers have found that ability tests do quite consistently predict subsequent job and job training performance (Mehrens, W.A. and Lehmann, I.J., 1987).

Misuses of Aptitude Test Data

A student will take a number of aptitude tests before graduating from public school systems. Both the public and educators, as well as test constructors, have been concerned about the potential misuses of aptitude tests.

1. Aptitude test scores should not be used to help teachers develop fatalistic expectations in regard to learning abilities of students.
2. Aptitude tests can be used like any other kind of data to label students. A label should never be used as an explanation, a label is a description.
3. Aptitude test scores need to be thoroughly explained to children and parents to help develop accurate self concepts without contributing to bad feelings or inaccurately high expectations.
4. Aptitude test scores should never be interpreted as immutable, permanent or a total picture.
5. Aptitude test scores should not be used to lock-step a child into a curriculum (Mehrens, W.A. and Lehmann, I.J., 1987).

Standard ability tests can establish students' current levels of performance but do not tell us how they got there! Students who have not had the opportunity to acquire skills and knowledge may be misjudged or misclassified.

> The classifications that result, already presumed to reflect general intellectual ability, are further regarded as fixed and unlikely to change. These expectations free teachers and schools from some of the responsibility for effective remediation (Campione, J.C., 1989, pg. 154).

There are other misuses of test results. If tests are used to evaluate instruction, the stakes become too high and the testing can become the curriculum (Madaus, George, 1989).

Some educators attempt to interpret test scores when they have not had a measurement course and lack training in this area. Many measurement experts seem to feel that the tests are often blamed for misuse rather than blaming the people or policies that used the information or misused it.

What Are the Affects of Schooling on Ability?

In order to address the question of the effects of schooling on ability, we need to briefly touch the great nature-nurture debate. We need to look first at individually and group administered ability tests or IQ tests and review the influence of heredity and environmental influences on those scores.

It is important to understand that children do not inherit an IQ! They inherit a collection of genes that set the upper and lower limits of their ability but the environment determines where in this range the final IQ will fall. There is considerable debate about how wide this range is. Although heredity may set the limits of the range, it is the environment that promotes or restricts intellectual development. An estimate of the heritability of a

trait describes the proportion of the variation of a trait in a given population that is attributable to genetic differences in that population. A heritability estimate refers only to population variance; it does not apply to an individual. Estimates of heritablity for intelligence range about 50% percent (Sattler, J.M., 1988' Weinberg, R.A., 1989). Some experts estimate the heritability much higher and some lower. As the environmental conditions affecting IQ become more equal for everyone in the population, the remaining IQ variation; although less, will be more a result of genetic influences (Jensen, A., 1981; Menreno, W.A. and Lehmann, I.J., 1987).

It is a myth that,if a characteristic is genetic, it cannot be changed. Genes do not fix behavior but establish a range.

> The conclusion that our genetic heritage contributes to the complex accounting of variation in our performance need not be pessimistic nor bode evil for social and educational policy (Weinberg, R.A., 1989, pg. 102).

The environment also effects test scores. Some environmental effects are surprisingly small such as pre-natal stress, nutrition and birth order. Some variables you might not think of such as parental discipline policies effect scores with middle-of-the road policies enhancing ability.There is some evidence that genetic variance in intelligence test scores is larger in middle class homes. In general, no single environmental factor has a large influence on I.Q. (Sattler, J.M., 1988).

We can now turn to the direct effects of ordinary schooling on ability measures. Inequality of schooling plays a minor role in individual differences in I.Q. Pre-school attendance has little effect on scores. Elementary school attendance,on the other hand, makes a "substantial difference on ordinary

group-administered ability tests" but high school and college "have smaller effects" (Jensen, A.R., 1981).

Do Ability Scores Ever Change?

If we are talking about individual children, the question of whether or not ability scores change must be answered with 'it depends'. The tested intelligence of a child under four years of age is unstable. As children get older, the stability of test scores increase quickly. The scores of most children over age five tend to remain in a similar position relative to their age group. The I.Q. of any given child may change dramatically, however. Test scores can and do fluctuate for indiviidual children and this is why permanent decisions, labeling, or program decisions should not be made on the basis of a single test score (Mehreno, W.A. and Lehmann, I.J., 1987; Sattler, J.M., 1988).

> If I.Q.'s and achievement scores are obtained at each grade level and averaged over three to five years, the correlation between them approaches .90, or nearly the reliability of the test (Jensen, A., 1981, pg. 29-30).

In the case of group ability or aptitude tests, verbal group test scores are more stable than non-verbal scores, below age 10 stability in group test scores is less than for individually administered test scores, but after grade 7, there is hardly any difference between stability of individual and group verbal ability tests (Mehreno, W.A. and Lehmann, I.J., 1987).

Changes in individual test scores occur for a number of reasons. Physical and emotional factors can effect test scores. Changes in motivation and in cognitive stimulation can occur as well. These are environmental factors that can effect I.Q. constancy. Some children have a growth pattern that is smooth and continuous, others have a growth pattern that consists of spurts

and pauses. This could cause changes in tested I.Q.'s which would be related to genetically based developmental trends (Sattler, J.M., 1988). Also it is important to realize that a genetic or environmental influence may operate at one point in time and not at another (McGue, M. 1989).

Personality may affect group ability tests as well. One hypothesis for the differential scoring of men and women on the Scholastic Aptitude Test (women score 61 points lower than men) is that men are more likely to take risks and guess at answers. Other hypotheses include larger numbers of women taking the tests and more women taking the test from lower income families who have had lower quality education (Carnegie, Mellon, September, 1988).

Although a close relationship exists between high ability and success at school, keep in mind that other factors also play a part such as persistence, hard work, personality (introverts tend to do better), emotional stability and attentional skills. The relationship between high ability and achievement is greatest for the most academic subjects (Latin) and lower to much lower for sewing, cooking and gymnastics (Eysenck, H.J. and Kamin,Leon, 1981).

Can Ability be Raised?

There has been and there remains considerable interest in raising ability scores. Studies suggest that special environmental stimulation can temporarily raise children's scores sometimes substantially on certain ability tests. However, we have no evidence at this time that appreciable and lasting changes can be made in the general ability factor that the I.Q. test measures and is the basis for the I.Q.'s correlation with scholastic achievement (Jensen, A., 1981).

There is also accumulating evidence that the low intellectual skills and thinking capacity of mildly mentally retarded students cannot be

substantially or permanently raised by special training (Weinberg, R.A., 1989).

Educational interventions that have shown some I.Q. gains are programs that involved poor income infants and that lasted until those children were school age and beyond. I.Q. gains occured on tests that allow for the most direct transfer of specific learning. "Virtually without exception, there is a partial or total 'fade-out' of treatment induced I.Q. gains within one to three years after treatment" (Jensen, A., 1981, pg. 187).

What can be influenced, however, is the learning of habits that allow a child to make the most of natural ability.

> Inquisitiveness, curiosity, exploration, learning, practice to attain mastery, the self discipline needed for sustained effort, and responsibility and dependability are all learnable habits to a large extent. Children at almost every level of I.Q. can acquire such habits, and, within broad limits, these will be at least as important to their well-being and "success" as the "I.Q." (that is, the general ability that the I.Q. is intended to measure) (Jensen, A., 1981, pg. 241).

If we move from the individual intelligence tests to group ability tests, there is debate about the effects of "coaching". The SAT test serves as a good example. An independent study by the Federal Trade Commission of two commercial SAT courses found that small but statistically significant gains in scores were found especially for students whose scores were lower than would have been predicted by high school grades. The SAT-M is considerably more susceptible to a practice effect than the SAT-V. Coaching can act as a review, can decrease test anxiety, can help students become test-wise and can increase confidence. Much of the score gain may be due to a practice effect (Jensen, A.R., 1981; Feder, B., 1979; Carnegie Mellon University, 1988).

INITIALLY THIS DATA MAY SEEM DISCOURAGING. HOWEVER, it should be pointed out that the SAT is designed to measure developed scholastic skills and knowledge acquired throughout a student's entire school career. The items on the SAT are content-specific. Performance on these specific types of items is undoubtedly trainable so it is conceivable that a coaching program can be developed that would be successful. Many items require content-specific knowledge especially on the SAT-M. SO IN ESSENCE RAISING YOUR APTITUDE TEST SCORES MEANS RAISING YOUR ACHIEVEMENT SCORES (Feder, B., 1979)!

Reading is probably the single most important skill that is tested on group ability tests such as the CTP ability tests of the ERB. Poor 'readers' read too quickly; they miss important connecting words, expressions and punctuation; they read their own opinions and views into what the author has stated; they jump to conclusions, and they don't go back and check impressions (Feder, B., 1979). RAISING APTITUDE TEST SCORES MEANS IMPROVING READING COMPREHENSION!

Some experts feel that short-term cramming will not affect aptitude test scores but LONG TERM INSTRUCTION IN BROAD COGNITIVE SKILLS MIGHT WELL IMPROVE ONE'S ABILITY (Mehreno, W.A. and Lehmann, I.J., 1987).

Finally, TEST TAKING SKILLS or test-taking orientation can remove some of the obstacles that might cause the student to inaccurately represent his or her performance (Mehrens, W. A. and Lehmann, I.J., 1987).

Raising achievement test scores and teaching test taking skills are objectives that we may readily accept in fact have already accepted. Improving reading comprehension is an objective of all elementary teachers but too often is left to a few departments at the secondary level. Instruction in cognitive skills is an objective that may have to be more broadly embraced by all teaching staff in order to make it effective.

Mehrens and Lehmann (1987) maintain that "Each participant in the educational process should be held responsible only for those educational outcomes that he or she can affect." It would seem that improving achievement, improving reading comprehension, teaching test taking skills and instructing in broad cognitive skills are educational objectives for which every teacher at every level, in every content area can assume responsibility.

For some individual students a comprehensive unified effort to meet objectives, such as those stated above, would make significant differences in aptitude test scores. But even if the gains were small, if they were uniform and across the board for all of our students and if they resulted in a permanent change in general ability, the consequences could be impressive! Jensen (1981) has pointed out that a 5 point gain in I.Q. for all students, for example, would double the percentage of students with I.Q's over130 (very superior) and would reduce by half the percentage of students with I.Q.s below 70 (borderline).

We already know a great deal about improving achievement and teaching study skills. There is new data in the areas of teaching reading comprehension that all teachers need to understand. Reading comprehension is usually taught by placing students in reading groups and asking them questions about what they have read out loud, or by having students read a text and then read and answer questions about the text. Current thinking about teaching reading comprehension focuses on teaching the process of comprehension. Researchers have identified activities that foster reading comprehension as well as the reader's monitoring of that comprehension. They include summarizing, self-directed questioning, clarifying and predicting (Belmont, J.M., 1989).

Younger children are thought to require guided practice to implement comprehension - monitoring. The teacher leads discussions focusing on these four main comprehension-fostering activities by beginning with a question and ending by summarizing content. Children learn to lead the discussions with the teacher acting as coach (Brown, A.L. and Campione, J.C., 1986).

Comprehension monitoring or the ability of a student to evaluate his or her comprehension while reading a text and to do something when comprehension breaks down is considered very important in the teaching of reading comprehension. Hypothesis formation or the ability to figure out what is happening, or will happen next and to revise these hypotheses as needed is critical to comprehension of text. Both strategies need to be modeled first by the teacher and then taken over by students. A reading curriculum should teach how to construct interpretations of text. High ability students may develop these skills on their own but others will only find reading frustrating (Collins, A. and Smith, E.E., 1982).

There is widespread concern that American schools are not doing a good job of teaching students how to think. Boosting the impact of instruction by improving student's aptitude is an appealing goal. Cognitive theory and research suggests that learning ability can be improved by training students in learning strategies. Learning strategies or cognitive strategies include goal identification, diagramming, labeling, working backward, working forward, underlining, summarizing, mnemonic devices, questioning, note taking, and text analysis. A great deal of strategy research is underway and this early work has raised the optimism of researchers regarding the possibility of helping students acquire such skills through training (Derry, S. J. and Murphy, D.A., 1986).

This research may be better described as attempts to train school-like cognitive skills rather than attempts to train intelligence (Brown, A.L. and Campione, J.C., 1982) Learning ability may be partly trainable intellectual skill and partly strategic thinking capability that must evolve as a function of experience and intelligence (Derry, S.J. and Murphy, D.A., 1986)

Strategies training not only has to teach the essential thinking skills but also must train "executive" control functions. "Executive" processes are involved in planning monitoring and evaluating one's own thinking. (See Table V). Standard methods of instruction cannot train executive skills. What seems to be needed is opportunity for long term and frequent practice within a curriculum (Derry, S.J. and Murphy, D.A., 1986) Teaching specific strategies is not as useful or as likely to generalize as teaching general thinking approaches or principles and how to apply them over a variety of different tasks and content areas. Students need to be able to predict the difficulty of a task and recognize when that difficulty changes. They need to know when directions are incomplete, when they understand what they hear or read and when they don't! They need to be able to plan ahead and apportion their study time. They need to know when they have studied enough and have mastered what they need to learn. Lower ability students need more highly structured situations in which to learn these skills (Wagner, R.K. and Sternberg, R.J., 1984) But, training can have a negative effect on high ability students in some situations (Snow, R.E., 1982)

When designing curriculum to facilitate cognitive development, a decision must be made whether to instruct students in cognitive strategies independent of content and context or to embed strategy teaching in the regular school

curriculum. The former does not provide for long term, varied practice in a realistic context, the latter does not transfer or generalize to other content areas. Another option is to teach strategies outside subject-matter instruction but introduce prompts or reminders into traditional subject-matter lessons to remind students to use them (Derry, S.J. and Murphy, D.A., 1986; Schwebel, M., 1986). It may be necessary to teach both general strategies and domain or context specific strategies.

Some suggest that it is helpful for teachers in a school system to adopt a common model on which to base their thinking instruction. Several examples are Bloom's Taxonomy, Sternberg's Problem Solving Components, Gagne's Training Theory and Meichenbaum's Cognitive Restructuring. There are many others.

The results of research on the effectiveness of many of the instructional models and on the long term impact of instruction in critical thinking are not impressive (Norris, S.P., 1985; Sternberg, R.J. and Bhana, K., 1986). Our views about the training of aptitude have become more complex. It is not as simple as was once thought. Improvement of academic aptitude may only be possible through a systematic curriculum that complements direct training in learning strategies while it fosters, encourages and enables the development of executive learning skills.

What has been learned about training of aptitude can be summarized as follows:

1. Attempts to train aptitude most go well beyond practice and feedback. Intensive training in strategies involved in task performance along with executive and control strategies involved in guiding performance and in transfering skills to new areas is needed.
2. Educational efforts need to be long term.
3. Abilities and methods of training interact. Attempts to train strategies must fit the tested aptitudes of students.

4. Practice and feedback is effective, however, when students are already proficient in the ability to be trained.
5. Intrusive training may be harmful to high aptitude students.
6. Training ability works best when treatment utilizes some of the students's other strengths.
7. Some aspects of intellectual aptitude may be more easily trained than others.

(Snow, R.E., 1982)

> Education has always been, in part, an aptitude development program (Snow, R.E., 1982).

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