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Science or the scientific approach has traditionally stressed organization and measurement whereby individuals observe, measure, and classify. This application of scientific knowledge has resulted in the development of technology, an applied science. The word "technology" is from the Greek technologia, and it means a systematic treatment. Technology embodies physically what science has already done.

Our new science is in its essence technological (1). Jose Ortega y Gasset said, "...technology in the fullness of its maturity begins around 1600, when man in the course of his theoretical thinking about the world comes to regard it as a machine." As this was happening, humanistic concerns regarding individual worth, independence, creative initiatives, individual potential, and human control with technology became most significant topics for discussion. While technology became extremely powerful there was reflection and fear that unique human characteristics might be suppressed or denegated.

The power of technology is a challenge to humanistic concerns is a challenge to humanistic concerns and forms the basis of the continuing debate, i.e., how should we use our educational technology and how do we keep it under control? There are many examples of raw technical power going haywire. For educators at all levels, technology must be under human control and carefully applied.

It is not difficult to demonstrate that modern technology is quite dangerous and at times exceeds the ability of humans to control it. On January 13, 1982, at 3:45 PM in a blinding snow storm, a Boeing 737 Air Florida, Flight 90 lifted off from National Airport in Washington, D.C. bound for Tampa. After clearing the runway, Flight 90 crashed into the 14th Street Bridge during rush hour traffic and plunged into the Potomac River (78 people were killed). About a half hour later and one mile east, Washington's Metro subway system had the first fatal accident in its six years of operation. Three persons were killed and 18 seriously injured in an underground derailment. Five days later on January 18, 1982 at 10:00 AM, four Air Force precision pilots flying T-38 jets flew into the ground near Nellis Air Force Base, Nevada, while practicing a loop maneuver. They were some of the best pilots the Air Force had and were part of the Thunderbirds demonstration

team. Five days later on January 23, 1982 a World Airways DC-10 with 190 passengers aboard skidded off the runway at Logan International Airport and slid into the shallow water of Boston Harbor. Three days later two missing passengers were finally declared unaccounted for and ultimately declared dead by drowning. Twenty-two days later on February 15, 1982, the world's largest semi-submersible oil rig, the Ocean Ranger, thought to be unsinkable, sank off the coast of Newfoundland in a storm (84 men were killed).

These tragic events occurring within 33 days were due in most part to human error. It demonstrates that a slight error with high technology can have disastrous consequences. Our technical efficiency can be a powerful opiate, disarming us of some natural concerns. It has been said that our extraordinary progress with technology has taught us how to become gods before we learned to be human (3).

Within the specific area of reading and the more general area of developmental study skills, human error by teachers is critical but not immediately obvious. Indeed, teachers may never know if they have made an error or not. They frequently must follow their instincts while in a particular remedial situation rather than acknowledge and accept what the test data predicts or prescribes.

Reading as a skill to be taught came along with behavioral science techniques of psychology that flourished in the first 40 years of the twentieth century. Numbers and various systematic approaches were used to help represent abstract human characteristics and organize data findings. With regard to reading ability, intricate concepts such as comprehension and flexibility were developed, analyzed, and studied. In an organized manner, educators attempted to use scientific methods by developing theories and testing their ideas on students.

Curriculum research on the process of reading was conducted along with theory-based research looking for outcomes from a particular method. The word "efficient" frequently appeared in the early reading literature along with suggestions for increasing reading rate. There seemed to be an infatuation with the term "efficient reader." Designated efficient readers had mastered certain reading techniques, but this did not make them wiser, more perceptive or more insightful than less efficient readers. Devices for measuring reading efficiency were developed--the tachistoscope, the reading accelerator, the shadowscope, and the metronoscope. Organized efforts to improve reading skills were started. One of the first college reading centers was established at Dartmouth in 1928 (4). Into the 1940s and 50s considerable effort was made to study eye movements, improve and develop testing procedures, and develop methods or approaches for college level study, such as Francis P. Robinson's SQ3R method.

As a result of the Russians having launched the first orbiting space vehicle on October 4, 1957, there was considerable activity within high education to become more scientific and efficient. In the 1960s it was quite popular to adopt notions of systems theory for educational activity. Systems theory was first used

during World War II with such new high technology devices as radar. Donald E. P. Smith has made reference to instructional system technology (IST) with reading and said it refers to behavioral engineering, that is, to arranging environmental events in order to produce reliable, given behaviors (5). Using something called High Intensity Learning Systems, S. Alan Cohen said confidently, "Designing curriculum is an engineering problem"(6).

There is considerable controversy regarding the use of behavioral engineering; even mentioning the term can generate controversy in some quarters. Humanistic misgivings with behavioral engineering have to do with control and manipulation in the hands of imperfect beings. If a skilled jet pilot can make a slight mistake with high technology and kill many people, it is reasonable to assume that a serious mistake can be made by a well-intentioned, experienced educator using methods of behavioral engineering. B. F. Skinner has been acknowledged as a popular and aggressive spokesman for behavioral engineering, but he has many critics. William Barrett said Skinner "...is particularly persuasive for the simple-minded and half-educated whose members constantly increase in our society" (7). These general perspectives (scientific versus humanistic) dominate educational approaches within reading and study skills environments.

Scientific Approaches

The scientific approach with humans is usually subject to many variables (human and environmental characteristics) that are difficult to control. Reading behavior and reading disability are two of the most researched topics in education and psychology, yet reading research continues to abound with contradictions and controversies (8). It is known that standardized reading tests are rather vulnerable to the effects of interest and previous experience when attempting to measure comprehension (9). Results of standardized and informal assessment could well be influenced by students' interest in the passages that are used (10). The lack of agreement as to what functional literacy is (or what should be measured) has resulted in illiteracy estimates ranging from one to twenty percent of the population (11).

Scientists often have difficulty getting a consensus regarding their methodology and results. Walter Lippmann in a half joking way said, "Science is the occupation of absent-minded professors, of difficult and unsociable persons, wise enough, no doubt, but not altogether in their right minds" (12). William Carlos Williams once referred to science and philosophy as little more than fetishes of unspeakable abhorrence (13). However, with the help of scientists many fraudulent practices within reading programs are exposed. Exaggerated claims for speed reading is a good example. Eleanor J. Gibson and Harry Levin identify research that indicates very rapid reading does lead to a loss of factual details, and as a result, a loss of ability to draw inferences from them (14).

Walter Pauk is quite specific and adamant when discussing students and their reading rate: "At 600 words per minute, they were not reading; rather, they were skipping and skimming and moving their eyeballs, but not their minds, over the lines of

print"(15). Bright students are sometimes taught to speed read so that they may keep up with the pack like jackals devouring words. Speed reading techniques seem to have lost considerable support from reading professionals. A recent International Reading Association's program listed 400-500 presentations with about 2000 presenters, and no one championed speed reading (16).

New high technology devices such as word processors, programmed television, and microcomputers are now being proclaimed as innovations for reading specialists and other developmental programs. Reading programs on many campuses are using these devices or investigating the possibility of using them. Computer assisted instruction (CAI) modules have been developed to improve reading comprehension at the post-secondary level (17). These types of modules are used to supplement classroom experience.

George E. Mason and Jay S. Blanchard have an excellent monograph titled "Computer Applications in Reading"(18). They review the history and use of computers and describe some applications for reading instructors (comprehension, critical reading, drill and practice). With a dependence on visual effects, Mason and Blanchard wonder if computers are helping or hindering.

Many uses have been found for computers beyond a supplement for instructional technique. Microcomputers are used to crank out readability formulas (19). Word processors and computers have been programmed to handle great quantities of test data and provide suggestions for remedial work. These techniques may be helpful to busy instructors, but they subtly imply that machines may be more knowledgeable or more in control than a classroom teacher. William Barrett warns that "If we try to flee from our human condition into the computer, we only meet ourselves there. Inevitably, the game of 'choice and consequences' is still to be played out, though on a different level"(20).

Martha Maxwell has said that students must be taught how to think critically about complex problems, to weigh evidence, to use logical processes, and to solve problems (21). With the inertia of technical efficiency there is the hidden danger that process or technique can overtake purpose. Learning a reading technique may be more important for a technologist than understanding what is read. A slavish application to technical exercises can be limiting and debilitating. The technical dimension must always play a supporting role to the classroom teacher and the dynamics of critical discourse. Humans produce the facts to be handled by machines, but the facts themselves are changed by conceptual revolutions (22).

Humanistic Approaches

During the first 40 years of this century, education's eloquent but controversial voice for a humanistic approach was John Dewey. He consistently emphasized that the classroom teacher must be sensitive to individual differences and human potential. With a philosophical bent, Dewey said, "Education is a mode of life, of action. As an act it is wider than science."(23) At times he was rather vague but also compelling:

> The sources of educational science are any

> portions of ascertained knowledge that enter into the heart, head and hands of educators, and which by entering in, render the performance of the education function more enlightened, more humane, more truly educational than it was before. But there is no way to discover what is "more truly educational" except by the continuation of the educational act itself. The discovery is never made, it is always making. (24)

The influence of John Dewey was waning in the 1960s and into the 70s when educators followed their political instincts and accepted government money to advance science. Many humanistic educational researchers specializing in reading were influenced by the psychoanalytic approach that required an analyst or teacher to be able to see the world through the eyes of his patient or student. Bruno Bettelheim and Karen Zelan have attempted to explain the psychoanalytic process with emphasis on the intricate student-teacher relationship. When working with children, they said, "What matters is that the child be given the conviction that he will learn to read..."(25) This has to do with the important concept of self-confidence being transmitted and reinforced by the teacher.

Knowing how to read in a technical sense does not prevent reading problems (e.g., problems relating to anxiety or lack of self-confidence).(26) A reading problem, when identified through testing, is only seen; there is no explanation as to why the problem occurred or what should be done about it. Representing the human element, teachers must solve those problems; they are the key to a successful remedial program.(27)

Experienced reading teachers understand that it is most helpful to take students into a sort of partnership and gain their trust in order to determine what the problem is and how to correct it (28). Reading skills can be improved and self-confidence enhanced. Those who cannot read at a minimal level are usually hindered by physiological and psychological handicaps (29). Correcting these problems can be a painfully slow process requiring a lot of student-teacher interaction.

The humanist places considerable emphasis on human dignity and is usually willing to make a genuine effort for students to overcome severe handicaps. When Anna Mansfield Sullivan took the responsibility of teaching Helen Keller, who was deprived of sight and hearing, she had no way of knowing what potential Helen Keller had. Teaching was done out of love, dedication, and compassion. The remarkable Helen Keller story is repeated in different ways and on different scales by classroom teachers who are able to beat the prediction formula cranked out by machines.

Humans are needed to take on the difficult tasks of overcoming educational handicaps and developing qualities of understanding and reasoning. This job may be aided by technology, but there is no indication that technology can control itself. Technical achievements always bring with them many undesirable side effects.

In the Soviet Union there is less emphasis placed on human

worth and dignity than in this country. Educational and industrial training efforts in Russia are highly advanced in the area of technology. It has been reported that Russia is further advanced than any other western country in the use of educational technology (30). This may be an indication that Russia does not want to develop critical thinkers. Machine smart technologists (who are "programmed") are easier to control and less likely to question the state's authority. People who think may disregard machines.

Summary

Contrasts between a scientific or technical approach and a humanistic approach are vivid. Electromechanical devices and other technical equipment are efficient, fast, capable of handling large amounts of data, but somewhat limited. Human characteristics stem from the soul or spirit, and they are embodied in specific traits, such as compassion, self-denial, insightful behavior, creative impulses, flexibility, a sense of moral value, and ability to set expectations for others. Technology tends to fragment or compartmentalize knowledge and skills while stressing a depth of knowledge. Humanistic approaches usually cut through technical barriers, when it is possible, and seek to achieve a broad integrated perspective for the individual.

We must be extremely careful with the technical knowledge we have developed. "To be an engineer and nothing but an engineer means to be potentially everything and actually nothing" (31). As an example, Vannevar Bush, the initial Chairman of the National Defense Research Committee during World War II published a book in 1946 titled Endless Horizons, giving an extremely optimistic view of atomic power. He said, "The atom should be at useful constructive work for us within ten years"(32). Twenty-one years later Bush published another book titled Science Is Not Enough, and he emphasized that humans must be concerned with the welfare of others (33). This shift from "endless horizons" with science to "science is not enough" represents to some degree caution and concern by an eminent scientist. It has been said that "The aim of life is to structure an architecture within the soul" (34). For many technologists, the aim of life is to structure an architecture around the soul.

Reading specialists must be humanistic in approach with a scientific understanding and indoctrination to research and applied clinical methods. It is only through an intense study and examination of technical methods that we come to understand their uses and limitations. In a somewhat balanced and harmonious way, scientific and humanistic concerns must come together in the reading laboratory to promote reason, understanding, and self-respect.

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