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What Socrates Began: An Examination of Intellect Vol. 2

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What Socrates Began:
An Examination of the Intellect
Vol. 2

Walter E. Russell
Endowed Chair in Philosophy and Education Symposium 1988

edited by
Libby G. Cohen
What Socrates Began: An Examination of the Intellect

Vol. 2

Libby G. Cohen
Editor

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This monograph is printed in accordance with requirements of the Walter E. Russell Chair in Philosophy and Education. The holder of the chair presents one or more public lectures on issues in education and/or philosophy.

Dr. Russell was the second principal of Western Maine Normal School at Gorham (1905-1940) and a teacher at that institution for many years. The University of Southern Maine is a successor institution.

Winifred S. Russell, Dr. Russell's widow, endowed the chair in her will, stating that the position is to be "devoted to the teaching of subjects which were not only Dr. Russell's professional specialties, but the passion of his life, and will perpetuate his name on a campus where he served with unusual distinction and fidelity."

A distinguished record of service at USM and evidence of significant achievement "in teaching and scholarly activity involving education and/or philosophy, service to the university and public service" are the qualifications.

The terms of Mrs. Russell's will require that each two years a member of the USM faculty be appointed to hold the chair for a period of two years. There is no limitation on the number of terms an individual may hold the chair; on the other hand, a different individual might be appointed at each two-year interval.
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PREFACE

"when everything around us was a mystery to be revealed"
(Primo Levi, 1984)

On March 24, 1988, the second symposium on the theme of thinking and critical thinking was held at the University of Southern Maine. Both the first symposium and the second offered sessions on the theme of “What Socrates Began—An Examination of the Intellect,” and were made possible by funds provided by the Walter E. Russell Endowed Chair in Philosophy and Education. While the first symposium had a theoretical thrust, the purpose of the second one was to present the views of practitioners.

A number of the papers that were presented at the second symposium are included in this monograph. The sessions were stimulating and lively and brought to mind the following quotation by Primo Levi (1984, p. 23): “We would dredge the bowels of the mystery with our strength, our talent: we would grab Proteus by the throat, cut short his inconclusive metamorphoses from Plato to Augustine, from Augustine to Thomas, from Thomas to Hegel, from Hegel to Croce.”

Walter E. Russell, the second principal of the Gorham Normal School (which has since become the University of Southern Maine), had a deep impact on the development of the Gorham Normal School and on education in Maine and New England. I am grateful to Walter E. Russell’s family, Mr. and Mrs. Irving Vaughan, and Mrs. Fritzi Russell for their encouragement.

A number of individuals have been extremely helpful during the past two years. I am indebted to Dorothy Moore, dean of the College of Education, for her continuing encouragement and support. Franklin Talbot, the head reference librarian on the Gorham Campus, has provided invaluable assistance and he has my deep thanks. I am also grateful to Alyce O’Brien, Mary Schools, and Frances Langford for organizing the symposia. Julie Cameron and her staff have provided meticulous attention to the publication of both of the monographs. I deeply appreciate the fine contributions by all of the individuals who presented at both of the symposia. Finally, Les and Seth have provided encouragement, understanding, and the much needed touch of humor.

Libby G. Cohen
Walter E. Russell Professor of
Philosophy and Education
DEDICATION
To the memory of Walter E. Russell and the Russell Family
First Problem: Three professors, Merle White of the mathematics department, Leslie Black of the philosophy department, and Jean Brown of the College of Education were having lunch together. The woman said, “Isn’t it amazing that our last names are Black, Brown, and White and that one of us has black hair, one has brown hair, and one has white.” “Yes,” said the person with black hair, “and not one of us has hair that matches his or her name.”

“You’re right!” exclaimed Professor White.

If the woman’s hair is not brown, what color is Professor Black’s hair (Gardner, 1966)?

Second Problem: One plane flies in a straight line from Portland to Hartford, and then back again. It travels at the same speed and there is no wind. Will the travel time for the same round trip be same, less than or greater than if, a constant wind blows from Portland to Hartford (Gardner, 1966)?

Before I continue I had better provide the answers to these problems or you will be thinking about them during the rest of this lecture. The suggestion, in the first problem, that Jean Brown is a woman leads to an error. The person with black hair responded to her opening remark. Therefore, Jean Brown’s hair is not black. Her hair is not brown, either, because it would be the same as her name. Thus, her hair must be white. Professor Black’s hair is brown and Professor White’s hair is black black. For the second problem, since the wind increases the speed of the plane from Portland to Hartford and decreases it on the return, it is tempting to reply that the travel time will remain the same. But, the total travel time, when the speed and direction of the wind are constant, is always greater than if there were no wind at all. Therefore, the total travel time will be greater than if there were no wind at all.

What is problem solving? For the large majority of us problem solving takes place on a daily basis. Chi and Glaser (1985) wrote that “a problem is a situation in which you are trying to reach some goal, and must find a means for getting there” (p. 229). Greeno (1977) has defined a problem as an “initial situation and a goal, and a restricted set of operators that can be used to transform the situation” (p. 43). Problem solving is the process of moving from that initial situation to a goal (Greeno, 1977).
Various kinds of problems, as well as approaches to problem solving have been studied. Some researchers have examined problem solving in laboratory situations in which individuals have been asked to solve formal problems. Other researchers have focused on problems that occur in classroom situations and problems that are encountered in our daily lives, such as writing a term paper, paying bills, avoiding traffic problems finding a parking spot at USM, motivating my child to do well in school, and solving physics problems (Kaheny, 1986).

In a conversation with Mr. Watson, Sherlock Holmes described the process of problem solving:

...it is not really difficult to construct a series of inferences, each dependent upon its predecessor and each simple in itself. If, after doing so, one simply knocks out all the central inferences and presents one's audience with the starting point and the conclusion, one may produce a startling, though possibly meretricious effect (Holmes, S., 1930, p. 511).

One approach individuals use to solve problems is by making "educated guesses" about their solutions (Borg, 1983). By gathering information and weighing it, we search for alternate solutions. Chi and Glaser (1985) have called this process "generate-and-test" and they wrote that:

Particularly relevant examples of the generate-and-test strategy are scientific research and medical diagnosis. In research, an investigator will generate a hypothesis to explain some observed phenomena (the behavior of humans solving problems, for instance) and then devise experiments to test it. In medicine, physicians typically make a tentative diagnosis (or hypothesis) based on a partial description of the initial state (the patient's symptoms), and then order various examinations and laboratory tests to confirm or disconfirm the diagnosis (p. 238).

A hypothesis can be a beginning of our search for knowledge about the world. It is the premise of an argument that can be tested and elaborated into a theory. In The Meno, Plato described the use of hypotheses as a method of solving problems. For Plato, once a hypothesis has been identified and analyzed, its consequences can be readily deduced (Rose, 1961). The International Encyclopedia of Education defines hypotheses as "informed propositions or speculations about values of two or more variables that may be observed concomitantly" (Finn and Dulberg, 1984, p. 2373). Kerlinger has said that hypotheses are "conjectural statements of the relations among variables" (Kerlinger, 1969, p. 1129).
Why are hypotheses important? There are several reasons why they should be considered. First, they are the means by which theories can be tested. They can be deduced from a theory and represent testable propositions about a theory. Next, because hypotheses can be tested, they can be shown to be probably true or probably false. Although hypotheses can never be accepted or disproved, they are an intermediary between research questions and observations. Third, hypotheses can be tested independent of the researcher’s personal values and beliefs. They permit the researcher a way of getting a more objective perspective on the problem under study. Finally, hypotheses guide the direction of the research. They present the variables to be studied, provide guidance on the direction of the research and the outcomes, and may also direct the data collection and data analysis procedures (Kerlinger, 1969). Hypothesis testing can be compared with the Anglo–Saxon system of trial by jury in which the researchers are the prosecutors, the data collection is the trial procedure, and the testing of the hypothesis is the deliberation of the jury (Kraemer and Thiemann, 1987).

The generation and use of hypotheses has been described by numerous authors. Konrad Lorenz mused: “It is a good morning exercise for a research scientist to discard a pet hypothesis every day before breakfast. It keeps him young” (Lorenz, p. 12). Primo Levi extolled, “There is nothing more vivifying than a hypothesis” (Levi, 1984, p. 76). James Watson, in the book The Double Helix, in which he described the feverish race to discover the structure of DNA, lamented that “The real problem was the absence of any structural hypothesis which would allow them to pack the bases regularly in the inside of the helix” (Watson, 1968, p. 169). Wallace Stevens wrote: “It comes to this that philosophers (particularly the philosophers of science) make no discoveries, but hypotheses that may be called poetic” (Stevens, 1957, p. 196).

Hypotheses are crucial to intellectual inquiry. The generation and testing of hypotheses are very powerful intellectual tools (Kerlinger, 1969). Several researchers have written that, “In the absence of hypotheses to guide data collection and analysis, the findings that emerge may not be among the more meaningful that the study can provide, and the most important variables may not be given the extra attention they deserve. Complex relationships involving several variables may be overlooked in the attempt to seek out those that are apparent” (Finn & Dulberg, 1984, p. 2374). In empirical research, hypotheses are essential and are employed to guide the methods that are used to investigate a problem.

Galileo, in the 17th century, hypothesized that in the absence of friction, everything would fall at the same speed. David Scott, an Apollo 15 astronaut, tested this hypothesis on the moon in 1971, when he dropped a feather and a hammer at the same time. These fell slowly to the moon’s surface and landed simultaneously. Scott remarked, “How about that! Mr. Galileo was correct”
(Wilford, 1987, p. C3). By the way, I understand that other hypotheses have been offered to explain this phenomenon.

Kerlinger (1969) has written that hypotheses are tentative statements that describe the relationship of one or more variables to one or more different variables. We can say that a is related to b, or if we know under what conditions a is related to b, we can also say a is related to c, d, and e. In a research study, there may be several a's and several b's (Kerlinger, 1969). For example, the hypothesis that teachers' perceptions of their students shape the expectations that teachers have about the students has been widely investigated. On first hearing this hypothesis, it sounds plausible and simple. But, in reality there are many complex variables interacting here rather than just the two variables of teachers' expectations and teachers' perceptions. Other variables that may influence teachers' expectations of their pupils include the pupil characteristics of gender, race, ethnic background, personal appearance, and test performance. There are also environmental variables such as tracking, students' behaviors, school expectations, and parental characteristics.

It is well known that every hypothesis must have at least one independent variable (the variable manipulated by the researcher) and one dependent variable (the variable that changes because of the effect of the independent variable on it). In reality, research is not that simple. There are usually one or more independent variables and several dependent variables, not to mention extraneous variables that are operating within a research study. To test one hypothesis at a time may not be very productive. Platt (1964) and Kerlinger (1969) have suggested that alternative or multiple hypotheses should be tested simultaneously.

The process involves devising alternative hypotheses, planning and conducting one or more research studies, and then recycling the procedures, creating alternative hypotheses along the way. These steps can be compared to climbing a tree. “At the first fork, we choose—or, in this case, ‘nature’ or the experimental outcome chooses—to go to the right branch or the left; at the next fork, to go left or right; and so on” (Platt, 1964, p. 347).

In empirical research, the null form of the hypothesis is usually used. For statistical purposes, researchers must first establish a false hypothesis and then attempt to reject it through the statistical testing of the data. If the data contradict the null hypothesis, then it can be rejected. When the data support the null hypothesis, it can be retained.

Some researchers strongly believe that the only way to test hypotheses is through the use of empirical methods and that hypotheses can only be tested after they have been advanced. It has been suggested that the empirical testing of hypotheses always follow specific steps: “From a new idea, put up tenta-
tively, and not yet justified in any way—an anticipation, a hypothesis, a theoretical system, or what you will—conclusions are drawn by means of logical deduction. These conclusions are then compared with one another and with other relevant statements, so as to find what logical relations (such as equivalence, derivability, compatibility, or incompatibility) exist between them” (Popper, 1961, p. 32).

Where do hypotheses come from?

Where do hypotheses come from? One source is observation. Sherlock Holmes was a keen observer who demonstrated his powers of observation when he explained to Watson how he had concluded that Watson had decided not to invest in South African securities:

1. You had chalk between your left finger and thumb when you returned from the club last night. 2. You put chalk there when you play billiards, to steady the cue. 3. You never play billiards except with Thurston. 4. You told me, four weeks ago, that Thurston had an option on some South African property which would expire in a month, and which he desired you to share with him. 5. Your checkbook is locked in my drawer, and you have not asked for the key. 6. You do not propose to invest your money in this manner” (Holmes, 1930, p. 511).

In “The Adventure of the Dancing Men,” Sherlock Holmes is on the trail of a murderer. Beginning with the hypothesis that the window in the study had been open when the murder took place, the following conversation occurred between the doctor, the local police detective, Inspector Martin, and Sherlock Holmes:

“You remember, Inspector Martin, when the servants said that on leaving their room they were at once conscious of a smell of powder, I remarked that the point was an extremely important one?”

“Yes, sir; but I confess I did not quite follow you.”

It suggested that at the time of the firing, the window as well as the door of the room had been open. Otherwise the fumes of powder could not have been blown so rapidly through the house. A draught in the room was necessary for that. Both door and window were only open for a very short time, however.”
"How do you prove that?"

"Because the candle was not guttered" (Doyle, 1930, p. 520).

In this example, Holmes used his powers of observation to test his hypothesis and to conclude that the murderer had been outside the window. By Plato! He was correct!

Hypotheses can also be derived from empirical data. For example, an analysis of the Scholastic Aptitude Test (SAT) scores of high school students has led to the hypothesis that an increase in the number of science courses that students take in high school will lead to an increase in the verbal scores of these students on the SAT.

Third, hypotheses can be derived from "a carefully formulated model that attempts to explain a class of outcomes (Finn & Dulberg, 1984, p. 2374). Sherlock Holmes, still on the track of the murderer, hypothesized that the murder was an American criminal and use empirical data to prove this:

I had every reason to suppose that this (man) was an American, since (his name) is an American contraction, and since a letter from America had been the starting point of all the trouble. I had also every cause to think there was some criminal secret in the matter. The lady's allusions to her post, and her refusal to take her husband into her confidence, both pointed in that direction. I therefore cabled to my friend Wilson Hargreave, of the New York Police Bureau, who has more than once made us of my knowledge of London crime. I asked him whether the name of Abe Slaney was known to him. Here is his reply: "The most dangerous crook in Chicago" (Doyle, 1930, p. 523).

Sherlock Holmes realized that the identity of the murderer could be discovered if certain messages could be deciphered. Beginning with the hypothesis that the dancing men represented letters, Sherlock Holmes did indeed identify the murderer. Using the dancing men below as a code, Sherlock Holmes trapped the murderer. Can you figure out the identity of the murderer? I will provide you with the solution at the end of this lecture.
Prejudice about the Null Hypothesis

When hypotheses are tested empirically, the null, or no difference, hypothesis is frequently used. A fundamental assumption of hypothesis testing is that the researcher’s hypothesis is false (Finn & Dulberg, 1984). Greenwald (1975) has lamented the state of the “lowly null hypothesis” (p.1). An examination of published research studies has revealed that many major journals contain a majority of studies in which the null hypothesis is rejected. Few studies are published in which the null hypothesis has been retained. In addition, researchers may be reluctant to write up their studies, submit them for publication, and replicate them if the null hypothesis is not rejected (Greenwald, 1975). Rosenthal and Gaito (cited by Johnson-Laird & Wason, 1977) and Greenwald (1975) have shown that researchers hold the following misconceptions about hypothesis testing: 1) only when the null hypothesis is rejected, can any conclusions be drawn about the relationship of the variables; 2) little is gained when two variables are found to be unrelated; 3) the obtaining of statistically significant results assures that the study was done properly; 4) if the null hypothesis is not rejected, the researchers were incompetent; and 5) the misinterpretation of the probability level as a measure of confidence rather than an a priori decision.

Rosenthal (1963) suggested that there is another reason for our prejudice against the null hypothesis. Researchers hold expectations for the outcomes of their research studies. In a summary of five studies of experimenter bias, Rosenthal documented that researchers can bias the outcome of their studies based on their expectations of these outcomes.

Inductive or Deductive?

The traditional view (Johnson-Laird & Wason, 1977) is that a hypothesis begins with inductive thought. Since hypotheses are based on observation, a connection between the observations can lead to a hypothesis. For instance, to notice that although the night sky is populated with stars, but that it is dark at night could lead to several hypotheses such as the following: there is no relationship between the number of stars and the amount of darkness at night; the sky is dark because we see the darkness between and beyond the stars; the sky is dark because the universe is enclosed and when we look beyond the stars we see walls (Ferris, 1987). Edgar Allan Poe hypothesized, “Let me declare, only, that as an individual I myself feel impelled to the fancy without daring to call it more—that there does exist a limitless succession of Universes more or less similar to that of which we have cognizance” and that “Space and Duration are one” (Poe, 1848, cited by Harrison (1987), p. 150). Of course, none of these
hypotheses is the correct one, although Poe was partially correct. Although we see a great deal of darkness, “the big bang covers the sky, filling the universe throughout space and time with its afterglow” (Harrison, 1987, p. 205).

One form of inductive reasoning is trial and error learning. Research psychologists have shown that even the earliest attempts by rats to learn a maze are haphazard and Johnson-Laird (1977, p. 260) wrote that it was one such researcher who exclaimed “Hypotheses in rats!”

Marc Kac, the noted mathematician, wrote about the use of the inductive method in his autobiography Enigmas of Chance:

Throughout my life I have had a number of bouts with the virus of obsession and a number of the problems causing the infection turned out to be of some significance in mathematics and science, but at no time after the summer of 1930 have I worked as hard or as feverishly. I rose early and, hardly taking time out for meals, I spent the day filling reams of paper with formulas before I collapsed into bed late at night. Conversation with me was useless since I replied only in monosyllabic grunts. I stopped seeing friends; I even gave up dating. Devoid of a strategy, I struck out in random directions, often repeating futile attempts and wedging myself into blind alleys (p. 3).

Both Hume and Popper (Johnson-Laird & Wason, 1977), among others, reject the inductive method as a source of hypotheses. Hume wrote that only ‘habit’ and ‘custom’ (cited by Johnson-Laird & Wason, 1977) justify the use of induction. The use of induction may be viewed as questionable because it combines the formulation of the hypothesis with the testing of it (Johnson-Laird & Wason, 1977). At the same time as the hypothesis is formulated, it is submitted for proof. The hypothetico-deductive method, however, provides a clear separation between the derivation of the hypothesis and its test. Karl Popper strongly opposed the use of induction and he has argued that to draw a universal conclusion from a particular statement will always turn out to be false. Popper has written, “Thus to ask whether there are natural laws known to be true appears to be only another way of asking whether inductive inferences are logically justified” (Popper, 1961, p. 28).

Physicians frequently employ the use of hypotheses early on when making clinical decisions (Elstein, Shulman & Sprafka, 1978). They collect information about the case in several different ways including observation, prior experiences and knowledge, discussions with the patient, and consultation with other medical personnel. Observations of physicians working has illuminated this process and have shown that beginning with the initial problem of “What is the matter with the patient?”
hypotheses are continually advanced, tested, modified, ruled out, or presumptively confirmed. Physicians apparently collect medical case data as much for the purposes of generating hypotheses and aggregating evidence in their favor as for the sake of building a database from which hypotheses are later generated. Cues are regularly reorganized and actively used by physicians at the earliest stages of a diagnostic interview (Elstein, Shulman, Sprafka, 1978, p. 252).

Elstein, Shulman, and Sprafka (1978) describe an experimental study in which medical students were taught five methods of solving problems that were designed to help the students generate and test hypotheses. The students were asked to reach a diagnosis when presented with information about a patient. One half of the students were taught how to generate and test hypotheses; the other half used idiosyncratic methods to arrive at a diagnosis. An analysis of the data indicated, that although both the experimental and control groups performed similarly, there was a trend for the group that was taught how to generate hypotheses to arrive at a more accurate diagnosis than the group that was left to use random methods of problem solving.

In an analysis of the use hypotheses, Elstein, Shulman, and Sprafka (1978) found that physicians generate alternate hypotheses by accessing long-term memory by associating a limited number of cues to information that is stored in memory. Alternate hypotheses are generated early in the process of making a diagnosis by association with one or more sets of cues. Progressive reformulations of the hypothesis may take place. The number of hypotheses that are generated seems to be unrelated to the prior knowledge of the physician. The number of alternate hypotheses that can be evaluated at one time range from four to five, with an upper limit of six or seven. Thus, the number of hypotheses that can be generated may be limited by the long-term memory and to the information processing capacities of the physician.

Although most mathematical games, from chess to tick tack toe, use deductive reasoning, there are some that require inductive reasoning (Gardner, 1961). For example, the game Battleship, the word game, Jotto, and the children’s game “Going on a Trip” in which one child invents a rule for deciding which objects can be taken on a trip require reasoning.

I have strongly argued that hypotheses are powerful intellectual tools. But it can be reasoned that proposed theories of deductive reasoning can result in irrational thinking. Although a conclusion may be valid, the thought processes used to arrive at that conclusion may be illogical (Johnson-Laird, 1982). Johnson-Laird (1982) has pointed out that observations of the way some people think and act support these theories. “Indeed, if you are of a Romantic cast of
mind, you might revel in irrationality like Walt Whitman, who delighted in his capacity for self-contradiction, or you might fear rationality like Tolstoy who wrote if human life were ever controlled by reason, then all possibility of spontaneity would be annihilated" (Johnson-Laird, 1982, p. 2).

The use of hypotheses can lead to inaccurate conclusions. Here is an example. After training a flea to jump on an auditory signal, a researcher removed the first pair of legs to see what the effect was. Noting that the flea was still able to jump, the researcher removed the next pair of legs. Noticing no difference in the jumping behavior of the flea, the investigator removed the final two legs and observed that the flea no longer jumped. The researcher concluded that the flea will no longer be able to hear when all the legs have been removed (Huck & Sandler, 1979). In this anecdote, the researcher reasoned that the removal of the flea’s legs affected the ability to hear. Obviously, there is another explanation—a rival hypothesis—to explain the behavior of the flea. In our search for knowledge, hypotheses are one way of knowing.

Before I end I want to provide the solution to the Sherlock Holmes mystery. By decoding the symbols on your program, the message left by the murderer was:

ELSIE PREPARE TO MEET THY GOD
AM HERE ABE SLANEY

Of course, once Sherlock Holmes decoded the message, the murderer was brought to justice and Sherlock Holmes was ready to solve his next case.

I want to end with a quotation by Primo Levi (1984), who described how exhilarated he felt when he realized that his hypothesis had guided him to the correct solution to a chemistry problem:

I was thinking of having opened a door with a key, and of possessing the key to many doors, perhaps to all of them. I was thinking of having thought of something that nobody else had yet thought, not even in Canada or New Caledonia, and I felt invincible and untouchable... (p. 77).

AHAH!
REFERENCES


The author is indebted to P.N. Johnson-Laird for the idea for the Sherlock Holmes example.
PROMOTING THINKING AND LEARNING IN THE ELEMENTARY SCHOOL

Dianne D. Todd

“See, see. Go, Sally, go. Go, go, go. See Baby Sally go. Oh, Mother
See Mother go. See Dick go. Oh, Oh, Oh. See Dick and Jane.
Go, Baby Sally. See Jane go. See Baby Sally. Go, Dick, go. Oh, oh, oh.”

The preceding passage is from We Come and Go, a pre-primer of the revised Elson-Gray Basic readers. It was copyrighted in 1940 and is typical of early primary instructional reading material developed in the 1930s, 40s and 50s. Boasting of genuine story plots, interpretative pictures, and small vocabulary of highly useful words (Gray, Baruch, and Montgomery, 1940) publishers responded to the demands of educators across America. Millions of books, “replete with genuine story plots” (Gray et al., 1940), were the first readers of a least two generations. Accompanying texts were workbooks such as the Think and Do Book. Publishers claimed the workbooks provided further development of word meanings, word forms, and practice in recognition (Gray et al., 1940).

Research during that period (30s-50s) suggested insights in preparing children to learn to read and assisting children who were experiencing difficulty learning to read. Studies developed in the 1940’s implied that perception, motor functions, and cognition, form a developmental hierarchy. Kindergarten children were taught to hop and skip, cut with scissors, name colors, and tell the difference between circles and squares. In some classrooms, reading instruction was delayed for those youngsters who were unable to master some motor skills. It was not uncommon in the 60’s for reading specialists, trained in the underlying abilities orientation, to lead reluctant readers from their desks out onto the playground to practice walking on a balance beam. The long term to objective of this activity was to increase reading ability.

A behavior approach to reading was developed in the late 1950s and early 60s. Behaviorism is based on animal psychology (Reid and Hresko, 1981). According to this orientation, instruction begins with small bits of information thought to be the easiest. As mastered, other easy bits are introduced, then more difficult ones (Reid and Hresko, 1981). The development of scope and sequence charts to address subskills of more complex skills is characteristic of this model. Also characteristic of a behavioral approach to literacy instruction is the study and teaching of hard and isolated phonics. That is, breaking words into discrete sounds, aligning sounds to specific letters, and repetitive practice memorizing phonic rules that worked some of the time. A typical instructional reading passage of the behavior model:
The cat can see the rat
The rat can see the cat
The rat sat on a mat
The cat sat on a mat
The cat and rat sat on a mat

Complementing controlled reading passages, worksheets and workbooks offered phonic drill to reinforce perceived subskills. Thinking required to complete tasks is superficial and not conducive to developing thinking abilities. The effects of this orientation are still alive. The average primary and middle grade youngster brings home an average of 1000 worksheet and workbook pages a year. There is no correlation between most worksheet and workbook pages and reading improvement.

Comprehension of what was read was, according to both the underlying abilities and behavior models, perceived to be limited to the surface, or literal level for most elementary students. Piaget’s concrete-operations stage suggests that children 7 to 11 years old rarely interpret language beyond the literal thinking level (Cullinan, 1981). Bloom’s taxonomy, developed in 1956, suggests comprehension (thinking), is hierarchial. That is, the literal data within a text has to be understood before one can think at a higher level.

After approximately sixty years of literacy instruction based on an underlying abilities and/or behavior approach, less than 10% of the American adult population read books or go to the libraries. Sixty million Americans are total, functional, or marginal illiterates (Kozol, 1987).

Why? Goodlad suggests that part of our failure in being effective is that those who still base practice in the past confidently set the norms for educating those who live in the future (Goodlad, 1983).

What, then, needs to occur so that young children can become literate thinkers? Adopting a description of human intellectual functioning can help educators recognize and develop teaching methodologies, curriculum, and learning experiences that go beyond superficial learning (Costa, 1986). This thought suggests that teachers seize opportunities to develop and practice discerning, literate, thinking themselves. Keeping abreast with evolving research, addressing learning theory, thinking development, and literacy acquisition, provides a rich knowledge base.

A review of the current literature indicates that contemporary psychologists suggest an additional stage for Piaget’s model. The stage is referred to as operational-operational, thinking about thinking.
Researchers in the psychology field and in the education field have been thinking about thinking. A new vision seems to be emerging. Hammill calls it holistic, Ausubell calls it cognitive, others call it information processing (Reid and Hresko, 1981). Instruction based on the cognitive model incorporates four principals that address thinking:

   a. learning is a personal process in which new knowledge is constructed and dependent on what is already understood
   b. learning needs to be holistic
   c. if what is learned is to be remembered, organization and integration are necessary
   d. learners need to be aware that they are responsible for their learning (Reid and Hresko, 1981).

Concomitant with the development of these principals, a deeper understanding of what reading is has evolved. No longer is reading viewed as a set of subskills to be mastered and glued together to make a whole. Psychologists have referred to reading as a skill, a complex integration of processes (Venesky, 1984). Literacy experts view reading as a complex, interactive process in which information from the text and the knowledge possessed by the reader act together to produce meaning (Commission to Study Reading, 1985). This definition is unlike the definition of reading suggested by the ambiguous naming and listing of skills and subskills found in education journals addressing reading instruction just ten years ago.

Research by cognitive psychologists and literacy experts have described three major levels of thinking (Costa 1985; Pearson & Johnson, 1986; Raphael, 1986). The first order, textually explicit level of thinking, is the collection of data, the gathering of information that exists within a given text. The second order is referred to as textually implicit. It is the level at which sense making of the information gathered takes place. Oftentimes, it is the level at which a deeper understanding of the data collected is justified within one’s mind. It is at this level that inferring and interpreting occur. Higher order thinking, scripturally implicit, is the level that involves application, evaluation, and/or synthesis. It also addresses metacognition, one’s knowledge or awareness of how one thinks and learns. At times, it is a task that requires higher order thinking that allows for the organization and integration of the data collected in the first order of thinking. How different from Bloom’s taxonomy!

A body of research in the field of literacy suggests that students, even very young students, can learn to stretch thinking and respond to reading passages
when taught about the different levels of thinking as described within this paper (Pearson & Johnson, 1978; Raphael, 1986). That is, young children can span thinking levels when instructed how and nudged to do so. This differs from Piaget's model.

A review of research in the neurological field however, is inconclusive. A neurological definition of thinking is still open to interpretation. In fact, brain researchers are attempting to discover whether thinking is a natural bodily function similar to the heart pumping blood or whether it is the result of intense effort, strict discipline, and careful programming of instructional outcomes (Costa, 1986). It might be found that thinking is a combination of both.

Implications that can be drawn from the current literature within the fields of cognitive psychology, literacy acquisition, and learning theory suggest that educators acknowledge the illiteracy rate in the United States and reexamine present pedagogy comparative to current understanding of how children think and learn.

Educators are encouraged to practice discerning literate thinking themselves. Thinking educators need not be automated and driven by a script that accompanies commercially published basals and context texts. A thinking practitioner would question if the basal and content texts at hand are conducive to promote thinking. If thinking is to be developed among students, the material to be read needs to be worth thinking about. Stories authored and published by rookie learners can offer rich alternatives in the early primary grades. Ryan's (6 years old) piece provides an example:

The wall turned
The room was shaped
like a big bottle.
And in that room there
are...monsters.
I went up the snake
stairs.
When I got up I saw
some creeps.
There was a laser beam
across the deedly pit.
I want across it.
When I got out, there was
a monster standing in the door,
(Riggs, 1988)

In conclusion, it is by keeping abreast with continuously evolving research that educators can develop and strengthen a viable knowledge base. Practitioners
who are aware of the literature directly affecting their profession are better able to stimulate thinking and learning among those who will live in the future. As the educational models that have preceded the cognitive vision, the present insights will be viewed as a necessary step, guided by attempts in the past, a needed risk, to attempt to refine the art and science of teaching.
REFERENCES


TEACHING CRITICAL THINKING SKILLS TO A SPECIAL POPULATION: IS IT A VIABLE PRACTICE?

Jo Anna Spruill

Common dilemmas for teachers of learning handicapped and other low achieving students are whether and how to teach their students critical thinking skills. A number of actors contribute to these dilemmas: the concrete nature of the students' thinking; limited time for instruction; and, the students' frequent need for functional living skills. Educators know, however, that being able to form and test hypotheses, to consider tentative explanations of phenomena, and to draw logical conclusions are prerequisites for becoming strategic language users and, indeed, thoughtful adults. This paper will examine some aspects of these dilemmas, how they may be resolved, and what the impact may be on school curriculum.

At this time, cognitive development theory views mental development as hierarchical in nature, with each stage of development dependent on the stages that precede it. Piaget posited the theory that individuals achieve the final and highest stage of cognitive development, characterized by the capacity for abstract thought (formal operations), during adolescence. Although there is evidence that formal reasoning abilities emerge in a predictable progression across the adolescent years, research has convincingly shown that as much as 50% of the general adult population do not demonstrate the problem solving skills associated with abstract mental operations (Dulit, 1972; Epstein, 1979).

Learning disabled students are believed to develop their cognitive abilities similarly to (or slightly behind) the general population (Tarver & Maggiore, 1979). If that is the case, many learning disabled and other low achieving students will not demonstrate evidence of abstract thinking during their school years. The practice of cognitive matching, through which students' academic task assignments are “matched” to their mental processing capabilities, suggests that critical thinking skills curriculum, encompassing as it does, abstract thought, is inappropriate for this population. The realities of learning handicapped students' needs for functional living skills and the press of time particularly at the secondary level further draw teachers away from critical thinking skills instruction for this student population.

Dominant views of teaching and classroom based learning also argue against critical thinking skills instruction. The academic task structure is thought to be the primary mediator of classroom based learning (Smith & Geoffrey, 1968; Doyle, 1982), while teacher behaviors influence learning to the extent that they induce desired student behavior (Schlechty, 1976)—completion of academic
tasks. Teaching effectiveness research has shown a high positive correlation between direct instruction teaching strategies and academic achievement for low academic ability students (Gersten, 1985). Direct instruction strategies, which draw on behaviorist principles of stimulus and response, include a low margin of challenge, structured learning sequence, and high teacher control, are considered highly effective for maintaining student involvement with assigned tasks (Gersten, 1985). Thus, the modern conception of academic teaching and learning draws on a behaviorist view of stimulus and response, and a cognitive psychology view of mental development. Neither perspective has applied the teaching of higher level cognitive skills to low achieving students.

Is there another approach of mental development that de-emphasizes the individual’s internal cognitive structures and does not depend on a stimulus and response interpretation of learning? The theorist who is usually credited with suggesting a social context view of learning and cognitive development is the Russian psychologist, Lev Semenovich Vygotsky (1978). Vygotsky proposed that society deeply affects cognitive growth in children through the tools and practices preserved by socio-cultural history and through interactions with adults and other knowledgeable people who transmit information about the tools and practices to children. In this way, social interactions mediate the cognitive activities which are then slowly transformed into intrapersonal mental abilities. Vygotsky stressed the contribution to children’s development of learning under the tutelage of adults; and he emphasized, especially, the importance of mental activities that an individual is capable of only with the guidance of a more knowledgeable person. A logical conclusion that may be drawn from this perspective is that “...knowledge is not something people possess somewhere in their heads, but rather, something people do together” (Gergen, 1985, p.270).

What happens when we look through a social context lens at introducing critical thinking skills curriculum to low achieving students? From this perspective, teachers are not merely attempting to bring about desired student behaviors through a structured sequence of activities, but are engaging in shared experiences through which they assist students to operate at a cognitive level above that at which they are able to function independently. When classroom activities which promote the growth of abstract thought are carried out under the tutelage and with the support of a knowledgeable and capable adult, they are eminently appropriate for learning impaired students. Without such experiences many of these students will almost certainly not reach the formal operations stage of cognitive development. With the scaffolding support of a learned adult, students have the opportunity to develop to their highest potential.

The role of the teacher as scaffold is crucial to the effectiveness of these experiences. By acting to bridge the gap between the task requirements and the
learner's functional level, the teacher extends the cognitive range of activities to which student have access. First, the teacher must select activities that, with support, are comprehensible by the students, because students will not learn from tasks whose solutions are incomprehensible to them even with assistance (Wood, Bruner & Ross, 1976). Secondly, the teachers must supply for the students steps which they cannot accomplish independently. Third, they should create opportunities for students to take over aspects of the activities for which they have become ready. Teacher sensitivity and judgement are critical here. Finally, it is appropriate for the teacher to aid students in consolidating their new abilities by conducting highly structured lessons on hypothesis forming, testing, and drawing conclusions at regular intervals.

Conclusions

Hypothesis testing and other critical thinking skills curriculum for learning disabled or low achieving students is difficult to conceptualize from a cognitive or behavioral psychology perspective. Critical thinking skills curriculum normally presumes student cognitive development significantly beyond that usually attained by a learning impaired population. Teaching by the direct instruction method which is often recommended for this group appears incompatible with abstract content. However, if learning and the creation of knowledge are viewed as something people do together, if the tutelage of young people by knowledgeable adults is considered a viable method, and if it is accepted that students will acquire abstract thinking only if they are exposed to the concepts, then supported, socially interactive, learning activities focused on creative problem solving will be an important part of the curriculum for low achieving students. Far from detracting from functional life-skills instruction, these activities will be a vital component for independent living.
REFERENCES


BUILDING STUDENT OWNERSHIP

Barbara Moore

Several months ago, I was talking to a group of high school teachers. One teacher expressed her concern about the fact that her students were not performing well on tests, nor were they as interested in her subject matter as she thought they should be. Her final comments were, "I don't know what's wrong. I give really good lectures." I realized as she spoke that she equated teaching with lecturing and failed to understand that not only do students learn in different ways but many have difficulty learning by taking notes.

A few weeks later, I read an article in Science News magazine (1988) which was talking about the small number of American college graduates who are entering the fields of science and math. One of the statistics they cited was that students spend less than 50 percent of the time in science classes actively involved in lab work. The rest of the time, they are sitting passively, taking lecture notes. I decided to ask a group of local high school seniors how much time they spent in their science courses actively participating in science experiments. I was surprised to find that the highest percentage they stated was 50 percent in chemistry and that the percentage dropped to as low as 5 percent in some of their other science classes.

This kind of passive learning experience is not unique to science courses. As a coordinator of programs for gifted and talented students, grades seven through twelve, I am able to see students over that wide span of years. When analyzing their creative writing last year, I noticed that my junior high school students were better creative writers than were my high school students. This observation could lead to one of two conclusions: either the students in high school are not as creative as the students presently in our junior high school, or we are somehow "teaching out" or extinguishing that skill and our students are no longer able to write as creatively after they have had four years of high school English courses as they were before.

All these observations viewed together seem to indicate that we are producing high school graduates who are consumers of knowledge rather than producers of knowledge. In other words, our high school students are not learning how to think like scientists, writers, historians or mathematicians but instead, they appear to be spending a great portion of their class time as passive receptacles of information.

Although I have not conducted any formal research on the relationship between the degree of a student's active participation in a classroom and his or her ability to use that subject matter as an adult, it seems from thirteen years of teaching
experience that there is a high correlation. Perhaps, then, we should be helping our students become more active participants in their own education in order to build greater student ownership in the educational experience.

One man who looked at the kinds of affective behaviors students exhibit in class was David Krathwohl, an associate of Benjamin Bloom. Krathwohl (1964) spoke of five levels of responses which one can elicit when teaching students and labelled these levels “receiving,” “responding,” “valuing,” “organizing,” and “characterizing.” When I read Krathwohl, it seemed to me that we could re-interpret these five levels so that they not only described a student’s response to individual questions, but also to the manner in which curriculum as a whole is presented. For example, I have observed many teaching situations, in which students are “receivers” of information. The teacher lectures, the students take notes and then give back to the teacher in some testing situation or essay the notes that the teacher has given. There is little interaction between teacher and student. The second level, “responding,” might describe question-and-answer activities. The answer can be very brief when the teacher asks factual questions, or the answer can be more complex when the student is asked to evaluate, synthesize or analyze.

At the third level of teaching, “valuing,” the student would not only receive information and respond to it but would also decide, “This is important.” At the fourth level, “organizing,” the students might ask themselves how this new knowledge fits in with what they already know. On the fifth level of “characterizing,” they would incorporate what they have learned in the classroom to conduct experiments, write poetry, conduct primary research or attempt to arrive at a new hypothesis.

If one were to ask teachers what level of affective response they hoped to elicit from their students, most teachers would say they wish their students would respond at one of the higher levels. They feel that the material they are presenting is important and they want the student also to view that material as important. They want their students to incorporate the particular subject matter into their lives and to, perhaps, have it affect their behavior in the future. There are very few teachers who want students to merely parrot back information and then forget it. Yet most teaching in secondary and post-secondary education elicits responses at the lower levels of Bloom’s and Krathwohl’s taxonomies.

The question, then, becomes: “How do we structure the curriculum so that students can become involved at a higher affective level?” In other words, “How can we help them become ‘heuristic learners’?” This term comes from the name of a Greek king, Heuros, who asked the scientist, Archimedes, to determine whether the king’s crown was pure gold. Archimedes was unable to solve this problem until one night as he was immersing himself in his bathtub, he discovered that the bath water sloshed over the edge. According to legend,
he suddenly leapt out of the tub and ran through the streets shouting, “Eureka!” His discovery was, of course, that by measuring the amount of water it displaced, one could determine whether the crown was gold or another metal. (In fact, the crown was not gold, and one can assume that someone lost his head as a result of this discovery...but it wasn’t Archimedes) (Carin & Sund, 1971).

Socrates later incorporated this idea of discovery learning by having his students become questioners and learn by trying to find answers to their questions. Although our twentieth century culture is vastly different from the culture of Socrates, the ideas embodied in his teaching strategies are still valid. How, then, can we, like Socrates, help our students discover knowledge for themselves? How can we help them become excited enough to arrive at a “Eureka!” or at least an “Ahah!” as a response to learning?

One means we have in the 1980s to assist us in the classroom is the computer. Many computer programs are available now which help students learn in a very exciting way that involves active discovery. One excellent example is a program called “The Geometric Supposer” which is put out by Sunburst Communications. It teaches geometry in such a way that the teacher serves as a facilitator of learning rather than as a traditional teacher. The computer program does all the computation for the students. It draws geometric figures, measures area, bisects angles, and performs many other functions. The students’ task is to manipulate the geometric figures, observe the results, and make conjectures based on their observations. They, then, draw related geometric figures (i.e., other kinds of triangles) to test their conjectures until they finally feel ready to state a hypothesis. While using this computer-based method of learning geometry, students have been known to arrive at hypotheses which have never been stated before by mathematicians. The teacher, as facilitator, helps guide the students to satisfactory answers to their questions, insuring that they do not meet a high degree of frustration. Students at all times are actively involved in thinking, hypothesizing, testing, and learning.

Computers can also be used to make the study of geography more personally relevant to the student. In the traditional geography class, students perform lower level thinking activities such as gathering information about countries, creating notebooks, coloring and labeling maps. Because they know that they will have no immediate need for this information, the data collected is quickly forgotten. Then, as adults, they can’t quite recall where Nicaragua or the Persian Gulf are. Computer databases can change this information-gathering activity from an impersonal end in itself to a means for framing exciting questions. Because of their computer’s ability to arrange databased statistics, students can see how different statistics correlate. For example, I recently watched a class studying a database which contained economic and population statistics about 70 countries. When they looked at the countries with the highest gross national product and then looked at the countries with the lowest infant
mortality rates, they discovered, to their amazement, that there was little correlation, and were further astonished to discover that the United States was not among the countries with the lowest infant mortality rates. These and other discoveries led to many questions. They were eager to know "Why?" Suddenly the reason for gathering data became meaningful and they wanted to conduct additional research to answer their questions.

One does not need technology, however, to help students become active learners. Donna Oliver, who was the 1987-88 national teacher of the year (Instructor, 1988), uses a variety of techniques to make science more interesting and relevant to her students. First, as an effective teacher, she tries to deal with the whole student and she wants to make her students feel good about themselves. She has decided that no student will fail her class, yet she will not lower her standards. But more important, she keeps the students very actively involved in experiments and relates science to larger interdisciplinary issues. For example, when her students study cells, they also discuss the ethics of genetic engineering.

In the field of English, a junior high school grammar textbook called Discovering Your Language (Postman, 1963) teaches grammar inductively. It gives students a sentence like "Boys run" and ask them to generate many other two word sentences which have the same pattern. Then students are asked to look at the first and second group of words and, again, make conjectures and generalizations about each of these groups. Students might discover that they can add an "s" to both groups of words. With one group the "s" makes the word mean "more than one," but with the second group it means something totally different. Or they might discover that they can put the word "the" in front of the first group of words, but not the second. When they have finished with that lesson, they have discovered many attributes of nouns and verbs, but the teacher does not label these two groups of words until the end of the exercise. The important difference between this approach and more traditional approaches is that the students create the rules themselves. As the students make generalizations about parts of speech, the book challenges these generalizations, for example, giving them phrases like "The little red school house" and asking them whether "school" is a noun or an adjective. Using this method to teach grammar can become very exciting because students leave the classroom arguing about what part of speech a word is, based on evidence that they have discovered. In short, they begin acting like grammarians.

I recently observed a science teacher who used a similar technique to teach his students about different kinds of rocks and minerals. Rather than lecturing to his class about rocks and their properties, he presented his students with a variety of rocks and asked them to separate them into two groups. Then they were to divide those two groups into two sub-groups. The students kept
dividing each group into subgroups until each rock was a "group" by itself, based on a variety of its characteristics. Only then did the instructor tell the students the names of the rocks and minerals.

One of the leaders in this field of discovery learning is Jerome Bruner (1963,1966) who has written several books on the Inquiry Method of teaching in which students are asked to create hypotheses. Recently I used this approach in teaching literature to high school students. After students had read an assignment, I asked them to write a paper in which they were to react to any element of the novel or story they read. I asked that the paper be one paragraph long and have only one central thesis statement or topic sentence. Students could compare what they had read to something else they had read or, perhaps, seen on television, could argue with some aspect of the assignment, or could analyze one character or incident. Frequently they arrived at some conclusion which was quite original and then were forced to support and defend it. The students read their papers in class and the class discussed them. I found that, through this method, I could usually cover all the points about the work that I wanted to make sure were discussed, without lecturing, and frequently without my saying anything at all.

One of the best examples of active learning in our high school is found in our industrial arts classes. If one were to analyze the way the instructor teaches, one would find that he proceeds through all the levels of Bloom’s and Krathwohl’s taxonomies. He begins by giving students a knowledge of the tools and terminology they will use and then they apply that knowledge. Students work on projects, analyzing the process they will use, evaluating the results and transferring that knowledge to other more complex projects. In addition, they respond to content at a high affective level. By being actively involved in subject matter they deem important, they begin acting like carpenters or woodworkers, frequently using that knowledge for the rest of their lives. Our teachers of academic classes would be well-advised to look at this process used in most vocational classes and try to adapt it to their subject areas.

These examples of books, teachers, and computer programs are just some ways in which teachers are helping students discover knowledge. If we want to build student ownership in the educational process, we have to change the way we are teaching so that students can become active learners in all their classes. Students need to learn how to ask relevant questions, create hypotheses, and create products in order to make the most of their educational experience. It is only then that students can begin to see the exciting real world of science, math, English, and social studies which lies behind the textbooks.
REFERENCES


THINKING SKILLS WITH SPECIAL EDUCATION STUDENTS

Rhonda Boyer

"Thinking is a skill that all people need in order to survive in any type of society but most particularly in a democratic society such as ours. Certainly the success of any democratic system depends on individuals’ ability to analyze problems and make thoughtful decisions. A democracy thrives on the productivity of its diverse constituency—a productivity fostered by free, critical and creative thought on issues of common interests" (Marzano et.al., 1988). As a special educator, I am very concerned about how well children in special education programs will be able to participate in a society that demands such thinking from its members. Thinking skills are being emphasized more and more among students in regular education programs. But is this an issue that is being addressed for children with special needs? By pulling children out of regular classes for remedial reading or by segregating them in special day classes, are we depriving them of the interactions with other children and involvement with activities that help to develop thinking skills in meaningful ways?

Of course, the activities in the regular classroom directly influence how much benefit the student with special needs will receive from participating in that class. If the classroom is organized in such a way as to promote interactions among children, interactions with adults, and interactions with objects in the environment, then the best way to promote thinking skills among students with special needs is to have them participate in activities in regular classrooms. The special education teacher can provide consultative services to the regular education teacher to meet the needs of the student. The special education teacher could also work with the student within the classroom but it should be work with which the rest of the class is also involved. Instead of having the child pulled from the classroom to receive one-on-one instruction, allow the child to interact with peers and engage in meaningful activities that challenge thinking as well as the thinking of students in the regular classroom. Even when we put children in a special day class, we are not providing models and the opportunity for these children to interact with other children who may have more highly developed thinking skills; we are simply allowing them to interact with children with similar weaknesses. “We need to reconsider the questionable notion that individual learning differences call for radically differentiated curriculums” (Goodlad, 1988).

Given that we want to provide equal access to learning for all children, the current reality is that for a variety of reasons the regular classroom may be unable to meet the needs of a few children and a special education class is necessary. Promoting the thinking skills of the student in this class should be the
first priority since it will reflect in every other activity in which the child is engaged. There are an abundance of programs that are designed to promote thinking. Offering one or more of these programs as the sole means of teaching thinking skills is a dangerous practice because it “ignores the need to conceptualize basic skills such as reading and writing as thinking because it ignores the need to infuse teaching thinking in all curriculum areas” (Marzano et.al, 1988).

One way to infuse thinking in all curriculum areas is through integration. Integrating the curriculum helps children to make connections. It more closely resembles how young children learn—whole to part and not part to whole. If we continue to teach individual skills as listed on an I.E.P. and not integrate those skills into a whole, the child is apt to know how to do specific skills in very specific situations but have no idea how to use these skills in real life.

One example of a teaching strategy that uses the whole to part approach is whole language. In this, children can see immediately what the reading process involves. Short predictable repetitive books, charts, stories and songs are used to demonstrate that printed symbols have meanings. Immediately, children can begin to discuss stories, dramatize them, and interact with them because the printed word begins to have meaning for them. Instead of learning isolated sounds that later are blended into a word and later are put together into a story, students can see within their first few experiences with reading that it is meaningful activity and not a progression of sounds strung together. Children can, then, immediately apply thinking skills and processes to reading by predicting what might happen next in a story, by finding a pattern in the story that they can use to create their own story, by finding common themes in several stories, and by beginning to develop specific concepts.

Another benefit of using whole language is that it leads very easily into integrating other parts of the curriculum. As an example, in our study of birds, we used the song about Five Little Ducks that went swimming and each time one less duck came swimming back. After singing the song several times over, we then wrote an equation that would represent what happened in the story e.g., 5-1=4, 4-1=3, etc. Those numbers were meaningful and concrete for students in contrast with what they may see on worksheets and in math books. The same week we were studying about birds we were involved in a number of different activities: reading a big book and finding all the words that told us what birds do, comparing real nests of different kinds of birds, writing questions about things we wanted to know about birds, reading about different kinds of birds from non-fiction books, and writing our own “report” based on what we had learned. The thinking skills of comparing, categorizing, organizing information, and formulating questions about what we knew and what we needed to find out were embedded in an experience in which all children were actively
involved. It was not the “thinking skills” time of the day but it was part of our activities and business of the day.

One goal of developing thinking skills with children is that thinking skills will be able to help them make decisions and to direct their own learning so that they can become life-long learners. One way to encourage children to begin to do this is through giving children choices in what they do and when they do it. This is a new experience for many children and many of them have difficulty organizing their time. By starting with a few choices and then expanding, children who may have a real weakness in this area can learn how to make choices over time. I use stations in my room to promote this decision making skill. Children work on a variety of activities. Some of these activities are outlined below:

• Sorting objects into categories: The objects depend on what theme we are doing. This is an important thinking activity because it involves seeing likenesses and differences and develops categorizing and concept formation skills.

• Writing: The topic is usually teacher selected in the morning and is a directed activity. In the afternoon, the topic is almost always student selected. Writing is the process of prewriting, writing, revising, editing, and publishing. This is an important area for developing thinking skills because children must begin to think in a logical organized manner, to listen to other children’s writing in order to evaluate what is “good” (and why), and to offer some suggestions to help improve the writer’s work.

• Art: An activity that can often provide a way for a child to express what the child knows in a creative manner and/or apply some of the concepts learned to plan and make new creations.

• Building block area: In this area, children are often using other thinking skills such as planning, organizing, categorizing, and evaluating. It gives children the opportunity to develop another kind of intelligence which involves spatial nonverbal ability.

Children are free to move from one of these stations to another at any time though there are some stations that students are required to do each week. It is the student’s job to decide how to organize time. Another advantage to using stations is that this sets up an environment for children to work with each other. By doing this, children are developing thinking skills not only through the activity, but also through explaining their ideas, working on plans together, and evaluating critically the plans and accomplishments of peers. Children are thinking about activities that are relevant to them while they are also developing necessary social skills. Obviously, these skills do not occur spontaneously
among children, but with teacher support, modeling, and good questioning, these skills can be developed.

One of the reasons thinking skills are difficult to teach with special education students is that they are difficult to assess. Writing objectives for I.E.P.'s that are measurable is difficult. As special educators, I feel we are very much aware that children learn things in a variety of ways. Part of our job involves finding the ways a child can learn since conventional ways rarely work. Now what we need to do is to find unconventional ways to measure how children think and to give them different opportunities to show us what they have learned. Usually, we ask children to respond to something verbally or in writing. If children have fine motor problems how much information are we going to get about how they think and what they may know about a topic by asking them to use their weaknesses to convey an idea? For example, why not ask this child to do an art project to convey the theme of a book? Certainly, this would give us more information about how the child viewed the book, what key points were gained from having read this book, and what key points were gained from having read this book than if we asked this child to respond to a book in writing. We must be careful that when we are assessing children's thinking skills that we allow them to use all their resources and abilities and not limit them to the conventionalities of standardized testing.

The activities described above are activities that could be found in regular classrooms; they are not unique "methods" to special education. Hopefully, as current knowledge in child development, cognition and learning is incorporated into the classroom, all activities with which children are involved will promote all kinds of creative and critical thinking. Thinking skills should not be activities which are taught and encouraged only among gifted and talented students. We need to ensure that as educators of children with special needs, that we do not put limitations on children due to a test score or placement in a program, rather we should be doing all we can to help children develop their thinking abilities so that they, too, can realize their fullest potential as equal members in a society that needs their creative and critical thoughts and efforts to survive.

REFERENCES


INTEGRATING CREATIVE THINKING SKILLS WITH THE REGULAR CURRICULUM

John Samara

As research in the field of education progresses, innovations inevitably emerge. Some adapt and blossom into philosophies and programatic efforts, while others briefly surface, only to vanish, not to surface again until the cycles of society call for reexamination. Some are accepted by broad populations, while others are more appropriately sought by specific groups of individuals.

Will the current focus on thinking skills flourish and become integrated into the many varied environments within public schools, or will it simply be assigned to the private domain of the education to the gifted and reside within “pull-out” programs which nurture the needs of a select population? While it is true that (1) gifted learners possess various thinking abilities to greater degrees than do other students of their own age and that (2) specialized programatic efforts are required to nurture these precocities, it is appropriate and necessary for regular classroom instruction to benefit from a “spill-over” effect (by utilizing those strategies which are appropriate for all learners). While creative thinking is often associated with giftedness, it is also believed that the ability to develop the skills of creative thinking is inherent to all students.

The degree to which students in the regular classroom are creative (or have creative potential), should determine the degree to which creative teaching strategies are employed. Callahan (1978) cites Rogers (1962) when she speaks of the universality of creativity. “Making no distinction between ‘good’ creativity and ‘bad’ creativity, his [Rogers] belief is that the ability to be creative (in this relative sense) is an attribute of every individual, but that it is often buried beneath layers of psychological defenses” (p.3).

In the rigorous pursuit of basic skills instruction, educational leaders have neglected to systematically incorporate creative production within each classroom. Many believe that already overinflated curricula have no remaining slots in which to insert innovative practices. In the search for basic literacy for all students, one strategy is to add new and different subjects. Societal needs predicate (dictate?) instruction in dental health, family living, sex education, affective development and the like, and in many cases, additional content is added as separate without integration into existing curricula. The result of overcrowded curricula is a situation in which more equals less, and newly suggested innovations are viewed by educators with skepticism.

Beyond the problem of overstressed curricula, there exists the need to prioritize available innovations. The criteria which educational leaders draw upon to
evaluate innovations are many. The origins of these criteria are manifold, but it is reasonable to conclude that any innovation must be perceived by the potential host community as having high priority over other possibilities. If an educational community (students, parents, and educators) perceives an innovation as worthwhile for its members, the acceptance of the innovation is more probable. However, myths regarding an innovation may stymie the growth of positive perceptions. The acceptance of creative thinking as an essential part of the general curriculum has been curtailed by myths.

One such myth is that creativity is an elusive entity, and if examined too closely, may vanish. Yet research on creativity has yielded volumes of information, both philosophical and practical. Creativity has been defined by many authors. Listed below are several for consideration:

1) Creativity is a combination of the flexibility, originality, and sensitivity to ideas which enables the learner to break away from usual sequences of thought into different and productive sequences of thought, the result of which gives satisfaction to himself and possibly to others (Jones, 1972, p.7).

2) Creativity is a mental process by which an individual creates new ideas or products, or recombines existing ideas and products, in a fashion that is novel to him or her (Gallagher, 1985, p. 303).

3) We have defined the “creative learning process” as one of becoming sensitive to or aware of problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; bringing together available information; defining the difficulty of identifying the missing element; searching for solutions, making guesses, or formulating hypotheses about the deficiencies; testing and retesting these hypotheses, and modifying and retesting them; perfecting them; and finally communicating the results (Torrance & Myers, 1970, p.22).

One might note consistencies common to the above (as well as other) definitions. This includes the ability of the individual to perceive and produce stimuli beyond the usual. Although broad in scope, the definitions provide direction to those interested in determining environments and situations which elicit divergent thought. What are appropriate situations for nurturing flexibility and originality? How might educators integrate these thinking processes with the regular curriculum to enhance student learning? How might teachers enhance students’ abilities to combine varied ideas or perceive deficiencies? Can psychological barriers be eradicated or at least modified, so that varied and unique responses to the learning environment occur more frequently?
Examinations of creativity further contradict the myth of its elusive nature. Callahan (1978) suggests that common personality traits which are related to high levels of creativity have been identified by Guilford (1959), MacKinnon (1970), and Roe (1952). These include:

- openness to experience
- internal focus of evaluation
- ability to toy with ideas
- willingness to take risks
- preference for complexity
- tolerance for ambiguity
- a positive self image
- the ability to become absorbed in a task (p.5)

Persons concerned with enabling others to become more creative may well use the above information in planning various learning experiences and considering those types of student behaviors to validate.

A second myth regarding creativity is that it is always spontaneous and filled with joy. Every educator has observed the child who, all of a sudden, "gets it"—the big "aha!" It is a common event for children (and adults) to experience "ahas", and the joy that accompanies them is significant. The joy is significant, but many times a first idea is not necessarily so. Callahan (1978) concurs, stating "the initial solution to a problem is not usually the most unique or elegant solution an individual can produce" (p.21). The first idea or solution which emerges is usually significant in that it is a catalyst to more and better ideas. Breakthrough ideas are generally the result of deliberation. Maslow (1968), as cited in Callahan (1978) suggests that "Secondary creativity is the type of creativity that results when one person works with and ‘stands on the shoulders’ of others and consciously proceeds cautiously to conclusions" (p.4). This conscious and cautious process may succeed the initial idea noted by Callahan, but all too often, first ideas are valued beyond their worth, circumventing the occurrence of deeper and broader thoughts.

A third myth responsible for the low prioritization of creativity is that it is filled with gimmickery. Little substance is recognized in creative activity until one acquires the language necessary to articulate demonstrated skills. Specific skills of creative thinking have been delineated by Guilford (1959) and are cited in Callahan (1978) as:

... fluency, the ability to produce several ideas or solutions to a given problem; flexibility, the ability to produce ideas or solutions to a problem that come from many categories of possible solutions;
originality, the ability to produce unique or novel solutions to a problem; and elaboration, the ability to add detail to a given idea in order to produce a new idea (p.6).

Many authors and practitioners in the field of gifted child education have utilized Guilford’s compilation of skills in creating teaching strategies, learning experiences, and educational programs to enhance creativity. As one studies applications of Guilford’s work, it becomes clear that not only can creativity be enhanced, but so can the acquisition and use of basic content which already exists in the regular curriculum. By integrating skills of creative thinking to introduce and/or consummate units of study, one may enhance productive thought and basic skills simultaneously. In addition to the aforementioned scholastic benefits, effective rewards accrue as well. These rewards (as compared to the previously mentioned joy which accompanies the “ahas”) provide a deeper sense of accomplishment which results when ownership of a sophisticated and/or complex adaptation of a concept develops.

To illustrate the practicality and ease of application of creative thinking skills, four examples are offered for consideration. The examples are integrated with content that is appropriate for average sixth grade learners. This content is used as a vehicle to demonstrate the relationship between content and process, which teachers can manipulate in order to make activities appropriate to various levels and subject areas. By substituting content at various levels of sophistication, educators can adapt learning experiences to match the curricular focus. Manipulating the thinking process within a learning experience offers educators one more way to effectively match activities to different learning needs.

The following examples could be used to enhance acquisition of basic knowledge and to extend creative thinking abilities as used to complete a unit on Mayan Civilization:

**Fluency:** Students will list as many known and probable crafts/occupations of Mayans as possible (based on what they have learned about customs, natural resources, climate, etc.).

**Flexibility:** Students will speculate about what would happen if Mayan civilization had continued to grow and prosper into the 1980’s (based on what they know about the propensities, strengths, and weaknesses of that civilization).

**Elaboration:** Students will add supporting facts and details to what they have already learned about transfer of knowledge between Mayan generations.
Originality: Students will create their own culture, different from the Mayans and other known cultures (based on component parts of any culture as learned in the unit on Mayans).

The learning objectives listed above offer examples of ways in which educators might articulate curricula to encourage students to go beyond that which is already known, while at the same time reinforcing basic content knowledge. Integrating creative thinking skills with the regular curriculum is a time-efficient strategy which is rooted in basic skills, but enhances productive thinking and affective links to subject matter. It is a strategy which discourages right answer fixation, but encourages students to examine basic concepts in new and different ways. It promotes questioning and curiosity—two basics of intrinsic motivation.

Beyond curricular strategies, there exists the variable of environment. The utilization of creative learning experiences will be more effective when they occur in supportive situations. Callahan (1978) notes, “The notions that developed as a part of the process approach to creativity suggest an open, free environment which is structured so that creative behavior can occur without threat and with reinforcement” (p.4). Torrance (1965) supports this concept when he says “...respect for the questions and ideas of the child, respect for his right to initiate his own learning effort, and respect for his right to reject, after serious consideration, the adult’s ideas in favor of his own” (p.252). Therefore, if efforts to implement strategies which elicit creative thought are to be successful, they must involve the validation of student attempts, as differentiated from the validation of student successes.

As the field of education becomes more specialized, educators in various domains acquire new and better methods of meeting student needs. As special populations of students are identified, new light is also shed on the needs of those students who do not participate in these programs. Parents and educators are becoming increasingly aware that some of the strategies used in special education and gifted child education are appropriate and necessary in the regular classroom and can increase efficacy within that environment. Cooperation among various school programs creates “learning links” within schools, and validates the importance of a total school environment.

Because of the rapid increase in knowledge, educators have new responsibilities to their clients. Two of these responsibilities involve prioritizing new content which might be added to (or taken from) the curriculum, and enabling students to utilize content in new ways. Training students to think creatively (or more creatively) and providing regular opportunities for practice will benefit our students in many ways. Why is creative learning important? Treffinger (1980) answers the question by stating “1) It helps children be more effective
when we aren’t around; 2) It creates possibilities for solving future problems that we can’t even anticipate; 3) It may lead to powerful consequences in our lives; 4) It can produce great satisfaction and joy” (pp. 9-13).

Will the current focus on thinking skills become integrated as practice into the many varied curricular offerings already existing within our public schools? We must look to the creative efforts of individuals in our educational communities for the answer.

REFERENCES


CRITICAL THINKING GOES TO POST-SECONDARY SCHOOL

Edna M. Smith

Critical thinking is a complex mental process valued by the members of all academic disciplines. However, not all educators consistently provide the environment or employ the types of instructional strategies that nurture the ability to think critically. After a brief glance at our fascination with the mind and its nature, this paper focuses on some of the factors which demand consideration by educators in the quest to promote the development and practice of teaching critical thinking.

That there is an abundance of rhetoric about the topic of critical thinking is evident to anyone who peruses professional journals, attends educational conferences or surveys school curriculum materials. Printed rhetoric is not limited to journal articles, but extends to all manner of professional literature, including a 856-page volume, *The Oxford Companion to the Mind*, edited by Richard L. Gregory (1987), that contains 1001 entries, some of which are brief statements and others entire essays. In addition, there are texts for classroom teachers, like *Teaching for Thinking* by Raths, et.al. (1987).

Neither is our fascination with the human mind and its nature new. The veracity of this statement demands only a cursory search of the literature which reveals, among other names, those of Socrates (470 B.C.), Dewey (1910), Keyson (1926), Judd (1936), Bartlett (1958), Bruner (1961), and Sternberg (1986). The prolificacy of literature offers knowledge, theory and justification of theory, and a challenge.

In the introduction to the second edition of *Teaching for Thinking*, Wassermann issues a challenge to the educational community admonishing professors in teacher training programs to help develop competence in teaching thinking (Raths et.al., 1986). In the search for the response to the question of what needs to be done, it is first prudent to become familiar with the various pitfalls that could mean failure both for the teacher of teachers and the perspective teacher.

Sternberg (1987) advances eight fallacies which he describes as “insidious and pernicious” in their effect on the teaching of critical thinking. These fallacies include:

1. believing that the teacher is responsible for the teaching, while the student is responsible for the learning;
2. assuming that the student alone is responsible for critical thinking;
3. maintaining that the paramount issue is to select the correct program;

4. assuming the existence of a group of binary choices as a basis for program selection;

5. focusing on the importance of the right answer;

6. viewing class discussion as only a means to an end;

7. concluding that mastery learning principles can be applied to critical thinking; and,

8. believing that the goal of the teacher of critical thinking courses is to teach critical thinking.

Although space prohibits a full discussion of each fallacy set forth by Sternberg, the eighth fallacy demands clarification since it is difficult to accept it as a fallacy. Sternberg's explanation of the eighth fallacy encompasses principles of individual learner differences and the unlikelihood of a transfer of a skill to a new situation when the process for problem solving has been provided by the teacher. Sternberg contends that in a course on critical thinking, the teacher can only provide the optimal conditions and opportunities to allow each student to discover methods of problem finding and problem solving.

To avoid the fallacies which Sternberg has placed on the path to successful teaching of critical thinking skills, it seems that instructors of teacher training courses need more than expertise in the various domains of academic disciplines. A teacher at any educational level must examine his or her own self-image and the environment for learning that he creates. Educators need to maintain the status of learners, risk-takers, and stimulators.

Maintaining the status of learner tends to shield the educator against rigidity, crusading for the one correct answer to a problem, searching for the one program for teaching critical thinking, or employing discussion as merely a means to an end, rather than an end in itself. Another desirable characteristic to be nurtured by the educator is that of risk-taking.

Critical thinking demands the willingness to take a chance, to do what we ask of the student, to share ideas (although this is a threat to the importance we place on credit for individual ideas), to think "out loud" as we solve problems, running the risk of an error in the process and the need for "fix-up" strategies. The teacher of teachers needs to run the risk of relinquishing the authority position to develop teachers who are also willing to relinquish authority. Hypothesizers
need not only associated knowledge and information, but an atmosphere which welcomes and encourages risk-taking, acceptance of error and the mess that productive, creative thinking often generates. Wasserman (1987) describes this “mess” in terms of “healthy skepticism, controversy, and uncomfortable questions” from students.

The simulation of a process has been used with success by space scientists, and to a great extent by proponents of artificial intelligence. Therefore, if prospective teachers are expected to concommittantly teach critical thinking skills and content subjects, they must be afforded the opportunity to learn in this same way. In other words, if teachers are expected to formulate questions which challenge thought processes, they must be asked questions which challenge their thought processes. If they are expected to teach pupils to become aware and to question their metacognitive strategies, they must become aware and able to question their own metacognitive strategies. If they are to help pupils learn to acquire knowledge through thinking and learning to create conceptional frameworks, they must learn by example, experience and practice to do the same. A lecture on teaching critical thinking is no more effective than an isolated study skills course, disassociated from immediate functional use in conjunction with an academic subject, is to a high school pupil.

If “thinking goes to post-secondary school,” it is at least out of the gate and with plenty of support, on the road to primary, elementary, junior and senior high schools.
REFERENCES


MY PROBLEM IS...PROBLEM SOLVING, CRITICAL THINKING, AND EVERYDAY LIFE

Sławomir Grzelkowski and Mark Hineline

The title of our discussion, "My Problems Is...," is, literally, an elliptical statement. As such it defines, in the words of John Dewey, an indeterminate situation. Note that it is elliptical at both ends. Not only does the ellipsis itself suggest an incomplete statement of a problem, but the antecedent of the pronoun "my" is equally undefined. So we can progress to a settled statement of a problem, we must decide whose problem it is.

Elsewhere, we have argued that programs designed to teach critical thinking must begin with a problem chosen by the student (Grzelkowski & Hineline, 1988). It is not our purpose to reargue this position here, other than to show why student-generated problems can be helpful in teaching strategies. The essence of this can be boiled down to an often touted but little understood word: context. We shall define context here as the details of a problem that transform it from a simple calculation to a complex decision. Context is the source of the maybes, if, ands, and buts of real-life problems that are too often skimmed away from their pedagogical counterparts.

As stated, it is not our purpose to reargue that position here, in addition to our own paper, a succinct account of it can be found in Robert J. Sternberg's "Teaching Critical Thinking: Are We Making Critical Mistakes" (1985). Rather, it is our interest to show how we could have gone further. As to the first of these points, the provision of context was a virtual counterpart of student-generated problems in our Technology Assessment Activity (TAA), which we developed for the Maine Summer Humanities Institute in the summer of 1986.

Our purpose for putting students through TAA was to provide an activity through which they could synthesize the lectures, reading, discussions, and discrete activities of a freshman-level interdisciplinary course offering, "Society and Technology." TAA employed role-playing by our students, who acted out predetermined roles as a way of getting them to deal, for two weeks, and in some depth, with a social problem of a technological nature. Where we intervened in this process, we did so, in part, to increase the complexity of the problem and the inputs to its solution. But the selection of the problems for TAA was left solely in the students' hands. The four problems they chose to solve—acid rain, drug testing, funding of fusion energy research, and mandatory seat belts—were their problems. All of the problems were—and are—real
life problems, each with a wealth of “context” that were available to be discovered by the participants.

Our experience with TAA showed, among other things, that students were satisfied with what we felt to be too-simple solutions to their problems. Given the need for closure in a two-week institute, the students had to be satisfied—there was little time for recasting of problems. And sometimes they ignored pieces of context, as when one facilitator at the institute attempted to confuse the students by suggesting that during the fusion energy recommendations session an ad hominem argument about Lyndon Larouche and his Fusion Energy Foundation. The participants did not bite at this.

Nevertheless, the participants did go through a process of decision-making given material of their own making. This, we suggest is preferable to working on a kind of problem that is no one's problem. “No one’s problem” is meant to provide a rehearsal of formal problem solving. The same sort of learning experience can be found in a genuine, student-generated problem. In his book, Surely You’re Joking, Mr. Feynman, the late physicist Richard Feynman identified a particularly egregious case of “no one’s problem” in a math text (Feynman, 1984). In the case he cited, students were given the temperatures of star A and star B, then asked to add the temperatures together. No one, Feynman pointed out, adds star temperatures. It is no one’s problem. Even where problems attempt to recreate a genuine human activity, such problems are typically resolved through trial and error. There are many problems that are resolved in just this manner—problems in which the collection of data is difficult or impossible, and the application of such information will not decide the matter, anyway.

This, we propose, is the result of skimming off context: simplifying the learning process by divorcing content from process. Whereas, in most pedagogical situations, opportunities to teach process are lost in overattention to content (the memorization of materials), the reverse is often the case when teaching mathematics. It is thought that, when teaching the process of problem solving through logical/mathematical modeling, any old content will do. The result may well be that many students come to see logical/mathematical models as inapplicable to any problem they have faced or will face at a future time.

Nevertheless, logical/mathematical modeling of problems is both possible and useful. The engineer models the stresses on an airfoil to decide whether it will support an aircraft; the businessman models demand for a commodity before proposing a price for it. Through a largely intuitive, but otherwise uninformed, process we model our daily activities on a quantitative analysis of time available weighed against time required to complete certain tasks. Our question becomes: what activities can students pursue that might provide useful problems which can be resolved through mathematical modeling?
In our experience with the Technology Assessment Activity there were several opportunities for proposing logico/mathematical models for problem solving. Because our focus was elsewhere, we overlooked all of them. But that does not preclude reflecting upon the experience to see where we might have successfully provided experience in mathematical problem solving.

A case in point was the seat belt bill. Here, the students proposed a bill to mandate the use of seat belts in automobiles. The design of the activity was such that the primary focus for arguments between students about seatbelts was political and ideological. Had we as teachers been interested in a more comprehensive learning experience, we might have intervened by suggesting the use of mathematical-physical model of seatbelts in one of at least two ways. The first of these might have been to Richard Weirich’s analysis of the physics of seatbelts as a persuasive argument for mandating the devices (Weirich, 1989). Specifically, a student might have acted as an “expert witness” and demonstrated the efficacy of seatbelts by explaining, in testimony, the physics of the devices. Another opportunity, and one which clearly presented itself but was lost, was to encourage a definition of seatbelts in the language of the proposed legislation. In their draft, the students responsible for the seatbelt bill merely proposed that driver and passengers in a moving vehicle wear whatever restraints were provided with the vehicle when it was purchased. But what is a seatbelt? Will two lengths of hemp rope, knotted when in use, suffice? Weirich’s physics provides an analysis from which a useful definition of “seatbelt” can be derived. In both cases, a seemingly arcane problem of physics grows directly out of a problem proposed by students.

To put it another way, here was an opportunity to take Newton’s law, F=ma, and to integrate it into the students’ experience at a point of interest so that the three terms of the equation, force, mass, and acceleration, have concrete meanings in relation to a problem that the students are predisposed to resolve.

We do not suggest that such interjection of context into the process of solving student-generated problems is a simple one. It requires attention to detail, a taste for cross-disciplinary communication between teachers from differing disciplines, an acceptance of “wasting” of time, and a predisposition for finding opportunities for teaching in the most unlikely of places. Most of all, it requires that we make the students’ problems our problems.
REFERENCES


DEVELOPING CRITICAL THINKING SKILLS IN THE FOREIGN LANGUAGE CLASSROOM

Camillo J. Profenno

For the last several years, the Portland Public School system has placed great emphasis in the curriculum on critical thinking skills. In this paper I shall describe several activities that I have used to help develop critical thinking skills and to nurture creative talent in the foreign language classroom.

To improve and increase both oral and written skills, I have found that one exercise in particular which has been successful involves the study of a magazine article.

The piece, entitled La forme d’abord, “Keeping in Shape First and Foremost” (L’Express: Ainsi Va la France, 1985) tells about the current preoccupation with being physically fit. It describes how a great number of Frenchmen have changed their lifestyles in search of a healthier body and mind set.

The students’ task is to read the account and to study the new vocabulary to resolve any problems that they may have in understanding the selection. A series of specific questions (based on the text) will be asked such as: “What has changed in the lifestyle of the French people? Give some examples of this new behavior.” (Express, p. 28). Then, the students will be asked to respond to questions of a general nature in order to elicit personal impressions of the material read. Two typical questions might be: “Is it important for you to feel well? When you are not in shape, what do you do to remedy the situation?” (Express, p. 28).

The third step in this process is to divide the class into groups of 3 or 4. The students will be presented a situation such as: “One member of the group decides to take a less paying job, one which gives him or her more free time to participate in a relaxing activity or hobby (Express, p 28). Each member of the group then gives his or her advice concerning this decision and explains why, using specific examples. This lesson helps the students to develop their creative thinking ability beyond the simple question and answer drill. At the same time they are encouraged to use the new vocabulary and idioms in a personal way which improves their spoken French and allows them to draw upon their own experiences and interests.

The final step, in this lesson, is to have the students write a composition based on the article and its related vocabulary. The topic of the writing sample may be to “describe one of the most evident changes in behavior in your country”
This exercise represents the logical conclusion in a series of steps that have attempted to increase the speaking and writing skills of the student.

To improve the reading ability of the student, I have introduced a reading comprehension exercise based on Barrett’s Taxonomy. This unit of study concerns a classification system developed by Barrett for assessing and teaching reading comprehension skills. This assignment is intended to help students look at different answers possible over what is read and to make more evident the thinking that is required by a variety of questions.

The labels of the taxonomy include: literal, inferential, evaluation, and appreciation. The literal comprehension level requires the reader to “remember and recognize the main ideas and details that are stated directly by the author.” The second level is inferential comprehension. Here, the student is expected “to interpret what the author means when he only suggests but does not state exactly what he wants the reader to conclude.” The third level is evaluation. The reader is asked to “make judgements based upon the author’s tone or purpose; determining fact and opinion, evaluating truth, accuracy or validity.” The final level is appreciation. The learner is asked to respond emotionally to the theme, character, or plot, and personal response based on the reader’s feelings and opinions” (Barrett).

The following passage is a free translation of an excerpt from Emile Zola’s novel, L’Assommoir (The Saloon), which appears in the Cours Supérieur, p. 256).

L’Assommoir (The Saloon) by Emile Zola, is a novel about the ravages of alcoholism in the working class society. The following passage describes the death of an alcoholic, Coupeau. His wife, Gervaise, awaits his end in the presence of doctors from the hospital.

“He sleeps,” murmured the chief doctor.

And he showed the face of the man to the others present. Coupeau, his eyelids closed, was making violent shaking movements, which pulled at his face. He was hideous to behold, his jaw sticking out. He looked like a dead man who might have had terrible nightmares. The doctors, having noticed his feet, took great interest in them. The feet were dancing. It was useless for Coupeau to sleep because his feet kept on dancing. Oh! Their boss could snore; that didn’t matter to them since they continued to dance at the same pace. They were mechanical feet that took their pleasure where they found it.
Gervaise, having seen the doctors put their hands on the torso of her husband, wanted to touch him also. She approached him slowly and placed her hand on his shoulder. She held it there for a moment. My God! What was happening inside his body? There was dancing taking place beneath his flesh. The bones even seemed to jump. Tremors and waves were flowing like a river under his skin. When she leaned closer to him, she could hear the cries of suffering from his very marrow. To the naked eye, one could see only little billows making holes and cavities like on the surface of a whirlwind or an eddy. Inside his body, however, there must have been one heck of a devastation going on! What a cursed job! It was the work of a mole. It was the brandy from the saloon which was now administering to him these pickaxe blows. His entire body was soaked in it, and damn it, it was necessary for this work to be completed. Coupeau’s body was trembling now, being reduced to crumbs. His entire carcass was being carried away.

The doctors had gone. After an hour, Gervaise, having stayed by his bedside, spoke in a low voice to the intern:

“Sir, Sir, he has died...”

But the intern, who was watching his feet, shook his head. The naked feet, now sticking out from the bed, were still dancing. They were not clean feet and had grown long nails. Several hours passed. Suddenly, his feet became rigid and motionless. Then, the intern turned toward Gervaise and said “That’s it.”

Death alone had stopped his feet.

The students are then given a series of questions concerning the extract.

1. Who is in the room with Coupeau?
2. What is his wife’s name?
3. What is the role of the doctors in this drama?
4. To which of our senses does the author call upon?
5. What prevails in the description, the psychology or the physiology?
6. How does Zola give the impression of the agitation of Coupeau’s entire body?
7. What is there in the description that is picturesque and biting?
8. How does the author suggest the sudden death of the alcoholic?
9. What is the author's attitude toward Coupeau? Is he detached or does he feel any emotion?
10. Show examples of clinical observation in the description.
11. In what sense can one say that the passage is naturalistic?

After answering the questions, the students are asked to classify them according to the four labels of the taxonomy. For example, the first two questions are obviously testing literal comprehension because they are recalling factual information. Question four would fall into the appreciation level of comprehension because it asks the student to offer a personal response based on his or her feelings.

The third question requires the student to read between the lines in order to find the answer. The doctors can do no more for the patient. What is the part that they play in this scene? This question demands that the reader make an educated guess from what the author has suggested. It is the inferential level of thinking.

In question nine the students are asked to make judgments based upon the author's attitude toward Coupeau. Is Zola more concerned with the emotion of the moment or is he more interested in the "clinical physiology" described in the narrative? This is, therefore, a question that fits the evaluation level of comprehension.

Categorizing the questions serves a dual purpose. The students are not only discussing and debating the levels of the classification system but are also using the target language in the process.

The final classroom activity that I shall describe in this paper is the oral report. As a variation to the regular textbook work, the students choose a topic on an historical figure, an artist, or a musician. They are then required to prepare a short report, from five to ten minutes in length, in the foreign language. The students may also bring to the class posters, pictures, slides and other materials pertaining to their report.

On the day that the oral presentations are to be given, all students must take notes in order to guarantee that their participation during the lesson will be as active as possible. For purposes of clarification, the students are encouraged to ask each other questions regarding their reports. These questions may refer to a grammatical point, vocabulary, or general content. In this way the students are reinforcing their newly acquired knowledge. This procedure also increases their ability to think creatively in the foreign language. After all the oral reports
are completed, a quiz is given to the class in order to evaluate their comprehension of the material covered.

In conclusion, the classroom activities described in this paper provide an excellent opportunity to combine critical thinking skills with the goals of learning a foreign language. The students, ultimately, are the beneficiaries of this approach.
REFERENCES


USING SEAT BELTS TO DEMONSTRATE THE INTERACTIONS OF SCIENCE TECHNOLOGY AND SOCIETY

Richard C. Weirich

What is Science, Technology and Society Education, and Why Use It?

Citizens of democratic countries must interact responsibly with their governments. They both make the rules and consequently are subject to them. In modern societies, citizens are also called upon to make decisions that can have dramatic effects on a local, national or even global scale. A society requiring a literate citizenry capable of understanding issues of political, social, and economic importance must depend greatly on education. With the advent of technological advances in supercomputers, satellite communication, and improved marketing and production techniques, the rate of change in today’s world is accelerating. To remain competitive, it is essential for any society to utilize the present technologies and seek new ones. Also, it is increasingly difficult for the public to see in advance all the positives and negative effects concealed in a new technology. This leads to the frightening possibility that decisions of vast importance may be made without a realistic understanding of the consequences.

Society is affected by, and affects, science and technology. Vaccines, nuclear power, and computers are but a few of the technological products developed from scientific research that are commonplace in modern life. The needs of individuals, organizations, and cultures often determine the direction of science and technology will take. In the United States, for example, nuclear power is increasingly unpopular while France becomes ever more dependent on it.

Can electorates be adequately prepared to face such scientifically and technologically intricate problems? If the answer is yes, how is this preparation to be gained? A reasoning citizen can be produced through involvement in the scientific processes. Such a person should be aware of gaps in information, should make inferences from the available information, should distinguish between fact and opinion, and should be able to analyze one’s pathway leading to an eventual conclusion (Arons, 1984). Arons further believes that a liberal education is of necessity, as science will not give any set “formulas” for sure solutions to the problems of society. Understanding the principles of science, technology and societal (STS) interactions has been proposed as a step toward helping students form rational decision-making skills based on accepted knowledge, procedures, and concepts (Harms & Yager, 1981).
Appropriate science education refers to teaching an understanding of the processes of science as well as its content. These processes can then be transferred and used in a society where citizens constantly face choices involving new technologies which affect their lives. STS education requires more than presentation of scientific concepts, more than understanding of the applications of these concepts, it requires student involvement, preferably having the student make a judgment on an issue.

Collaboration among disciplines should help students gain a complete reference of a particular societal issue and be of valuable assistance in formulating a rational decision-making process. Students would clearly see that science has a lot to offer in the public domain, and, just as importantly, that the public has an obligation to provide science and technology with constructive goals. The closer a student can come to experiencing the total picture of an issue, the greater the possibility of that student having a realistic viewpoint and being able to function constructively in society.

Ideally, an STS activity, lesson, or unit should have all three components (Science, Technology, and Society) present. Following is an example of how STS concepts could be applied to the topic of Seat Belts.

**Seat Belts**

In Maine, the topic of seat belts is of particular STS value because:

1. Maine citizens pride themselves on their independence. They cherish the right to decide personal issues for themselves.

2. The seat belt issue goes beyond personal choice. Do individuals realize the pain, anguish and financial burdens they may place on loved ones through failure to use seat belts? Who makes the decision whether minors wear seat belts or not? Will increased injury rates and death rates due to the lack of use of seat belts result in increased insurance premiums for all drivers? Will the state receive less federal highway funding if seat belt laws are not enacted or enforced?

3. The technology of seat belt design uses basic physics principles. Seat belts use a pendulum to sense acceleration. The belt and harness are designed to stretch to increase the time and distance of the user’s deceleration. The belt and harness are also designed to keep the pressure on the wearer high enough to slow him/her down, yet low enough to allow minimal injury from the harness.
4. To understand why seat belts reduce injury requires a working knowledge of one or more concepts of physics. These concepts include, acceleration, displacement, velocity, forces, impulse, momentum, and energy.

5. Physics concepts are readily applicable to a more recent device designed to aid in passenger safety, that of air bags. STS education should provide students with the scientific background to allow them to make decisions on issues in the future.

6. Students are forced to make a decision on the issue for themselves. The decision is not required to satisfy a school requirement, it must be made when they ride a vehicle equipped with a seat belt.

States are receiving pressure from the U.S. Government to enact laws requiring citizens to wear seat belts. Many citizens see such laws as infringements of their rights and wish to let the choice of using seat belts be an individual decision. A scientific investigation of the physics principles involved should leave little doubt concerning the value of using seat belts. During a collision, seat belts stretch, which gives a person an increased "stopping time" compared to the time it takes a dashboard or steering wheel to stop the person. This increase in stopping time is inversely related to the average force of impact. A five-fold increase in the stopping time results in an average impact to be reduced by a factor of five. Literature and films of which most are geared for driver education programs but are readily adaptable to the science classroom, and are available from the state and federal Departments of Transportation.

The book *Physics and Automobile Safety Belts* (DOT, 1977), has numerous mathematical crash-related problems; recommended demonstrations; laboratory experiments; and data from tests in which dummies were involved in crashes both with and without seat belts. The material ranges from basic notions of acceleration to more complex concepts about energy and vectors. The information includes facts that would be difficult to obtain in the classroom, such as the stopping times of the dummies at various speeds.

By knowing the stopping times, the average deceleration of a dummy can be calculated using constant acceleration equations. This deceleration could be compared to the acceleration of gravity which would indicate the number of "g's" or how many times one's normal weight one would experience in a rapid stop. Comparisons can also be made equating various vehicle speeds to free-falling from different heights. Graphs of passenger velocity vs. time during a collision are shown. These make an excellent practical example of the graphical interpretation, as it enables one to find the instantaneous deceleration which may be many times greater than its average acceleration. The message is personal—seat belts minimize harm to those wearing them—as well as
social—the use of seat belts saves a natural resource: people—and economic—medical and insurance bills are reduced.

While the above paragraph focused on the motion (kinematics) during a crash, the cause of motion (dynamics) is the real “test” of a working knowledge of physical laws. Again, by knowing the time (delta T) to stop in various situations, the equation, \( \text{impulse} = \text{change in momentum} (F \Delta T = m \Delta v) \), can be used to determine the average force (F), on a person of a given mass (m), stopping from a given velocity (v). This force can be compared to the person’s weight, which emphasizes the severe stress a body undergoes during a collision.

Demonstrations on the topic of seat belt safety can range from simple to sophisticated. A teacher can “crash” a laboratory cart carrying clay dummies. One dummy is attached to the cart via a rubber band “seat belt” and thus will stay with the cart, while the other unrestrained dummy would be subject to the law of inertia and will experience whatever fate lies in front of the crash site. More elaborate is a demonstration known as the “Convincer”; an automobile seat that is involved in a sudden stop after sliding down an incline. This portable demonstration is available to schools and other public activities in Maine through the Maine Highway Safety Commission in Augusta, Maine. A number of measurements can be taken to determine the speed of impact of students as they ride the sled wearing seat belts toward the abrupt collision at about 5 to 7 mph. Many students are surprised at the force of the impact and admit they are indeed “convinced.”

Another activity demonstrating how increasing speed at the time of impact can reduce the average force experienced is to throw a raw egg into a sheet held by two students. Amazingly, it doesn’t break no matter how fast the throw because the sheet increases the time of the stop, compared to a direct egg-wall collision. Another explanation is that seat belts stretch under stress and increase the stopping distance, compared to a collision with the interior of the car. Simple laboratory exercises are available from “Seat Belt Science: Activities for General Science” (DOT, 1982). For example, by using a bathroom scale students can estimate the maximum crash velocity in which they could successfully avoid the “second” collision with the inside of the car dashboard or steering wheel by using their arms as a brace. The scale can be used to determine their weight and the maximum push their arms can produce from a sitting position. The push gives the force of the collision. Time is given, mass is determined for their weight, leaving v as the only unknown. Typical values for the maximum velocity in which are effective as a brace are between 1 and 4 mph.
Summary

Science principles and processes can be used to show that not wearing seat belts has more negative than positive aspects. Whether or not to “buckle up” is a choice to be dealt with on an individual basis although many states already have laws requiring the use of the seat belts. Certain issues dealing with current science are decided through the process of voting. For citizens to deal successfully with such decisions requires them to have a basic understanding of the facts and principles involved. Education utilizing STS interactions is designed to enable students to formulate rational decision-making skills, applicable to future issues of unpredictable nature.
REFERENCES


BIOGRAPHICAL SKETCHES

Rhonda Boyer is a special education teacher at New Suncook School in Lovell, Maine. She received her bachelor's and master's degrees in special/elementary education at the University of Delaware.

Libby G. Cohen is an associate professor of exceptionality and the 1986-1988 holder of the Walter E. Russell Endowed Chair in Philosophy and Education. She received her Ed.D. from Boston University and is the author of numerous articles in the areas of education of students with handicapping conditions, assessment, and ethical issues relating to persons with handicaps. She resides in Cape Elizabeth with her husband, Les, and son, Seth, who share the credit for the success of the 1987 and the 1988 Russell Chair Symposia.

Slawomir A. Grzelkowski, associate professor of sociology, University of Southern Maine, received an M.A. in philology, University of Warsaw in 1962. He received a Ph.D. in sociology from Indiana University in 1974. Prior to coming to the University of Southern Maine in 1873, he taught at Colorado College in Colorado Springs, Colorado. His interests include sociology of organizations and sociology of education.

Mark Hineline is a graduate of the University of Southern Maine. In September 1986, Hineline was named winner of the John Dewey Essay Project sponsored by the Center for Dewey Studies for his paper, "John Dewey and Thomas S. Kuhn: A Parallax Vision of Science." Hineline is continuing his studies as a graduate student in the history of science.

Barbara Moore is the coordinator of programs for gifted students, grades 9-12, at Lake Region School District. She received her bachelor’s degree in speech from Northwestern University, her master's degree in drama from San Francisco State University, and is currently working toward her second master's degree in gifted child education at the University of Southern Maine. She has recently received state recognition for her work with using computers in the classroom and for her program for at-risk gifted high school students.

Camillo J. Profenno is a foreign language teacher at Deering High School, Portland, Maine. He received his B.A. in romance languages from the University of Maine, his M.A. in Spanish from Middlebury College, and has done further study at the University of Wisconsin.

John Samara graduated from the University of Massachusetts at Amherst with a B.S. in elementary education in 1976. He taught grades three and six for a total of nine years and more recently coordinated an elementary school program for gifted and talented learners. Samara received a master’s degree in education.
from the University of Southern Maine, and is currently coordinating the Technical Assistance Program in gifted child education and serving as adjunct instructor in the Exceptionality Department at USM.

Edna M. Smith is a part-time assistant professor in the graduate program at the University of Southern Maine. She received her doctoral degree from Boston University.

Jo Anna Spruill received her B.A. degree in English literature from Smith College. She received an M.Ed. in learning disabilities and an Ed.D. in special education leadership from Boston University. She has a special interest in the development of thinking during adolescence. She is currently an assistant professor at the University of Wisconsin at Oshkosh.

Dianne D. Todd graduated from Framingham State College in Massachusetts and from the University of Southern Maine with a master’s degree in literacy. Presently, she is the Chapter I Coordinator in the Augusta, Maine, Department of Public Schools.

Richard C. Weirich teaches science at South Portland High School. Prior to his teaching in South Portland, he taught at Rumford High School, Rumford, Maine. He received a B.S. in physics from Elizabethtown College, Pennsylvania in 1966, an M.Ed. in science education from the University of Maine at Farmington in 1971, and a C.A.S. in science education from the University of Maine at Orono in 1982.