USE OF BRAIN FUNCTION CONCEPTS BY SOCIAL STUDIES TEACHERS

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The School of Graduate Studies
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Doctor of Education

by
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USE OF BRAIN FUNCTION CONCEPTS BY SOCIAL STUDIES TEACHERS

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USE OF BRAIN FUNCTION CONCEPTS BY SOCIAL STUDIES TEACHERS

An abstract of a Dissertation by
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The problem. The basic problem examined in the study was the degree to which selected brain-function concepts had been applied to teaching techniques by Des Moines area secondary social studies teachers who responded to an opinionnaire. There were three primary questions: (1) How aware were respondent teachers of the selected concepts? (2) Did the respondent teachers believe the concepts were applicable to social studies teaching techniques? and (3) To what extent had teaching techniques compatible with these concepts been implemented by respondent teachers?

Procedure. The study was conducted as a non-experimental research project. The opinionnaire was distributed to all secondary social studies teachers in the Des Moines, West Des Moines and Urbandale, Iowa, public schools. Nine brain-function concepts were selected for the survey after an extensive review of relevant literature and an assumption of appropriateness to social studies teaching techniques. The concepts were: The Triune Brain, Functional Organization, Brain Growth Spurts, Neuro-chemical Processes, Functional Integration, The Split-Brain, Learning Style Preferences, Visual Thinking and the Proster Model. The opinionnaire asked teachers to respond to questions on a four-part scale which indicated their current state of awareness, acceptance and application of the selected concepts in their classrooms. An arbitrary point value was assigned to each response and the data then analyzed descriptively using several sub-group and total group comparisons.

Findings and Conclusions. The findings are summarized in three statements: (1) The respondent teachers were largely unaware of the selected brain function concepts, (2) teachers who were aware of the concepts tended to believe that these concepts were applicable to social studies teaching strategies, and (3) the concepts had been implemented by few respondent teachers to a very high degree.

Much work remains to be done on brain function, but the favorable response of teachers who are aware of brain function concepts indicates that the effort would be well worth while.
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CHAPTER ONE

Introduction

In recent years there has been a growing interest on the part of researchers and the general public on functions of the human brain. This interest has been manifested in numerous research projects, books, magazine articles, journal articles, television specials and discussions on radio programs. The result of this activity has been the emergence of a large number of new or revised concepts on how the human brain actually functions and how this determines human behavior. This topic is, or should be, of paramount interest to educators. Teachers, dealing as they do with human behavior, should have a vital interest in brain function.

But do they? Numerous critics have long charged that American educators are very conservative and slow to adopt new methodologies. Leslie Hart asserted that educators' ignorance of brain function allows them to adopt practices that are not only unsuited to good learning conditions, but actually produce counterproductive fear and stress.¹ Carl

Sagan has also been a persistent critic of educators' failure to utilize knowledge of the brain to improve the state of education. Sagan called American schools "repressive" and alleged that many important brain functions are ignored by the educational system.\(^1\) R. Buckminster Fuller also expressed a concern that the American educational system has not fully exploited the potential of whole brain function.\(^2\)

Within the educational community there have been charges that important brain functions have been ignored. Arthur Foshay observed that the intuitive mode of thinking has been extensively overlooked by educators.\(^3\) This charge was echoed by Robert Samples in the same volume which contained Foshay's most pointed criticism.\(^4\) Michael Grady reiterated these charges and encouraged schools to develop


"an integrated and balanced perspective toward consciousness."\(^1\)

The charge that teachers are not utilizing recent knowledge concerning the functions of the brain has come from many quarters in addition to those cited. Some of the criticisms are mild, while others are quite harsh. Although generalized studies and surveys indicate a conservative stance by teachers in the area of instructional practice, no study had been conducted among Des Moines area teachers which specifically surveyed these teacher's attitudes and awareness of brain research. No study had been conducted which traced the implementation of strategies based on a knowledge of brain function. For these reasons this study was designed and conducted.

The general purpose of the study was to determine whether or not selected concepts of human brain function had been implemented into the teaching techniques and strategies of classroom teachers. The area of social studies was chosen for a test case because the researcher is familiar with the content, having taught social studies for over twenty years. Any subject area or grade level could have been selected. The researcher chose to survey a target population within a narrow range of subject content and teaching situations. The purpose of this

\(^1\)Michael Grady and Emily Luecke, Education and the Brain (Bloomington, Indiana: Phi Delta Kappa Fastbacks, 1978), pp. 36, 39.
strategy was to minimize factors such as subject matter, grade level and location of school which would possibly cause differences in the responses. One might expect special education teachers, art teachers, and chemistry teachers to be interested in different aspects of brain function to differing degrees than social studies teachers for instance. These are the kind of factors the researcher hoped to avoid or minimize. Consequently, subject matter was not intended to be a principal issue. The principal issue was the application of brain-function concepts to classroom techniques by teachers. The first question to be answered was whether or not anyone had applied brain-function concepts to classroom techniques and strategies.

The vehicle chosen was a survey of teachers with similar teaching situations, especially regarding subject matter, grade level and geographic location of the school. Accordingly, an opinionnaire was designed to be answered by secondary social studies teachers in three central Iowa school systems.

Statement of the Problem

The specific problem examined in the study was the degree to which a knowledge of brain function has been translated into teaching practices by social studies teachers in the Des Moines, West Des Moines and Urbandale secondary public schools. The analysis of this question led to the division of the problem into three areas, including:
(1) awareness of concepts, (2) acceptance of the concepts, and (3) implementation of techniques, strategies or activities based on, or compatible with, these concepts.

Three primary questions were investigated:

1. To what extent are Des Moines area public school secondary social studies teachers aware of selected concepts of brain function?

2. Do the teachers who are aware of these concepts believe that they have any applicability to the secondary social studies curriculum?

3. To what extent have teaching strategies, techniques or classroom activities compatible with these concepts been implemented by these teachers?

**Purpose of the Study**

The purpose of the study was to assess and descriptively analyze the present acceptance and inclusion of new brain function concepts by secondary social studies teachers in three central Iowa school districts. Acceptance, for the purpose of this study, meant that a teacher would indicate that they thought the concept was applicable to social studies teaching techniques. Inclusion was interpreted to mean the adoption or implementation of teaching strategies, techniques and classroom activities which were based on or compatible with selected concepts.

The charge that teachers are not even aware of new concepts of brain function, as stated by Hart, Sagan, and others, is a serious one. In an age when America's security, progress and well-being are increasingly based on a well educated and technologically advanced populace, an
antiquated educational system is not acceptable. Therefore, it was first necessary to ascertain whether or not the target social studies teachers were aware of recent developments in the area of brain function research.

Having made a determination of the level of awareness, it would next be necessary to determine whether or not teachers who were aware of a particular concept believed that this concept had any applicability to social studies teaching techniques or strategies. Finally, it was necessary to determine the extent to which strategies compatible with the selected concepts had already become part of the teacher's repertoire of teaching strategies.

With a determination made in the levels of awareness, acceptance and application, it would then be possible to make an assessment of the utilization of brain function concepts based on more substantial evidence than had been heretofore collected. From the implications of the reviewed literature, strategies and activities could be recommended to the teachers which would benefit their classroom practice.
CHAPTER TWO

Description of the Study

Methodology of the Study

The study used a non-experimental research design. An opinionnaire was distributed to all secondary social studies teachers in the Des Moines public schools, West Des Moines public schools and Urbandale public schools. Permission to conduct the study among the target teachers was obtained from the appropriate personnel in each school district. A copy of the opinionnaire and accompanying cover letter are found in the Appendices.

The first task was to select appropriate brain function concepts to be surveyed. Recent books, monographs and journal articles were examined to identify a reasonable number of concepts which were readily available to the professional educator. The researcher relied heavily on professional educational journals, but the popular print media were also surveyed.¹

¹For example, a discussion of various brain function concepts was found in Family Circle, July 21, 1981, pp. 92-93, 102-04; J. C. Penney Forum, Fall-Winter, 1980; Des Moines Register, May 22, 1982, June 11, 1982; Discover, April, 1981, pp. 14-20; Psychology Today, June, 1968, p. 38, and January, 1974, pp. 31, 49; Time, January 14, 1974; Saturday Review, September 25, 1976 and March 5, 1977; and
In addition, two popular books on the subject were relied upon for concepts which would be available to a general readership: *The Dragons of Eden*, by Carl Sagan, and *The Brain: The Last Frontier*, by Richard Restak. Initially, the concern was to identify concepts that were prevalent in educational and popular literature. It was also necessary to limit the number of concepts to keep the opinionnaire from becoming cumbersome. A final requirement, which was largely met by subjective determination by the researcher, was that the concept had to describe some aspect of human brain function which could be applied to instructional practices.

The analysis of the various publications resulted in the selection of nine concepts. Some of the concepts selected were the work of one particular researcher or writer (the "Proster Model," for instance), while others were the result of the work of many individuals. The nine concepts, and an individual closely identified with each are:

1. The Triune Brain Concept (Paul MacLean).

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2 The concepts are discussed at greater length in chapter three.
3. Brain Growth Spurts (Herman Epstein).


5. Functional Integration (Moishe Feldenkrais).

6. The Split-Brain Concept (Roger Sperry).

7. Learning Style Preferences (Rita and Kenneth Dunn).

8. Visual Thinking (Rudolf Arnheim).


The next task was to prepare an opinionnaire to be completed by the target teachers. The format consisted of a brief description of the concept, followed by four choices from which the teacher would select that which best indicated their familiarity with the concept. The "Key to Response Symbols" was explained on the opinionnaire:

a. I am not familiar with this concept.

b. I am familiar with the concept, but do not feel that it has any applicability to secondary social studies teaching techniques or activities.

c. I am familiar with the concept, I feel that it is applicable to secondary social studies teaching strategy, but I do not currently have it in my social studies techniques and activities.

d. I am familiar with the concept, I feel that it is applicable to secondary social studies, it is presently included in my classroom techniques and activities.

The opinionnaire included one additional item concerning an inquiry about the respondent's knowledge of brain function based on general readings, rather than those related to a specific concept. Teachers were asked to respond to this item in the same manner as the other nine.
The opinionnaires were distributed to 135 teachers. Each opinionnaire was accompanied by a cover letter explaining the purpose of the study and an envelope addressed to the researcher. Des Moines teachers returned the opinionnaire by internal mail delivery, West Des Moines Valley High School teachers left them with a teacher at that school, and the remainder were returned by stamped, self-addressed envelopes through the Postal Service. Teachers were assured of their anonymity and of the researcher's interest in group data only. Respondents were promised a summary of the findings when the study was completed.

The opinionnaires were distributed by mid-October, 1982. By the end of November, 1982, a total of seventy-nine had been returned. The researcher then conducted a follow-up study among thirty randomly selected teachers to obtain data from initial non-responders. The researcher encountered a determined resistance and reluctance to respond on the part of many teachers who were contacted. The remainder of the sample replied that they had already returned the opinionnaire. As a result of these findings, a further attempt at data collection would have been futile.

It was also decided to exempt item ten on the opinionnaire from analysis. The respondent's answers to this question, and their marginal comments, indicated that they were confused about the meaning of the item. Since the item did not pertain to a specific concept, it was possible
to ignore these responses without deterring from the analysis in any way.

Definitions

For the purpose of the study, terms were defined as follows:

1. Innovator: A person who has contributed a significant amount of research, study or development of one of the selected concepts of brain function. These are identified in the text and in the opinionnaire.

2. Applicability of a concept: The respondent believes that the concept is relevant to social studies teaching techniques or activities.

3. Concept: Selected ideas of brain function. These are identified in the text and in the opinionnaire.

4. Respondent: A person from one of the target groups who returned a completed opinionnaire.

Other specific or technical definitions are provided in the text or opinionnaire.

Assumptions

The following assumptions were made in the conduct of this study:

1. The selected concepts are applicable to the educational process.
2. The selected concepts are relevant to the social studies curriculum.

3. Teachers consciously choose certain educational models and concepts and can identify them.

4. The awareness level of a selected concept among teachers can be determined by an opinionnaire which includes a four-part Likert-type scale.

5. Teacher's perception of the applicability of a concept can be determined by an opinionnaire with a four-part Likert-type scale.

6. The implementation of the concepts in teaching strategies and activities can be determined by an opinionnaire with a four-part Likert-type scale.

**Description of the Study Sample**

Opinionnaires were sent to all secondary social studies teachers in the public schools of Des Moines (n=95), West Des Moines (n=24) and Urbandale (n=16), Iowa. Respondents were asked to identify themselves only by school district and teaching level. The social studies teachers in these districts tend to be male Caucasian, with a minimum of ten years' teaching experience. Due to retrenchments brought on by declining student populations, few teachers in these three school districts have fewer than ten years' experience in the respective district.
Limitations

The sample population consisted of those social studies teachers in the public secondary schools of Des Moines, Urbandale, and West Des Moines who chose to respond to the opinionnaire. No generalizations were made or are implied beyond this population. The data generated by the opinionnaire may be used for comparative or descriptive purposes for school districts surveyed by using the same opinionnaire. The data may also be used for comparison with future data collected among the same population or among the teachers of the same school districts.
CHAPTER THREE

A Review of Relevant Literature and Research

There has been no survey of brain function awareness conducted among the target social studies teachers. A study was conducted in 1981 by the Department of Evaluation and Research of the Des Moines Independent School District which assessed the social studies teachers' responses to various questions. One hundred nineteen of the 166 teachers completed surveys concerning class time utilization, methods of instruction, areas of emphasis, sources of new ideas, contact with other teachers, testing methods and job stress. This study was similar to a national study conducted between 1978 and 1981 by the Social Science Education Consortium (SSEC), a nation-wide consortium of social studies teachers and curriculum specialists. These two studies, while not specifically paralleling the present study, did provide some interesting related data. The SSEC found that the "dominant methods of instruction in social studies are lecture and discussion/recitation based on textbooks." The SSEC study also revealed that teachers evaluate students

on a "narrow range of variables, primarily low-level cognitive operations." They also found that, although in recent years a significant amount of research on student development and learning had been done, few social studies teachers were aware of, or had been influenced in their teaching strategies, by this research. Finally, the SSEC study indicated that the social studies curriculum in many schools was not basically different from that of fifty years ago.

The results of the Des Moines survey indicated that the teachers who responded to the questionnaire were also most likely to instruct by large group lecture, rated creative thinking and critical thinking skills lower than vocabulary and facts in degree of emphasis, and rated journals and magazines only 3.37 (slightly higher than "somewhat helpful") on a five-point scale. Local college professors (a possible source of new concepts) were rated "of little help." From these two studies, one could conclude that overall awareness of new instructional techniques and ideas have not generally been a high priority among local or national social studies teacher populations.

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1Ibid., p. 10.  
2Ibid.  
3Ibid., p. 12.  
In specific areas of brain function the research is voluminous. Brain hemisphericity, learning styles, and brain growth have all received extensive attention from researchers and writers. There is also a considerable body of research on cognitive processing and brain evolution. A brief review of some of these areas of research revealed the nature and direction of the investigation.

Brain hemisphericity (or brain lateralization, or the Split-brain process) has been especially popular. Beginning in 1968, Robert Samples and Dorothy Curtis conducted an investigation of the effects of "right-brain" and "left-brain" modalities in the teaching of inner city students. The investigation was continued in 1969 under a grant from the National Science Foundation. The findings of this study included three results relevant to cerebral hemispheric functions, as summarized by Samples:

1. When educational environments were created in which the functions of the right hemisphere were enhanced, the students' self-image increased.
2. The performance of skills typically assigned to the left hemisphere also were increased.
3. Students explored greater numbers of content areas and to greater depth than they had in previous experiences.1

Samples also found confirmation of these findings in the work of Jones, Bruner, Lepper, Bateson, Watzlawick and Scott.2

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1Samples, "Toward a Synergy of Mind," p. 117.
2Ibid., pp. 117-18.
Tadanobu Tsunoda conducted experiments in Japan which indicated that hemispheric preference has a strong environmental aspect. His tests showed that Japanese receive a wider range of sounds in the left cerebral hemisphere than people from Western countries do. For the right hemisphere, the situation is reversed. Japanese receive a limited amount of man-made, artificial sounds in comparison to subjects from Western countries. For Japanese living outside Japan, this condition changes after two or three generations, while Korean or American children raised in a total Japanese environment respond the same as Japanese living in Japan. These experiments led Tsunoda to conclude that hemispheric brain function is influenced by environment.¹

Many experiments have been conducted on the effects of split-brain function on individual thinking processes. The experiments of Sperry, Bogen, Gazzaniga, Levy-Agresti and Nebes established the concept of right hemispheric superiority for visual-spatial operations.² The right

¹Gabriel Racle, "Civilizations of the Left Cerebral Hemisphere?" (Ottawa, Canada: Research Report, 1979).

hemisphere was also found to be superior/dominant in the recognition of complex visual patterns through research done by Jerre Levy, Roger Sperry and Colwyn Trevarthen.\(^1\) The left cerebral hemisphere is superior for speech and mathematical operations, word analysis, decoding of written words and other linear-linguistic functions.\(^2\) These findings were not refuted by Day's experimental discovery that the right hemisphere does perform a language-processing function. Rather, Day hypothesized that the left hemisphere achieves dominance by suppressing the language function of the right hemisphere in normal right-handers.\(^3\)

Levy also confirmed hemispheric specialization in a series of experiments conducted with Colwyn Trevarthen. Moreover, the Levy-Trevarthen split-brain experimental results led them to speculate that "perception is an active, constructive process . . . which appears to depend on


constraints imposed by values, knowledge, expectations and intentions.\(^1\)

The original research on the split-brain was conducted on subjects who suffered from nervous disorders, but in recent years these experiments have been applied to normal subjects. One of the most fascinating is the differences in the way males and females process information and use the hemispheric functioning processes. Jerre Levy has also been prominent in this area of study. Related work has been done by Roger Gorski, Deborah Waber, Mark Gurney and others. The research of this group, and the implications were summed up by Jo Durden-Smith who speculated that the findings "may mean that the differences between men and women . . . are also true genetic differences, established in the womb and governed, more or less immutably, by a hormonal inheritance."\(^2\)

There are many other studies being conducted on various aspects of split-brain function, but no clear pattern of practical suggestions has yet emerged on how all of these findings should be translated into classroom

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strategies for teachers.¹

There are some school projects and programs which have shown encouraging results. In addition to the four and one-half year study conducted by Samples and Curtis (see above), Michael Grady identified other programs which produced higher test scores in the basic subjects for students. Grady found that the inclusion of "holistic" studies in the curriculum improved scores in the basic skill areas for students involved in these programs:

1. The "Learn to Read Through the Arts" program, New York City.
2. The Mosswood "Mini-school Program," Oakland, California.
3. The "Interdisciplinary Model Program in Arts for Children and Teachers," Columbus, Ohio.²

King, Dunn and McKenzie reported that student learning improved when individual learning strategies and creative and aesthetic experiences were presented in an informal classroom environment.³

A similar divergence of opinion, terminology and


²Grady, Education and the Brain, pp. 25-26.

recommendations for teacher behavior exists in the area of learning style preference. Rita Dunn and Thomas De Bello surveyed the different definitions of learning style and the recommendations offered by researchers. Although they found differences, they emphasized the "widespread agreement" for the "existence of individual differences."¹ In their survey of learning style research, Dunn and De Bello considered the work of Canfield and Lafferty, Dunn and Dunn, Gregorc, Hunt, Kolb, Schmack, Hill, Price, Ramirez and Castenada. The conclusion of Dunn and De Bello was that much more research is needed before a unified set of recommendations can emerge.² There is, however, some evidence of learning style accommodation in programs already in operation. Kenneth Dunn noted the Madison Prep experiment in New York City as a program that resulted in higher reading and mathematics scores, as well as improved attitudes and attendance, for the students involved.³ Rita Dunn and Marie Carbo cited research which was conducted on a wide age-range of students which concluded that students perform better when taught through their modality strengths,


²Ibid.

that students are capable of identifying their own strengths, and that younger children learn better through visual modalities.¹

Some work has been done in alternative modes of consciousness, especially by Richard Jones. Drawing heavily on the thoughts of Michael Polanyi, Jones has attempted to use dreams and the "Metaphorical idiom" in the classroom. Jones found this experiment fruitful, but decried the situation in the schools:

Curricula continue to be developed that give seriously short shrift to the private, subjective, subsidiary, assimilative, presentational, divergent, metaphorical ways of knowing, in contrast with their often exclusive emphasis on the public, objective, focal, accommodative, discursive, convergent, literal ways of knowing. Teachers continue to be trained away from their good impulses to redress the imbalance through their own artistry, by means of which any curriculum could be honestly and interestingly taught. What we need, in order to turn this corner, is not more terms for the two basic kinds of consciousness, but more knowledge of how they interact in the achievement of specific kinds of learning objectives and more knowledge of the psychological conditions conducive to these various kinds of interaction.²

Among researchers there are considerable differences in terminology, interpretation and recommendation for action. Most of the studies cited a need for more research, more


analysis of the results of research already completed, and caution about making premature evaluations. All of the researchers, however, agreed that the research of brain function is a fertile, important field of study, which will bring dramatic revisions in the way people teach.

A Review of Literature Pertaining to the Selected Concepts

This section is a summary of the literature extant which pertains to the nine selected concepts related to brain function. This summary is not intended to be comprehensive, but merely to provide a general background on the specialized literature and research which is available for each concept.

The Triune Brain

The development of this concept is almost exclusively due to the efforts of Paul MacLean, Director of the Laboratory of Brain Evolution and Behavior at the National Institute of Mental Health, Bethesda, Maryland. The concept has been popularized most energetically by Leslie Hart in his book, How the Brain Works, and in numerous journal articles.¹ MacLean's thesis is that the human brain is actually a triune brain or "three-brains-in-one." He says that the evolutionary process resulted in the human brain containing vestiges of ancestral brains. Thus humans have

¹Hart, How the Brain Works, pp. 41-58.
a "reptilian brain" and an "old mammalian brain" encased in the same cavity as a modern "neo-cortex" or human brain. Because of the workings of the evolutionary process, organisms tend to retain vestiges of previous functioning units as long as their existence does not interfere with new functioning units or functioning of the total organism.

Because of this evolutionary process, the human brain retained two units which previously functioned in a somewhat different way for Man's ancestors. MacLean named these two units the "R-Complex" and the "limbic system." These brains exist simultaneously with the modern neo-cortex.

The R-Complex, or Reptilian Brain, is the oldest and most survival-oriented. It is located in the lower, central part of the human brain and includes the brain stem, part of the mid-brain, and some other structures. This primitive reptilian brain, MacLean believes, serves some of the same functions that were provided by the total brain of our reptilian ancestors. This brain programs the most essential survival behaviors: mating, foraging, hunting, homing, breeding, formation of social groups, and so on. MacLean and his co-workers have, in fact, identified twenty-four "primal patterns of behavior" which they believe are

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programmed by the R-complex. MacLean and his colleagues compiled this list after thousands of observations of lizard behavior. MacLean has speculated that the human manifestations of these behaviors are ritualism, awe for authority, social pecking orders, territorial prerogatives and certain types of intraspecific aggression.¹

While evidence of these behaviors being programmed in the R-Complex in humans is still incomplete, MacLean's research shows a definite localization of the control of the behaviors in the brains of lizards and squirrel monkeys. The experimental technique is to destroy part of the brain and then observe subsequent behavior of the subject. Of course, this research cannot be done on humans. Thus, much of the human evidence has come from a study of persons who incurred brain injury in warfare, in accidents, or in diseased patients who have had their brains surgically altered. These subjects do not offer a completely desirable experimental situation, but there is evidence of ritualized "reptilian" behavior which has a "localized" control center in the human brain.²

Surrounding this "R-Complex" (and hence the name) is a structure, or group of structures, which MacLean called


the "limbic system." This was developed at a later evolu-
tionary stage in paleomammalian animals. The function of
this "old mammalian" brain was to add programs not found in
the reptilian brain. These programs are reflected in the
behavior of humans, mirroring new behaviors emerging with
the early mammals. The principal addition brought by
these new programs was in the area of emotions. Reptiles
are considered to be devoid of the emotions exhibited by
mammals. With some exceptions, reptiles show little indi-
cation of love, hate, remorse, or even parenting. Brain
scientists, on the other hand, have linked the limbic
system to certain emotion-connected hormones, emotional
drives, temperature control, reward and punishment and rudi-
mentary memory functions.1 One of the primary functions of
this brain is to cope with new situations. As MacLean put
it, "Clinical and experimental findings of the past forty
years indicate that the limbic brain derives information
in terms of emotional feelings that guide behavior required
for self-preservation and the preservation of the species."2
Survival is still a major function, but it is achieved
through different brain processes. MacLean explained the


differences between the brains in this fashion:

. . . Instead of explaining experience in
terms of compulsion, as was implied in consider-
ing the reptilian brain (R-complex), or in terms
of abstract thoughts, as was presumed in the case
of the cerebral hemispheres, the mentation of the
limbic system would appear to involve a process
whereby information is encoded in terms of emo-
tional feelings that influence its decisions and
its course of action.1

Much of the evidence associated with the function of the
limbic system in humans has come from the clinical study
of epileptics. Birth trauma, accidental injury or infection
can affect the limbic system, affecting in turn the emo-
tions of the subject. The clinical findings on patients
with such disorders indicate "vivid emotional feelings"
and strong convictions which may or may not be true. The
patient may also have difficulty in experiencing personal
identity or in remembering specific events.2

The last "brain" which functions inside the human
cranium is the human brain, the neo-cortex, or, as MacLean
labeled it, the "New Mammalian" brain. This is the
"thinking brain." In reptiles this structure is virtually
non-existent. In most mammals it is very small. In humans
this brain surrounds and dominates the other structures.
Scientists have linked speech, memory, spatial perception,
anticipation of the future, and other "human" powers, with

1Restak, The Brain, p. 68.
regions of the neo-cortex. Clearly, humans possess thinking powers which are far in advance of all other forms of life on earth. Humans also have, along with porpoises, the largest ratio of neo-cortex-to-body weight on the planet. Our intelligent and human behavior stems from the operation of the cells of this new brain, in conjunction with the two older brains. As MacLean put it, when a human lies down on a couch they are, allegorically speaking, lying down beside a crocodile and a horse. Normally these three brains function in harmony, but under stress or fear the brain may "down-shift" to the old mammalian brain or the reptilian brain, which are both more geared for survival.

Functional Organization (the Aggressive Brain)

Alexander R. Luria was, for many years, Professor of Psychology at Moscow University. He is known, among brain researchers, as one of the pioneers of neuropsychology. Luria, conducting research on Soviet soldiers who suffered brain injuries during World War II, developed a theory of the organizational nature of human thinking. This theory, though different in form, is compatible with MacLean's findings. The key to understanding Luria is his use of the


\[2\] MacLean, as quoted by Hart, How the Brain Works, p. 125.

\[3\] Hart, How the Brain Works, pp. 59-68.
term "function." By function he meant what a particular group of tissues does. Thus he was really speaking of a functional system.\(^1\) In dealing with functional systems, Luria was able to avoid the trap of localizing a function too narrowly. While it is possible to speak of the function of the liver as the secretion of bile, Luria believed that other processes are too complex for such a simple description. The function of digestion, for instance, involves many different tissues. In the same way, the functions of the brain involve many complex interactions of many different tissues.\(^2\)

In this manner, Luria described three functional systems of the human brain. The three units are: (a) a waking or tone regulating unit, (b) a unit for obtaining, processing and storing information from the outside world, and (c) a unit for programming, regulating and verifying mental activity.\(^3\) These functional units are compatible with MacLean's theory of the triune brain since the first unit is generalized within the brain stem (MacLean's Reptilian brain), while the other two units are localized in the neocortex. The third unit, located in the frontal lobes of


\(^2\) Ibid., pp. 27-28.

\(^3\) Ibid., p. 43.
the neo-cortex, is the most "human" unit. According to Luria, this unit "creates intentions, forms plans and programmes of [human] actions, inspects their performance, and regulates [human] behavior so that it conforms to these plans and programmes. . ." The human then "verifies his conscious activity, comparing the effects of his actions with the original intentions and correcting any mistakes he has made." Luria's concept of this third unit or functioning system in the brain has led to a radical reappraisal of brain function. As recently as forty years ago, the human brain was generally thought of as being an apparatus for reacting to stimuli arriving from the outside world or reacting to the responses to stimuli which had already formed in the brain. Thus the brain was thought of as constantly responding to past experience. The human brain was thought to be a passive system or, at best, a reactive system. Indeed, some psychologists still think of the brain in this way. Luria, however, devised his theory that the third functioning unit of the brain aggressively seeks information and formulates plans. In Luria's words:

It has become abundantly clear that human behavior is active in character, that it is determined not only by past experiences, but also by plans and designs formulating the future.

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1Ibid., pp. 79-80.

2Ibid., p. 80.
and that the human brain is a remarkable apparatus which cannot only create these models of the future, but also subordinate its behavior to them. It has become evident at the same time that recognition of the decisive role played by such plans and designs, these schemes of the future and the programmes by which they are materialized, cannot be allowed to remain outside the sphere of scientific knowledge, and that the mechanisms on which they are based can and must be the subject of deterministic analysis and scientific explanation, like all other phenomena and associations in the objective world.\(^1\)

**Brain Growth Spurts**

This concept, first introduced by Alfred North Whitehead more than fifty years ago, has been given new impetus by the studies of Herman Epstein.\(^2\) Epstein's evaluation of pertinent research has led to a new theory about the relationship of brain growth to mental development. Epstein noted that the formation of brain cells ends before the second year of life in humans.

The brain, however, continues to grow. The best evidence is that this brain growth occurs "in the form of (a) more extended and branched axons and dendrites of brain cells, (b) the laying down of the fatty insulation (mylenin sheath) of axons, and (c) increased input of energy and materials through an increase in arterial blood supply to

\(^1\)Ibid., pp. 13-14.

the brain.\textsuperscript{1} More importantly, to Epstein's theory, is the nature of the growth of the brain. The brain grows more rapidly at certain times ("spurts") and less rapidly at other times ("plateaus"). These brain spurts occur, within "western" cultures, between the ages of three to ten months, two to four years, six to eight, ten to twelve, and fourteen to seventeen years. Furthermore, Epstein alleged, these stages "correlate well in timing with stages found in mental growth.\textsuperscript{2} The importance of Epstein's analysis for education is his belief that humans learn new material more readily during growth spurts and less readily during growth plateaus.

**Neuro-chemical Processes in the Brain**

The brain contains millions of nerve cells (neurons) which transmit and receive impulses both along their bodies and across minute gaps (synapses) by some electro-chemical process and thus, in possible conjunction with proteins such as RNA, are responsible for intelligent behavior. Intelligent behavior, in this case, means any activity directed by this neuro-chemical process. The basics of neuro-chemical process have been understood since the 1880's. This initial understanding was furthered by the

\textsuperscript{1}Ibid., p. 343.

\textsuperscript{2}Ibid., p. 344.
discoveries of Ramon y Cajal at the beginning of the present century. The number of these micro-circuits and "switching elements" may be directly related to intelligence. What has not been precisely established is exactly how this process works and how it directs behavior. Even such recent and authoritative works as Gordon Shepherd's The Synaptic Organization of the Brain allude to the tremendous amount of research which remains to be done on the subject.

Grigorii Izrailevich Poliakov summarized the position of one school of neuroscientists in the following manner:

The progressive development of reflex activity--caused by effects of dynamic conditions of life specific for the self-organizing biological system of the animal type--begins with the ability of the organism to effect coordinating responses to stimuli, i.e., responses regulated in space and time and being of an adaptable character. . . . the coordinating mechanism . . . is the morphophysiological basis of all vitally important autoregulations taking place inside the organism and appearing in its reactions to external stimuli in the process of constant adjustment to environmental changes.

The basic biological task of these central nervous formations is the realization of afferent syntheses inside the actual receptor sphere of the organism. This causes the formation of the necessary anatomical-physiological prerequisites for the realization of qualitatively higher forms of reprocessing of the total number of impulses entering the central nervous system, qualitatively superior to those of which the coordinating system


2 Shepherd, p. 339; Sagan, Dragons, p. 46.

3 Shepherd, pp. 5-6, 387.
is capable. This process is responsible for producing programs of response reactions ensuring an active adaptation to combinations of rapidly and diversely changing impulse stimuli. In other words, something comes in and something goes out and intelligent behavior results. The greater the number of such interactions of which the system is capable, the more intelligent the process.

Of growing interest to educators, social scientists and medical personnel is the relationship between the neurochemical process and the way neuro-transmitters are affected by diet and drugs. Researchers at the National Institute of Mental Health, especially Frederick Goodwin, have found evidence that persons who have committed suicide or have suicidal tendencies have defects in the way their brain uses serotonin. Serotonin, a chemical found in many places in the body, is one of the neurotransmitters which carries impulses across the synapses. The researchers hope to not only find the chemical cause of such tendencies, but to isolate drugs which will correct these tendencies.²

There is also a popular diet book on the market which links the development of "positive" neurotransmitters to regular diet. The thesis is that certain foods promote the formation of "positive" neurotransmitters, which chemically

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²Des Moines Register, June 11, 1982.
enhance mood and relieve stress, while other foods contribute to stress and gloomy moods.¹

Diet and drugs may not only have previously unpredictable effects on behavior, but their manufacture, use and control have more than passing importance for social scientists. If suicidal tendencies are linked to chemical defects in the brain, and if diet is linked to mood and behavior in neuro-chemical ways, what happens to theories of social responsibilities in the commission of crimes and other acts? The answer to this and other questions about behavior is not readily apparent, but the possible implications for educators should be clear.

Functional Integration: The Inter-relationship Between Body and Mind

Functional integration is a technique for body education. It consists of a repetition of numerous tiny movements. Through this technique Feldenkrais claims to have helped invalids, athletes, and other people, function at a higher level of physical proficiency. The exercises which accompany this technique are intended to duplicate the slow process of tiny "adjustments" by which the adult human has learned to respond to the environment. This is necessary because the human, unlike other animals, is born with so little programmed behavior. In humans, Feldenkrais

wrote,

... the brain grows and forms while he adjusts himself to life. The parts of the nervous system that develop after birth are connected with voluntary action, muscular or otherwise, and the actual motor patterns of the cortex are formed and deeply influenced by the actual individual experience. The human motor cortex is therefore unique in its reactions and no two of them are identical.¹

Feldenkrais continued by saying that the "weaknesses of instinctive patterns of doing in man, and the long period of growth of the voluntary innervations, are mostly responsible for the infinite ways of doing of the most fundamental and the most simple acts."² The total human response, Feldenkrais alleged, is tied up in these tiny adjustments which the body makes to the environment:

Abstract thinking is possible only in conjunction with a special configuration or pattern, or state of the body. The whole nervous system, therefore, participates in every act; whether it is easily observable or not is only a matter of knowing what and how to observe.³

The Split Brain (Hemisphericity)

The most significant research on the split brain has been conducted by Nobel Prize winner Roger Sperry of the California Institute of Technology. This concept has become increasingly fashionable for discussion in the educational field. In its most popularly stated form it is


²Ibid.

known as "left-brain" and "right-brain" thinking. It stems from an examination of the functions of the two halves of the neo-cortex. The neo-cortex or cerebrum is divided into two halves, a left and a right, connected by the corpus callosum. Each half also has extensive connections with other parts of the nervous system. The split-brain concept basically asserts that these two halves function separately and in usually different ways. Aside from considerations of localization of such functions as speech and motor control, the two hemispheres seem to adopt very different thought processes. Psychiatrists and psychologists had noted that persons who were injured on just one side of the neo-cortex exhibited certain behavioral characteristics, but little experimental evidence existed before the 1960's. At that time Joseph Bogen, a neurosurgeon, surgically separated the hemispheres of sixteen patients who suffered from severe epileptic seizures. The corpus callosum, which connects the two hemispheres of the neo-cortex, was cut in an attempt to confine the seizures to one hemisphere. It was then possible for Sperry to study these patients and experiment with each hemisphere independently. By blocking one eye and flashing images to only one part of the subject's field of vision, Sperry was able to test the function and perception of just one hemisphere. This was possible because half of each eye transmits to one side of the neo-cortex and the other half to the opposite hemisphere.
Since the corpus callosum had been severed in these patients, the hemispheres could not exchange information as happened in a normal brain. Sperry's studies confirmed what was already suspected about the brain: That the hemispheres, in many persons, have different thinking modalities. Michael Grady summarized the Sperry-Bogen theory in stating that the left hemisphere mode specializes in sequential, linear, analytic operations, while the right hemisphere mode includes holistic, spatial, intuitive operations.¹ Speech functions and mathematical operations are confined to the left hemisphere for most people, for instance.

Grady elaborated on the basic tenets of this concept:

... the two dominant modes of consciousness are the right hemispheric (simultaneous) and the left hemispheric (linear) processing systems. Functions of the modes are activities associated with one of the two. For example, reading, writing, and arithmetic are among the functions of the left hemispheric mode that utilize the linear/sequential processing system. Art, visual media, and metaphors are functions of the holistic right hemispheric mode of consciousness.²

Grady continued by pointing out that although the two modes have existed side by side throughout the history of mankind, the analytical (left hemisphere mode) process "continues to be the most respected process used by the intellectual community in dealing with the world."³

¹Grady, Education and the Brain, p. 10.
²Ibid.
³Ibid., p. 11.
implications of this situation, according to Grady are:

Problems with population, pollution, energy, ecology and medicine are the result of the linear thought processes. Solutions to these problems are continually advocated but are usually linear, piecemeal answers. Only parts of the problems are solved, not complete ones, and often more problems are created by the solutions. For example, man-made energy users, created to make life easier and more comfortable, have begun to exhaust our natural resources.  

The right hemispheric or holistic mode, by focusing on general relationships, may be more suited to solving complex problems. "Western culture in recent times has turned further away from holistic consciousness and in their schooling modes," said Grady, and should "develop and encourage an integrated and balanced perspective toward consciousness and schooling." Educators could well profit from examining these historical trends noted by Grady and the impact it has had on modern behavior.

Learning Style Preference

This concept has, like the split-brain concept, become very popular as a source for research, discussion and innovation in American public education. The concept is neither as esoteric nor as speculative as some of the others, and the practical applications seem to come more readily to mind for educators. There are, however, wide differences among researchers in the way they define "learning style"

1Ibid.  2Ibid., p. 12.
and wide differences in their recommendations. All agree that each student does have a unique way of learning (learning style) and that educators must accommodate these learner differences if each student is to learn most effectively. Most learning style researchers define the factors of learning style in two broad categories. Dorothy Davis and Phyllis Chiasson Schwimmer refer to these two categories as "processing systems" and "input/output factors."¹ Anthony Gregorc used different terms: (1) Distinctive behaviors, and (2) How a person learns from and adapts to environment.² Ramirez and Castaneda used "field independence/sensitivity" and "cultural differences."³ Rita Dunn and Thomas De Bello compared the models and terms used by different researchers in an article in Educational Leadership. While pointing out the differences which existed, Dunn and De Bello stated categorically: "We can no longer afford to assume that all students will learn through whichever strategy the teacher prefers to use."⁴ James Keefe emphasized the importance of learning style research to educators:

⁴Ibid.
Learning style diagnosis opens the door to placing individualized instruction on a more rational basis. It gives the most powerful leverage yet available to educators to analyze, motivate, and assist students in school. As such, it is the foundation of a truly modern approach to education.¹

Kenneth Dunn pointed to the success of the Madison Prep (an alternative school in New York City) innovation as evidence that the use of learning style accommodation can have remarkable results even with students who had been designated as the "twenty 'worst' youngsters at Junior High 22." Despite this disturbing epithet, the progress of these students was deemed "astonishing." Some of the students gained "two to four years in reading and mathematics in a ten-month period."²

Davis and Schwimmer said:

Learning about learning styles won't alone solve the problems in education but once educators begin to recognize learning style as a way of organizing the world [italics mine], it will become possible to provide appropriate settings for all students without disrupting the entire educational system.³

A knowledge of learning style differences, even in the embryonic state of the research, should alert social studies teachers to the fact that each learner constructs an


³ Davis and Schwimmer, "Style," p. 376.
impression of the world "out there" in highly individualistic ways. Environment, culture, cognitive styles and preferences are different and unique for each individual. A knowledge of how those factors work is important for understanding, not only each individual, but the social systems constructed by groups of individuals.

**Visual Thinking**

Rudolf Arnheim is the father of the school of "visual thinking." Arnheim alleged that the way people perceive images and process them in the brain is intimately intertwined with the cognitive process. He theorized that the dichotomy of intelligence (thinking) and perceiving (seeing) was a false one. He said:

... A review of what was known about perception, and especially about sight, made me realize that the remarkable mechanisms by which the senses understand the environment are all but identical with the operations described by the psychology of thinking. Inversely, there was much evidence that truly productive thinking in whatever area of cognition takes place in the realm of imagery.\(^1\)

Arnheim found many applications of his theory in the area of social studies, particularly in the way the images of the past, present and future interact in the mind. He said:

... perception cannot be confined to what the eyes record of the outer world. A perceptual act is never isolated; it is only the most recent phase of a stream of innumerable similar acts,

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performed in the past and surviving in memory. . . . Similarly, the experiences of the present, stored and amalgamated with the yield of the past, precondition the percepts of the future.¹

In summarizing his position, Arnheim said:

. . . The mind, reaching far beyond the stimuli received by the eyes directly and momentarily, operates with the vast range of imagery available through memory and organizes a total lifetime's experience into a system of visual concepts. The thought mechanisms by which the mind manipulates these concepts operate in direct perception, but also in the interaction between direct perception and stored experience, as well as in the imagination of the artist, the scientist, and indeed any person handling problems "in his head."²

A similar thought was expressed by Caleb Gattegno who said that man, in becoming aware of the dynamic nature of the mind

. . . is finding means of replacing the technique of looking behind his back at his past by looking at what he needs to do with himself to permit the future to act upon both the past and the present so that these gain significance and meaning for the process of living.³

The implications for education, and the social sciences that Gattegno perceived (and envisioned) were that utilization of the knowledge of visual thinking would "give every adult what ignorance and preconceptions have prevented him from acquiring during his education, a power to think quickly and correctly in a complex way on complex things."⁴

¹Ibid., p. 80. ²Ibid., p. 294.
⁴Ibid., p. 163.
The Proster Model

This model is uniquely and singularly the work of the fertile mind of Leslie Hart. There are many "computer" models for how the brain works, both digital and analogical, and nearly all of Hart's theory stems from the research of others. Nonetheless, this particular way of looking at the brain is Hart's own creation.

There are two assumptions, based on research findings, upon which Hart based his model:

1. Humans operate by programs. [Humans] do not sit waiting for stimuli to move us to action, but carry out goal-oriented plans by means of learned sequences of action. Our capacity to deal with the world increases as we build and store huge numbers of programs. . . .

2. The brain is by nature a subtle, flexible computer that detects and recognizes patterns by noting similarities and differences. . . . Pattern recognition tells us what programs to use, from those we have stored.1

Hart called these program structures "prosters." The process involves a two-step pattern in Hart's concept. The first step is "choosing, from an existing repertoire, a program that best seems to fit the observed situation." Then the human puts the selected program into effect.2

No program, no action. Each human, drawing on different


2Hart, How the Brain Works, p. 71.
experiences, creates a distinct and unique set of prosters. Because of this, Hart alleged, the students in a classroom all are in the same "setting," but each of the students would be in a different "situation."¹

The natural way for the brain to function, Hart theorized, was to search through these programs and select the appropriate one (or ones) which suit the "situation" each person is in. Traditional education, in Hart's estimation, by stressing "rote" learning and creating threatening conditions does not allow this natural process to work.²

Summary

The past fifteen to twenty years have been the setting for an increased interest in research on the human brain. New advances in technology, as well as novel ways of conceptualizing brain function, have resulted in a tremendous burgeoning of the information available about the brain. These new concepts and the new information available have caused some people to challenge the way educators have attempted to transmit knowledge and learning to students. The field of neuropsychology, and related schools of educational practice, is in its infancy. New material is emerging all of the time. Not all of the new concepts could be covered in a study such as this. The

¹Ibid., p. 88.
limited number of concepts presented here are those selected for the survey. It is believed that the selected concepts represent a fair cross-section of the research that has been conducted and that the foregoing capsule descriptions captured the essence of the voluminous efforts of the researchers.
A total of 135 opinionnaires were sent to the target teachers. Seventy-nine (58.5 percent) were returned. Fifty-six of the ninety-five Des Moines teachers returned opinionnaires (58.9 percent) and twenty-three of the forty suburban teachers responded (57.5 percent). The respondents were organized into four basic subgroups: Des Moines senior high school teachers (thirty-three), Des Moines junior high school teachers (twenty-three), suburban senior high school teachers (twelve), and suburban junior high school teachers (eleven). The respondents had four choices for each of the nine concepts. An arbitrary point value was assigned to each response:

<table>
<thead>
<tr>
<th>Response Code</th>
<th>Summary of Meaning</th>
<th>Assigned Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Not aware of the concept</td>
<td>1</td>
</tr>
<tr>
<td>b.</td>
<td>Aware, but reject applicability</td>
<td>2</td>
</tr>
<tr>
<td>c.</td>
<td>Accept, but haven't implemented</td>
<td>3</td>
</tr>
<tr>
<td>d.</td>
<td>Have implemented strategies</td>
<td>4</td>
</tr>
</tbody>
</table>

A response mean of 1.00 on any concept or combination of concepts was considered to be a least favorable response, a mean score of 2.50 was considered to be neutral, and a mean score of 4.00 was considered to be the most favorable.
response in terms of acceptance of a concept or implementation of activities and techniques related to a concept.

For additional purposes of analysis, the individual and group means were interpreted in the following manner:

<table>
<thead>
<tr>
<th>Mean</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00-1.49</td>
<td>Not aware of the concept(s).</td>
</tr>
<tr>
<td>1.50-2.49</td>
<td>Aware of the concepts, but reject applicability to the social studies strategies.</td>
</tr>
<tr>
<td>2.50</td>
<td>Neutral response.</td>
</tr>
<tr>
<td>2.51-3.49</td>
<td>Aware of the concept(s), but have not implemented.</td>
</tr>
<tr>
<td>3.50-4.00</td>
<td>Have implemented techniques based on the concept(s).</td>
</tr>
</tbody>
</table>

When this scale was used as a basis for analysis (Table 1), it was observed that only thirteen out of fifty possible group means were higher than the 2.50 neutral point. In Table 2, the means were arranged in descending value, which further indicated the positioning of the scores when evaluated on the basis of the pre-determined scale.

When the responses were plotted on a line graph (Figure 1), a similarity of the pattern of the responses of the four basic subgroups was observed. This similarity of pattern did not negate the sometimes considerable difference in level of response between subgroups. There was, nevertheless, a consistency of variation in the responses by subgroups to the various concepts (i.e., a concept which was scored low by one group tended to be scored lower by
Table 1  
A Comparison of Mean Response Scores by Subgroups

<table>
<thead>
<tr>
<th>Concept</th>
<th>DSM Senior</th>
<th>DSM Junior</th>
<th>Suburb. Senior</th>
<th>Suburb. Junior</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triune</td>
<td>1.45</td>
<td>1.61</td>
<td>1.58</td>
<td>1.64</td>
<td>1.54</td>
</tr>
<tr>
<td>Luria</td>
<td>1.33</td>
<td>1.74</td>
<td>2.25</td>
<td>1.27</td>
<td>1.58</td>
</tr>
<tr>
<td>Spurts</td>
<td>1.97</td>
<td>2.70</td>
<td>2.50</td>
<td>2.45</td>
<td>2.33</td>
</tr>
<tr>
<td>Neuro-Chem</td>
<td>2.55</td>
<td>2.26</td>
<td>2.83</td>
<td>3.09</td>
<td>2.58</td>
</tr>
<tr>
<td>Feldenkrais</td>
<td>1.42</td>
<td>1.43</td>
<td>1.83</td>
<td>1.00</td>
<td>1.43</td>
</tr>
<tr>
<td>Split-brain</td>
<td>2.21</td>
<td>2.22</td>
<td>3.08</td>
<td>2.82</td>
<td>2.43</td>
</tr>
<tr>
<td>Learning Style</td>
<td>2.67</td>
<td>3.39</td>
<td>3.83</td>
<td>3.63</td>
<td>3.19</td>
</tr>
<tr>
<td>Visual Thinking</td>
<td>1.55</td>
<td>1.52</td>
<td>2.08</td>
<td>1.81</td>
<td>1.66</td>
</tr>
<tr>
<td>Proster Model</td>
<td>1.55</td>
<td>1.65</td>
<td>1.50</td>
<td>1.00</td>
<td>1.49</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>1.86</strong></td>
<td><strong>2.06</strong></td>
<td><strong>2.39</strong></td>
<td><strong>2.08</strong></td>
<td><strong>2.03</strong></td>
</tr>
</tbody>
</table>
A Comparison of Subgroup Response Means in Descending Order

<table>
<thead>
<tr>
<th>Concept</th>
<th>Suburb Junior</th>
<th>Suburb Senior</th>
<th>DSM Junior</th>
<th>DSM Senior</th>
<th>Average of All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn Style</td>
<td>3.33</td>
<td>3.63</td>
<td>3.39</td>
<td>2.67</td>
<td>3.19</td>
</tr>
<tr>
<td>Neuro-Chem</td>
<td>2.83</td>
<td>3.09</td>
<td>2.26</td>
<td>2.55</td>
<td>2.58</td>
</tr>
<tr>
<td>Split-brain</td>
<td>3.08</td>
<td>2.82</td>
<td>2.22</td>
<td>2.21</td>
<td>2.43</td>
</tr>
<tr>
<td>Growth Spurts</td>
<td>2.50</td>
<td>2.45</td>
<td>2.70</td>
<td>1.97</td>
<td>2.33</td>
</tr>
<tr>
<td>Visual Thinking</td>
<td>2.08</td>
<td>1.81</td>
<td>1.52</td>
<td>1.55</td>
<td>1.66</td>
</tr>
<tr>
<td>Luria</td>
<td>2.25</td>
<td>1.27</td>
<td>1.74</td>
<td>1.33</td>
<td>1.58</td>
</tr>
<tr>
<td>Triune Brain</td>
<td>1.58</td>
<td>1.64</td>
<td>1.61</td>
<td>1.45</td>
<td>1.54</td>
</tr>
<tr>
<td>Proster Model</td>
<td>1.50</td>
<td>1.00</td>
<td>1.65</td>
<td>1.55</td>
<td>1.49</td>
</tr>
<tr>
<td>Feldenkrais</td>
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<td>1.00</td>
<td>1.43</td>
<td>1.42</td>
<td>1.43</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>2.39</strong></td>
<td><strong>2.08</strong></td>
<td><strong>2.06</strong></td>
<td><strong>1.86</strong></td>
<td><strong>2.03</strong></td>
</tr>
</tbody>
</table>
Figure 1

A Comparison of Subgroup Means by Concept
others and vice versa). In general, Des Moines senior high school respondents scored toward the "less favorable" end of the scale and suburban senior high respondents scored highest on the scale. A consideration of the mean responses to each concept, taken in the order in which they appeared on the opinionnaire, revealed these differences more pointedly.

For each of the concepts additional groupings were made to compare all suburban respondents with Des Moines schools respondents and senior high respondents with junior high respondents. The first concept surveyed was the "Triune Brain" (Table 3). All response means were lower than the 2.50 neutral point, with the highest mean being the 1.64 recorded by suburban junior high respondents. The mean response of all respondents (1.54) was also very near the bottom of the scale. It would appear that respondent teachers were generally unaware of the concept of the "Triune Brain." The graph of the responses (Figure 2) also illustrates the preponderance of "A" responses.

The second concept was Alexander Luria's "Functional Organization." When the subgroup means were compared the results were very similar to the responses to the "Triune Brain" (Table 4, Figure 3). None of the response means exceeded the neutral point of 2.50, and only the response means of suburban senior high teachers (2.25) even remotely approached the neutral point. Fifty-one of the respondents
Table 3
Mean Responses to the "Triune Brain" Concept

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Response Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM Senior High</td>
<td>33</td>
<td>1.45</td>
<td>0.79</td>
</tr>
<tr>
<td>DSM Junior High</td>
<td>23</td>
<td>1.61</td>
<td>0.92</td>
</tr>
<tr>
<td>Suburb. Senior High</td>
<td>12</td>
<td>1.58</td>
<td>0.90</td>
</tr>
<tr>
<td>Suburb. Junior High</td>
<td>11</td>
<td>1.64</td>
<td>1.07</td>
</tr>
<tr>
<td>All Des Moines</td>
<td>56</td>
<td>1.52</td>
<td>0.85</td>
</tr>
<tr>
<td>All Suburban</td>
<td>23</td>
<td>1.61</td>
<td>0.99</td>
</tr>
<tr>
<td>All Senior High</td>
<td>45</td>
<td>1.49</td>
<td>0.82</td>
</tr>
<tr>
<td>All Junior High</td>
<td>34</td>
<td>1.62</td>
<td>0.99</td>
</tr>
<tr>
<td>All Respondents</td>
<td>79</td>
<td>1.54</td>
<td>0.89</td>
</tr>
</tbody>
</table>

Response Code

<table>
<thead>
<tr>
<th>Code</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>a(1)</td>
<td>(53) (67.1%)</td>
</tr>
<tr>
<td>b(2)</td>
<td>(13) (16.5%)</td>
</tr>
<tr>
<td>c(3)</td>
<td>(9) (11.4%)</td>
</tr>
<tr>
<td>d(4)</td>
<td>(4) (05.1%)</td>
</tr>
</tbody>
</table>

Mean 1.54  
Median 1.25  
Mode 1.00  
Skewness 1.494

Figure 2
Graph of Triune Brain Responses by Response Code
Table 4
Mean Responses to Luria's "Functional Organization" Concept

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Response Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM Senior High</td>
<td>33</td>
<td>1.33</td>
<td>0.69</td>
</tr>
<tr>
<td>DSM Junior High</td>
<td>23</td>
<td>1.74</td>
<td>0.92</td>
</tr>
<tr>
<td>Suburban Senior High</td>
<td>12</td>
<td>2.25</td>
<td>1.29</td>
</tr>
<tr>
<td>Suburban Junior High</td>
<td>11</td>
<td>1.27</td>
<td>0.65</td>
</tr>
<tr>
<td>All Des Moines</td>
<td>56</td>
<td>1.50</td>
<td>0.81</td>
</tr>
<tr>
<td>All Suburban</td>
<td>23</td>
<td>1.78</td>
<td>1.13</td>
</tr>
<tr>
<td>All Senior High</td>
<td>45</td>
<td>1.58</td>
<td>0.97</td>
</tr>
<tr>
<td>All Junior High</td>
<td>34</td>
<td>1.59</td>
<td>0.86</td>
</tr>
<tr>
<td>All Respondents</td>
<td>79</td>
<td>1.58</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Response Code | Percent of Total |
---------------|------------------|
\(a(1)\)      | (64.6\%)         |
\(b(2)\)      | (19.0\%)         |
\(c(3)\)      | Mean 1.58, Median 1.28, Mode 1.00, Skewness 1.454 (10.1\%) |
\(d(4)\)      | (06.3\%)         |

Figure 3
Graph of "Functional Organization" by Response Code
had not heard of the concept (64.6 percent).

The third item surveyed was the concept of "Brain Growth Spurts." Marginal comments indicated that some respondents equated this concept with Piaget's developmental stages. Although these two concepts attempt to explain the same behavior, it would be a mistake to assume that a knowledge of Piaget's theories would automatically lead to an understanding of Epstein's concept. The responses to the concept of "Brain Growth Spurts" (Table 5, Figure 4) may have been somewhat elevated by the association respondents made with Piaget's concepts. This did not necessarily guarantee acceptance. Only two group means exceeded the 2.50 neutral point. These were Des Moines Junior High (2.70) and all junior high (2.62). The suburban senior high respondents equalled the neutral point (2.50). The response mean for all subjects was higher than the two preceding concepts (2.33) but was still well below the midpoint.

The fourth category, "Neuro-Chemical Processes," was more favorably accepted by the subjects than the preceding three (Table 6, Figure 5). The grand mean for all respondents was above the neutral point (2.58) and more than half of the respondents (44 to 55.7 percent) marked a "c" or "d" response. Suburban teachers scored especially high on this concept (2.96 combined), but Des Moines respondent's scores were still well below the midpoint (2.43 combined). Although the responses did not indicate wide implementation, the concept could be observed as having moderate acceptance.
Table 5
Mean Responses to "Brain Growth Spurts"

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM Senior High</td>
<td>33</td>
<td>1.97</td>
<td>1.02</td>
</tr>
<tr>
<td>DSM Junior High</td>
<td>23</td>
<td>2.70</td>
<td>1.26</td>
</tr>
<tr>
<td>Suburban Senior High</td>
<td>12</td>
<td>2.50</td>
<td>1.31</td>
</tr>
<tr>
<td>Suburban Junior High</td>
<td>11</td>
<td>2.45</td>
<td>1.13</td>
</tr>
<tr>
<td>All Des Moines</td>
<td>56</td>
<td>2.27</td>
<td>1.17</td>
</tr>
<tr>
<td>All Suburban</td>
<td>23</td>
<td>2.48</td>
<td>1.20</td>
</tr>
<tr>
<td>All Senior High</td>
<td>45</td>
<td>2.11</td>
<td>1.11</td>
</tr>
<tr>
<td>All Junior High</td>
<td>34</td>
<td>2.62</td>
<td>1.21</td>
</tr>
<tr>
<td>All Respondents</td>
<td>79</td>
<td>2.33</td>
<td>1.17</td>
</tr>
</tbody>
</table>

Response Code                  | Percent of Total |
--------------------------------|------------------|
a(1)                           | (36.7%)          |
|-------------------------------|------------------|
b(2)                           | (13.9%)          |
c(3)                           | (29.1%)          |
d(4)                           | (20.3%)          |

Figure 4
Graph of "Brain Growth Spurts" by Response Code
Table 6
Mean Responses to "Neuro-Chemical Processes"

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Response Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM Senior High</td>
<td>33</td>
<td>2.55</td>
<td>0.94</td>
</tr>
<tr>
<td>DSM Junior High</td>
<td>23</td>
<td>2.26</td>
<td>1.14</td>
</tr>
<tr>
<td>Suburban Senior High</td>
<td>12</td>
<td>2.83</td>
<td>0.94</td>
</tr>
<tr>
<td>Suburban Junior High</td>
<td>11</td>
<td>3.09</td>
<td>0.83</td>
</tr>
<tr>
<td>All Des Moines</td>
<td>56</td>
<td>2.43</td>
<td>1.02</td>
</tr>
<tr>
<td>All Suburban</td>
<td>23</td>
<td>2.96</td>
<td>0.86</td>
</tr>
<tr>
<td>All Senior High</td>
<td>45</td>
<td>2.62</td>
<td>0.94</td>
</tr>
<tr>
<td>All Junior High</td>
<td>34</td>
<td>2.53</td>
<td>1.11</td>
</tr>
<tr>
<td>All Respondents</td>
<td>79</td>
<td>2.58</td>
<td>1.01</td>
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Response Code

<table>
<thead>
<tr>
<th>Code</th>
<th>Percent of Total</th>
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<tbody>
<tr>
<td>a(1)</td>
<td>Mean 2.58</td>
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<tr>
<td></td>
<td>Median 2.66</td>
</tr>
<tr>
<td>b(2)</td>
<td>Mode 3.00</td>
</tr>
<tr>
<td></td>
<td>Skewness -0.154</td>
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<tr>
<td>c(3)</td>
<td></td>
</tr>
<tr>
<td>d(4)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 5
Graph of "Neuro-Chemical Processes" by Response Code
The fifth concept, "Functional Integration" (Moshe Feldenkrais), was unknown to fifty-nine of the seventy-nine respondents (74.7 percent). The mean response in no case exceeded 1.83, and the grand mean response was only 1.43 (Table 7, Figure 6). This concept was observed to be unknown to the respondents as a group.

The sixth concept, the "Split-Brain," was known to sixty-eight of the seventy-nine respondents (86.1%). This was not surprising, considering the extensive publicity this concept has received in both popular and professional publications. What was surprising was the fact that thirty-two of the respondents rejected the applicability of the "Split-Brain" concept to social studies teaching techniques or activities. Furthermore, a majority of all respondents (43 - 54.4 percent) either had not heard of the concept or rejected its applicability. In addition, the mean response of all subjects (2.43) was still below the neutral point (Table 8, Figure 7).

The seventh question concerned the concept of "Learning Styles." This widely publicized concept, which has been in vogue for some time, was observed to have the highest "acceptance" level of any of the concepts which were surveyed (3.19). All group responses were above the 2.50 "neutral" point (Table 9, Figure 8). All suburban teachers who responded indicated that they had already implemented this concept (mean score 3.74) in their classroom activities.
Table 7
Mean Responses to Feldenkrais' "Functional Integration"

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Response Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1.42</td>
<td>0.83</td>
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<tr>
<td>DSM Junior High</td>
<td>23</td>
<td>1.43</td>
<td>0.90</td>
</tr>
<tr>
<td>Suburban Senior High</td>
<td>12</td>
<td>1.83</td>
<td>1.11</td>
</tr>
<tr>
<td>Suburban Junior High</td>
<td>11</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td>All Des Moines</td>
<td>56</td>
<td>1.43</td>
<td>0.85</td>
</tr>
<tr>
<td>All Suburban</td>
<td>23</td>
<td>1.43</td>
<td>0.90</td>
</tr>
<tr>
<td>All Senior High</td>
<td>45</td>
<td>1.53</td>
<td>0.92</td>
</tr>
<tr>
<td>All Junior High</td>
<td>34</td>
<td>1.29</td>
<td>0.76</td>
</tr>
<tr>
<td>All Respondents</td>
<td>79</td>
<td>1.43</td>
<td>0.86</td>
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</table>

Response Code

<table>
<thead>
<tr>
<th>Code</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>a(1)</td>
<td>(59) (74.7%)</td>
</tr>
<tr>
<td>b(2)</td>
<td>(11) (13.9%)</td>
</tr>
<tr>
<td>c(3)</td>
<td>Mean 1.43</td>
</tr>
<tr>
<td></td>
<td>Median 1.17</td>
</tr>
<tr>
<td></td>
<td>Mode 1.00</td>
</tr>
<tr>
<td>d(4)</td>
<td>Skewness 2.04</td>
</tr>
<tr>
<td></td>
<td>(5) (06.3%)</td>
</tr>
</tbody>
</table>

Figure 6
Graph of "Functional Integration" by Response Code
Table 8
Mean Responses to the "Split Brain" Concept

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Response Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM Senior High</td>
<td>33</td>
<td>2.21</td>
<td>0.74</td>
</tr>
<tr>
<td>DSM Junior High</td>
<td>23</td>
<td>2.22</td>
<td>0.95</td>
</tr>
<tr>
<td>Suburban Senior High</td>
<td>12</td>
<td>3.08</td>
<td>0.90</td>
</tr>
<tr>
<td>Suburban Junior High</td>
<td>11</td>
<td>2.82</td>
<td>0.60</td>
</tr>
<tr>
<td>All Des Moines</td>
<td>56</td>
<td>2.21</td>
<td>0.82</td>
</tr>
<tr>
<td>All Suburban</td>
<td>23</td>
<td>2.96</td>
<td>0.77</td>
</tr>
<tr>
<td>All Senior High</td>
<td>45</td>
<td>2.44</td>
<td>0.87</td>
</tr>
<tr>
<td>All Junior High</td>
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<td>2.41</td>
<td>0.89</td>
</tr>
<tr>
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<td>2.43</td>
<td>0.87</td>
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</table>

Response Code

<table>
<thead>
<tr>
<th>Code</th>
<th>Frequency</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>a(1)</td>
<td>(11)</td>
<td>(13.9%)</td>
</tr>
<tr>
<td>b(2)</td>
<td>(32)</td>
<td>(40.5%)</td>
</tr>
<tr>
<td>c(3)</td>
<td>(27)</td>
<td>(34.2%)</td>
</tr>
<tr>
<td>d(4)</td>
<td>(9)</td>
<td>(11.4%)</td>
</tr>
</tbody>
</table>

Mean 2.43
Median 2.39
Mode 2.00
Skewness 0.100

Figure 7
Graph of "Split-Brain" by Response Code
Table 9
Mean Responses to "Learning Styles"

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM Senior High</td>
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<td>2.67</td>
<td>1.22</td>
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<tr>
<td>DSM Junior High</td>
<td>23</td>
<td>3.39</td>
<td>0.99</td>
</tr>
<tr>
<td>Suburban Senior High</td>
<td>12</td>
<td>3.83</td>
<td>0.39</td>
</tr>
<tr>
<td>Suburban Junior High</td>
<td>11</td>
<td>3.64</td>
<td>0.92</td>
</tr>
<tr>
<td>All Des Moines</td>
<td>56</td>
<td>2.96</td>
<td>1.18</td>
</tr>
<tr>
<td>All Suburban</td>
<td>23</td>
<td>3.74</td>
<td>0.69</td>
</tr>
<tr>
<td>All Senior High</td>
<td>45</td>
<td>2.98</td>
<td>1.18</td>
</tr>
<tr>
<td>All Junior High</td>
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<td>3.47</td>
<td>0.96</td>
</tr>
<tr>
<td>All Respondents</td>
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<td>3.19</td>
<td>1.11</td>
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</table>

Response Code

<table>
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<th>Code</th>
<th>Percent of Total</th>
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</thead>
<tbody>
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<td>Mean 3.19</td>
</tr>
<tr>
<td></td>
<td>Median 3.62</td>
</tr>
<tr>
<td>b(2)</td>
<td>Mode 4.00</td>
</tr>
<tr>
<td></td>
<td>Skewness -1.079</td>
</tr>
<tr>
<td>c(3)</td>
<td></td>
</tr>
<tr>
<td>d(4)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 8
Graph of "Learning Styles" by Response Code
and teaching techniques. This concept was observed to be accepted and generally implemented by respondent teachers. There was nonetheless a high percentage of teachers who indicated that they had never heard of the concept (12 - 15.2%), while six who had heard of it rejected its applicability to the social studies (7.6%).

Concepts eight and nine, "Visual Thinking" and the "Proster Model" were both observed to be basically unknown to respondent teachers (Tables 10 and 11). It appears that the books and numerous journal articles by and about Leslie Hart and Rudolf Arnheim have not served to proselytize Des Moines area respondents.

A similar pattern is evident when the responses are plotted out on Figures 9 and 10.

The final analysis of group means was applied to the total scores of each individual as a cumulative total response to all nine concepts. Thus each individual had a maximum cumulative score of thirty-six points (4x9) and a minimum score of nine (1x9). These cumulative means (see Table 12) were used to make gross comparisons between each subgroup. Again, the suburban senior high respondents scored highest and the Des Moines senior high respondents scored the lowest. The junior high subgroups were nearly identical.

The comparison of the cumulative scores for the various subgroups led to the observation that the mean scores of Des Moines senior high respondents were substantially lower
Table 10
Mean Responses to "Visual Thinking"

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Response Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM Senior High</td>
<td>33</td>
<td>1.55</td>
<td>1.00</td>
</tr>
<tr>
<td>DSM Junior High</td>
<td>23</td>
<td>1.52</td>
<td>0.99</td>
</tr>
<tr>
<td>Suburban Senior High</td>
<td>12</td>
<td>2.08</td>
<td>1.38</td>
</tr>
<tr>
<td>Suburban Junior High</td>
<td>11</td>
<td>1.82</td>
<td>1.25</td>
</tr>
<tr>
<td>All Des Moines</td>
<td>56</td>
<td>1.54</td>
<td>0.98</td>
</tr>
<tr>
<td>All Suburban</td>
<td>23</td>
<td>1.96</td>
<td>1.27</td>
</tr>
<tr>
<td>All Senior High</td>
<td>45</td>
<td>1.69</td>
<td>1.11</td>
</tr>
<tr>
<td>All Junior High</td>
<td>34</td>
<td>1.62</td>
<td>1.06</td>
</tr>
<tr>
<td>All Respondents</td>
<td>79</td>
<td>1.66</td>
<td>1.10</td>
</tr>
</tbody>
</table>

Response Code | Percent of Total
---|---
a(1) | (55) (69.6%)
b(2) | (6) (07.6%)
c(3) | (8) Mean 1.66
| Median 1.22
| Mode 1.00
| Skewness 1.320 (12.7%)
d(4) | (10) (10.1%)

Figure 9
Graph of "Visual Thinking" by Response Code
### Table 11
Mean Responses to the "Proster Model"

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Response Mean</th>
<th>Standard Deviation</th>
</tr>
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<tbody>
<tr>
<td>DSM Senior High</td>
<td>33</td>
<td>1.55</td>
<td>0.90</td>
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<tr>
<td>DSM Junior High</td>
<td>23</td>
<td>1.65</td>
<td>1.07</td>
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<tr>
<td>Suburban Senior High</td>
<td>12</td>
<td>1.50</td>
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<tr>
<td>Suburban Junior High</td>
<td>11</td>
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<td>0.00</td>
</tr>
<tr>
<td>All Des Moines</td>
<td>56</td>
<td>1.59</td>
<td>0.96</td>
</tr>
<tr>
<td>All Suburban</td>
<td>23</td>
<td>1.26</td>
<td>0.61</td>
</tr>
<tr>
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<td>0.89</td>
</tr>
<tr>
<td>All Junior High</td>
<td>34</td>
<td>1.44</td>
<td>0.91</td>
</tr>
<tr>
<td>All Respondents</td>
<td>79</td>
<td>1.49</td>
<td>0.89</td>
</tr>
</tbody>
</table>

Response Code

<table>
<thead>
<tr>
<th>Code</th>
<th>Frequency</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>a(1)</td>
<td>---------</td>
<td>(56) (70.9%)</td>
</tr>
<tr>
<td>b(2)</td>
<td>---------</td>
<td>(12) (15.2%)</td>
</tr>
<tr>
<td>c(3)</td>
<td>---------</td>
<td>(6) (07.6%)</td>
</tr>
<tr>
<td>d(4)</td>
<td>---------</td>
<td>(5) (06.3%)</td>
</tr>
</tbody>
</table>

**Figure 10**
Graph of "Proster Model" by Response Code
than the other three subgroups. An analysis of the variance (ANOVA) between the Des Moines senior high respondents and the combined scores of the other groups was conducted. Re-grouping in this fashion also made it possible to compare groups of more equal size (n=33, n=46). The means of these two groups met the requirement of homogeneity of variance (Bartlett's - Box F=0.421, p 0.516). Analyzed in this fashion, the means of the two groups were found to be statistically significant beyond the .05 level (see Table 13). Although the requirement of randomness was not met, the difference between the two groups leads to the speculation that a true experimental study might reveal statistically significant differences in the brain research awareness level of Des Moines senior high teachers when compared with sample populations of the other subgroups. 

One additional grouping of the data revealed the distribution of all responses (Table 14) to be strongly weighted toward a lack of awareness of the concepts. Nearly half (47.9%) of all responses indicated lack of knowledge of a particular concept. The data, however, was observed to indicate that a high percentage of those teachers who indicated an awareness of a concept did believe that the concept was applicable. Two hundred forty-four of the 371 responses were marked "c" or "d", while only 127 were marked "b". This would indicate that in a majority (65.8 percent) of the cases in which a concept was known to a
Table 12

Means of Cumulative Scores by Subgroup

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>n</th>
<th>Cumulative Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM Senior High</td>
<td>33</td>
<td>16.70</td>
<td>5.64</td>
</tr>
<tr>
<td>DSM Junior High</td>
<td>23</td>
<td>18.52</td>
<td>5.54</td>
</tr>
<tr>
<td>Suburban Senior High</td>
<td>12</td>
<td>21.50</td>
<td>5.57</td>
</tr>
<tr>
<td>Suburban Junior High</td>
<td>11</td>
<td>18.72</td>
<td>2.57</td>
</tr>
<tr>
<td>All Des Moines</td>
<td>56</td>
<td>17.45</td>
<td>5.62</td>
</tr>
<tr>
<td>All Suburban</td>
<td>23</td>
<td>20.17</td>
<td>4.52</td>
</tr>
<tr>
<td>All Senior High</td>
<td>45</td>
<td>17.98</td>
<td>5.96</td>
</tr>
<tr>
<td>All Junior High</td>
<td>34</td>
<td>18.59</td>
<td>4.74</td>
</tr>
<tr>
<td>All Respondents</td>
<td>79</td>
<td>18.24</td>
<td>5.44</td>
</tr>
</tbody>
</table>

Note: Grand Mean = 18.24; Median = 18.06; Mode = 17.00; Skewness = 0.698

Table 13

Analysis of the Variance Between Cumulative Means of Des Moines Senior High Respondents and the Other Subgroups Combined Mean Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F Ratio</th>
<th>F Prb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>135.0248</td>
<td>135.0248</td>
<td>4.775</td>
<td>0.0319</td>
</tr>
<tr>
<td>Within Groups</td>
<td>77</td>
<td>2177.4043</td>
<td>28.2780</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
<td>2312.4292</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bartlett's Box F=0.421, p=0.516
respondent, it was judged to be applicable to the social studies.

Table 14

Distribution of Total Responses by Response Code

<table>
<thead>
<tr>
<th>Response Code</th>
<th>n</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>340</td>
<td>47.9</td>
</tr>
<tr>
<td>b</td>
<td>127</td>
<td>17.8</td>
</tr>
<tr>
<td>c</td>
<td>129</td>
<td>18.1</td>
</tr>
<tr>
<td>d</td>
<td>115</td>
<td>16.2</td>
</tr>
<tr>
<td>Total</td>
<td>711</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The analysis of the data revealed a similarity of the pattern of responses when plotted on a line graph (Figure 1). Further analysis, however, revealed wide differences between the groups. In general, Des Moines senior high respondents were the least informed and suburban senior high respondents the best informed about the concepts. In the final analysis, however, the respondents were observed to be generally unaware of the selected brain function concepts.
CHAPTER FIVE

Findings

The study sought to answer three primary questions:

1. To what extent are Des Moines area public school secondary social studies teachers aware of selected concepts of brain function?

2. Do the teachers who are aware of these concepts believe that they are applicable to the secondary social studies curriculum?

3. To what extent have teaching strategies, techniques or classroom activities compatible with these concepts been implemented by these teachers?

Interpretation of the statistical analysis led to certain conclusions about the respondents' replies to the questions about the concepts. The conclusions pertaining to each primary question were:

1. The data revealed that the respondent teachers were largely unaware of the selected brain function concepts. Many response means did not rise above the 1.50 "awareness" level. Five of the concepts (Triune Brain, Functional Organization, Functional Integration, Visual Thinking, and the Proster Model) were unknown to a majority of the respondents. In total responses, 340 out of a possible 711 choices (47.9 percent) were "a" responses, indicating that the respondent was "not familiar with the
concept." From the analysis of the data, it was apparent that many respondent teachers did not consider themselves to be familiar with the selected concepts.

2. The answer to the second primary question would be "yes." Teachers who were aware of a concept tended to believe that the concept was applicable to social studies teaching strategies. Two-thirds (65.8 percent) of the teachers who were aware of a concept indicated that they thought it was applicable to their teaching situation.

3. The concepts do not appear to have entered the instructional practice of the respondent teachers. Only a few responses (16.2 percent) indicated that teachers felt they had implemented a particular concept in the form of activities and techniques. Most of these "d" responses were indicated for either learning styles or neuro-chemical processes.

The analysis of the respondent's choices led to the observation that differences did exist between the respondent subgroups. These differences were not as important to the observer as the revelation that the respondents were not, in general, aware of the selected concepts of brain function. Only six respondents indicated that they were aware of all nine concepts, while five individuals indicated that they had not heard of any of the concepts. Of particular interest is the high percentage of respondents who, when aware of a concept, considered it applicable. This would indicate that a lack of awareness was the cause
of the generally low scores rather than a rejection of brain function research as being germaine to the social studies. The lack of awareness on the part of the majority should not obscure the fact that many respondents indicated a high degree of awareness and implementation of the concepts.

Further study might be conducted on a true experimental basis to examine differences between, for instance, age groups, sex, academic background, years of teaching, or other factors on the responses of the surveyed population. The researcher was interested in developing an instrument that could be used to indicate general levels of awareness of the total respondent group. To that end the assembled data and statistics attest.
CHAPTER SIX

Interpretations and Recommendations

Analysis of teacher responses to the opinionnaire used in this study indicated that all of the selected concepts had been applied to teaching techniques by at least a few teachers. The next logical step, in a follow-up to this study, would be to identify those teachers who have successfully applied these concepts in their classroom strategies. Next, the researcher could catalog these strategies. This could eventually be expanded to all subject areas and include additional brain-function concepts. In time, a catalog of appropriate proven strategies could be assembled for all levels and subject areas of teaching.

Ideally, a teacher who wished to activate, or develop, a specific brain function could select a strategy that had proven successful under real classroom conditions and use that strategy with confidence. Until such a comprehensive catalog of strategies can be assembled, the interested reader may want some suggestions for the application of brain-function concepts to teaching techniques.

The literature provides many strategies which are related to brain-function concepts. The bibliography appended to this paper includes publications with many such strategies.
The following strategies for classroom application are suggested by the related literature and research.

**The Triune Brain and Functional Integration**

The Triune Brain research indicates that it is most important to create the proper classroom climate for the human brain to function at optimum levels. For a student to think creatively the brain must be free to function in the best way for each individual. If fear and coercion are present the brain process can be forced into lower modes or regions of the brain. These lower and older regions of the brain work faster and more efficiently for simple survival type decisions (fight or flight) or functions (breathing, adrenal levels, heartbeat). Abstract and creative thinking are not done efficiently, if at all, by these older and more primitive parts or modes. The newest, highest brain (the neo-cortex) does the creative thinking. But this brain, or mode, functions more slowly than the R-complex or limbic system (or lower brain modes) and must be free of stress to do so.

A student needs time and freedom from threat to be able to function at optimum proficiency in the highest brain levels. Creative thinking is less likely to happen if fear and time pressure are present. Leslie Hart's explanation of what he called "downshifting" is essential to understanding this situation.
Hart said that "downshifting means any emotional biasing away from the fullest use of the neocortex and its resources toward reliance on older, cruder portions of the whole brain system." Sudden threat can shift the brain process so low that the subject cannot think abstractly at all. Hart said that a more common problem is from milder threat which consistently impairs the mental performance of large numbers of students. Hart listed many of the forms of threat which can impede intellectual functioning at higher levels. Among them were the following:

1. Separation from parental care and affection.
2. Separation from protectors.
3. Lack of acceptance.
4. A sense of lower group status.
5. Anxiety toward the future.
6. Confinement.
7. Damage to possessions or symbols.
8. Hazard of bodily damage.

Hart detected the presence of all of these inhibiting factors in schools. In order for the student to think at the highest level, Hart suggested that certain conditions must be present in schools. To summarize his position:

1. To think creatively, the student must be allowed and encouraged to function in the highest portions of the brain system.

2. To function in this higher part of the brain system the student needs adequate periods of time.

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1Hart, How the Brain Works, p. 126.

2Ibid., pp. 127-29.

3Ibid., pp. 126-31.
The highest brain parts work slowly and deliberately.

3. To function in these higher parts of the brain the student must be free of threat and fear.

4. In the earliest, formative phases of a project the student needs to be inundated with information. At this time pressure may be exerted to meet deadlines and retain needed data.

5. When the student enters the "creative" phase of a project, threat and time pressure must be alleviated as much as possible.¹

Imagine a hypothetical situation: a teacher has introduced a new topic unit, or subject which eventually will lead to a student paper. In the early phases the student should be literally bombarded with information in various forms of presentations. This phase should continue until the teacher is satisfied that enough information has been provided. Then, in the second phase, the student should work under some pressure (i.e., deadline) to identify a suitable topic for the paper. In the third phase, the student must be allowed time and freedom from threat, so that he/she can create. This requires the removal of threat and time-pressure to the greatest extent possible.

The triune brain research also indicates that timed tests, common in schools, are not performed under optimum conditions of brain performance. The presence of threat from time pressure, possible embarrassment or punishment for

¹Ibid.
poor performance, and long confinement, do not allow students to function at the highest brain levels. Timed tests have a place in the evaluation of low-level thinking, for example in typing or rote-memorized material, but other tests and strategies must be used to evaluate the "whole" child.

Brain-Growth Spurts

The ability of a student to learn new material better at certain times is a matter of interest to all concerned teachers. Epstein identified these "spurt periods" as coming at ages three to ten months, two to four years, six to eight years, ten to twelve years and fourteen to seventeen years. The basic aspects of this phenomenon should be of interest to all educators. Epstein's research suggests that somewhere around age eight to ten, and age twelve to fourteen, students experience growth "plateaus" where the brain does not grow as much as during the "spurt" periods. New learning at these plateau times is more difficult for the "normal" student. Reinforcement of already-learned material should be emphasized over "new" learning. The curriculum should be organized so that new learning is stressed during growth periods and reinforcement stressed during plateau periods.

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1 Epstein, "Growth Spurts During Brain Development," p. 344.
Classroom teachers should be alert for students who are in plateau periods. This should be expected around age eight and again around age thirteen. If such students are having a difficult time learning new concepts, the teacher may have to re-structure the student learning situation to emphasize concepts and material already learned. This, of course would require a greater "individualization" of teaching methods than exists in many classrooms today. Students who are in brain growth plateaus have different learning needs than students who are undergoing brain growth spurts.

Before teachers can properly respond to this growth spurt phenomenon it is necessary to have available accurate means of determining exactly when a student is in a spurt period and when they are in a growth period. This information is not presently available to teachers.

**Neuro-chemical Processes**

Teachers should understand that classroom behavior is related to both long-range and short-range dietary habits. To learn at the optimum level a student (1) must have been properly nourished from conception so that brain development was not permanently inhibited, (2) must continue to receive proper daily nourishment, and (3) must not be inhibited by mood-altering drugs (including prescription drugs) and foods (candy, chocolate). Elementary teachers have noted the
"hyper" tone of a classroom after students intake excessive sweets at Halloween and Easter, but these are just the most overt effects of neuro-chemical factors which affect learning.

Sensitive teachers are always on the alert for students who are improperly nourished, under the influence of drugs, learning disabled, or whose socio-economic situation has contributed to permanent brain deficiency. Sensitive teachers will continue to search for ways to accommodate each student's special needs for learning.

The neuro-chemical processes of the brain include far more aspects than covered in this section, of course. Only some very simplistic and overt aspects are considered. It is possible that educators will some day have the benefits of chemical treatments which can correct some of the chemically-related learning impairments of students. In the meantime, it is important for teachers to recognize the existence of chemically and nutritionally related learning disabilities, both temporary and longer-ranged.

**Functional Integration**

Feldenkrais' work indicates that the human orientation, attitude, and movement in space is intimately related to abstract thinking.¹ When teachers trap students in cramped

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desks in straight rows and columns and keep them that way for nearly an hour there is a profound effect on the thinking process. After years of such bodily restriction, there is a danger that the student's thinking can be similarly restricted.¹ This does not mean that random, unpurposeful movement will inevitably lead to better learning. Purposeful movement can lead to better learning, and has long been used by creative teachers:

1. Group work.
2. Field trips.
4. Simulations.
5. Active role playing.
6. Acting and dramatizations.
7. Discussion groupings.
8. Minimum restriction of purposeful movement in the classroom.
9. Construction projects and other hands-on projects.
10. Classroom duties and chores for students.

These are techniques which have been used for years. The significance of Feldenkrais' work goes beyond these strategies. If teachers understand the relationship between body and mind, they can develop strategies to cope with some persistent student learning problems. For example, many students today have a very difficult time with map reading and other geographic concepts. The real problem does not seem to be their inability to memorize names of places and cities. The real problem seems to be their orientation in space. They cannot visualize where they are

¹Ibid., pp. 113-16.
in relation to the rest of the world. For some students this is merely a developmental stage problem, but for others it is a more fundamental problem of being unable to integrate their physical body and the physical world with their mental processes. Awareness exercises should be incorporated into the school curriculum at all levels. A model for these types of exercises is described by Masters and Houston in *Listening to the Body*.¹ In the exercises utilized by Masters-Houston and Feldenkrais, the subject begins by repeating tiny movements. These movements are associated with visual constructions that the subject is asked to create in the mind. If social studies students could similarly relate their physical body with visual images of the world, their sense of orientation should improve.

**The Split-Brain**

Betty Edwards outlined an entire course of study for using the right hemisphere modality in teaching art. Her book, *Drawing on the Right Side of the Brain*, tells teachers how to enhance creativity in any subject area.² Edwards lists many strategies in great detail and in easily followed

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exercises. Although this work is of primary interest to art teachers, it may be applied to other fields. The chapters dealing with the theory of hemisphericity are recommended for the excellent background they provide. In addition, there are possible applications of some activities to other subject areas. One example is contour drawing, where the artist looks at the subject, but is not allowed to look at the paper on which they are drawing the subject. The purpose is to screen out the critical left hemisphere of the brain with its "verbally-linked" symbols and allow the right hemisphere to operate freely.\(^1\)

A social studies teacher could use the same technique to develop map skills. The student could be asked to draw a contour map of a county, country or continent or other geographic area without looking at the paper on which they are drawing. The right hemisphere, which is more spatially oriented, could then be brought into play in helping the student visualize geographic relationships. Summarized, a suggested strategy would be:

1. Have the student draw a geographic region without looking at a map of the area.

2. As a second exercise, have the student draw the same region again. This time, they may look at a map of the area, but may not look at the paper

\(^1\text{Ibid.}, \text{pp. 82-87.}\)
on which they are drawing.

3. Have the student compare the two maps. How similar are they? How are they different? What was the most difficult part of the task?

4. Have the student draw the map a third time. Again they must draw it without looking at a map. Compare with the first drawing. Has the accuracy, detail, shape, proportion improved?

5. For many students, the third map will be more accurate and detailed than if they looked at a map first, and then drew it immediately afterward.

There are many other strategies which could be used. Michael Grady proposed several techniques in *Education and the Brain*. One such strategy is to have students draw depictions of answers to questions rather than to have them write them out. This technique could be used in science, mathematics, language arts, art and social studies. Another technique would be for the teacher to present the questions in the form of a pictograph, drawing, or photograph. This would require the students to activate the less-used right hemisphere.1 Another strategy suggested by Grady is to have students act out a typical day in an earlier period of history, or to pantomime great historical moments.2 Students

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2Ibid., p. 29.
might also construct masks of important historical, literary, or scientific persons, and read or recite their theories, thoughts or speeches while wearing these masks.

Richard M. Jones offered ten suggestions for the classroom application of the right hemispheric mode:

1. The idiom of metaphor must be used more frequently.
2. The creative thought may come from our weakest or strongest moments.
3. Have the students learn a lot about some Narrow subject, then tackle a difficult subject they know nothing about.
4. Practice interdisciplinary study.
5. Have the students teach what they have learned.
6. Teachers should reward interesting ideas, as well as right responses.
7. Students should be encouraged to personalize knowledge.
8. Reflect the "personal knowledge" they have gained back into "public knowledge."
9. Dreams should be actively used in the teaching process.
10. The teacher should "present the realities of the human condition as they exist and have existed." ¹

Other suggestions are offered in other articles in Beyond the Scientific, edited by Foshay and Morrissett. The entire volume is dedicated to an exploration of ways in which differing modes of thinking can be applied to the classroom.²

Arthur Foshay summarized the conditions necessary for intuitive thinking (right hemisphere mode):

²Foshay and Morrissett, Beyond the Scientific.
1. Provide a rich environment.
2. Have the student practice seeing analogies.
3. Saturate the student with information.
4. Provide the student with occasions for using intuition.¹

For teachers to develop strategies for enhancing both hemispheric modes of thinking they must first understand and accept the concept. After understanding and acceptance are achieved, many strategies are available.

**Learning Style Preferences**

Barbara Fisher advised teachers on how they could best use the concept of learning style preferences to facilitate the learning process:

1. Be aware of the many ways in which people learn.
2. Present every major learning in a variety of modes. Allow students to handle, hear, see, read, do, discuss, etc.
3. If your curriculum requires the use of programmed materials (which are sequenced, require reading, are unemotional and solitary), balance this at other times with more active, hands-on, exciting group activities.
4. Remember that any subject can be taught in an emotionally charged manner. Be excited about what you teach and find ways of communicating this excitement. Know which ideas and situations are inherently interesting to your students and relate them to the lessons to be learned.²

Fisher listed nine different types of learners, each of which has a different learning style:

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In a sense, all of the strategies suggested in this chapter would be useful in accommodating different learning styles. An interested educator must keep abreast of development in this embryonic field through constant review of the professional literature.

**Visual Thinking**

Rudolf Arnheim devoted an entire book to the subject of visual thinking. Many strategies are offered in this work. There are two salient premises which Arnheim proposed concerning visual thinking:

1. Every visual pattern--be it that of a painting, a building, an ornament, a chair--can be considered a proposition which, more or less successfully, makes a declaration about the nature of human existence.
   
   2. If thinking takes place in the realm of images, many of these images must be highly abstract since the mind operates often at high levels of abstraction.

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1. Ibid.
3. Ibid., p. 296.
Pursuant to these premises Arnheim suggested several strategies, among them are the following:

1. Have students depict abstract notions with drawings: Past, Present, Future, Democracy, Good, Bad, Marriage, Youth. Next, have the students provide verbal explanations of the drawings.

2. Have students look at abstract or symbolic images and explain what they mean in their own spoken or written words.

3. Encourage open-ended, unrestricted thought and expression.

4. Have students explain complicated processes without using drawings, diagrams or hand gestures. For instance, have them describe water going down a drain in this fashion.

5. Explore the relationships between words and their meanings. Have the students try to imagine a single word which describes the notion "all the surfaces of a room."

The Proster Model

Leslie Hart is one of the most energetic proponents of "brain-compatible" education. His Proster Model is an attempt to explain human behavior in terms of brain function. In arriving at this model, Hart synthesized the work of many brain researchers. He listed the "laws" which he believes result from Proster theory:

1. Unity: the brain has only one basic organizational form—programs, in prosters, in hierarchies.

2. Availability: since the brain functions by programs, it can function only to the extent that programs, as of the moment, have been established.

\[1\text{Ibid.}, \text{pp. 23-38, 120, 144-48, 152, 244.}\]
3. **Foundation:** all programs must be built on existing programs.

4. **Connection:** sudden increases in mental capacity occur when links are established between two or more proster networks not previously connected.

5. **Rutting:** addressing tends to rut, program selection does not.

6. **Change:** variation in program selection can be effected (a) by changing bias, and (b) by causing abortion.

7. **Threat:** in proportion to perceived threat, downshifting to faster, simpler, and more primitive brain function occurs. As a corollary, the less threat and the more confidence is felt, the more effectively the cortex can be utilized.

8. **Search:** the procedure is effected by (a) providing strong and specific input, (b) disengaging attention, and (c) avoiding threat and time pressure.

9. **Mode:** in proportion to thought process being toward the PAC mode (perception, analysis, choice) and away from SSM mode (symbol selection and manipulation), thinking is faster, more accurate, effortless, and reliable.

10. **Totality:** the brain functions as a whole, its output reflecting total built-in schemata, stored input, and the summing of total biasing.

From these ten laws, Hart derived four applications of Proster Theory to learning:

1. **The child, from the earliest age, must receive "inputs" of quantity and variety. These must be selected by the child.**

2. **When a "program" is being developed, the child needs repetition.**

3. **The process of developing programs is initially very slow.**

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4. The child's programs are built on previous programs, "all learning must be built on previous learning."\(^1\)

Many of these strategies overlap. Hart's applications, for instance, stem from MacLean and Luria's work, as well as his own Proster Theory. Strategies suggested by the split-brain concept are compatible with visual thinking and learning styles. The strategies listed above can never be considered as dogma. Techniques that work for some teachers will not work for other teachers.

Social studies teachers have frequently been accused of being among the most "conventional" and unimaginative members of the teaching profession. The use of strategies and classroom techniques compatible with known concepts of brain function could not only advance social studies teachers to the forefront of progressive educational practice, but could also serve real and immediate needs of students with varied and individual learning styles and preferences. The research indicates that many such techniques are available. The experiences of creative educators such as Kenneth Dunn, Martha King, Betty Edwards, and others, indicates that these techniques have been advanced beyond the theoretical stage to strategies which actually work. The responses to the survey conducted by the researcher indicated that social studies teachers become more willing to accept and apply

\(^1\)Ibid., pp. 195-96.
brain function concepts as their awareness increased. If continued research upholds this preliminary finding, increased awareness should lead to increased acceptance and application. The research was conducted to acquire information which would provide some suggestions for curriculum specialists as to the state of development and interest in instructional techniques which are compatible with the selected concepts. Based on an observation of the collected data and analysis of the data, three suggestions are advanced:

1. Teacher training institutions should expand instruction in the practical application of esoteric brain function concepts to classroom techniques and instructional practices.

2. Social studies curriculum specialists in the public schools should initiate inservice and staff development programs designed to increase awareness among teachers of recent brain function research.

3. Curriculum specialists in the public schools and teacher training institutions should expand research to study ways to apply brain function research to social studies teaching methods and techniques.

The research and development suggested above should not be limited to the selected brain function concepts. The study indicated that the respondent teachers were more likely
to accept concepts (such as learning style) which had been massaged into usable form by curriculum specialists and practitioners. This observation should encourage the continued efforts of specialists to transform esoteric concepts into usable form for classroom practitioners.
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———, March 5, 1977.


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Time, January 14, 1974.

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APPENDIX A

SAMPLE COVER LETTER
Dear

The opinionnaire which is enclosed with this letter is an integral part of a Doctoral research project in Curriculum and Instruction, the College of Education, Drake University. The project is a study of the applicability of current theories and research on human brain function to the social studies classroom.

The purpose of this questionnaire is to a) determine the present state of awareness of Des Moines area social studies teachers in the area of new concepts of brain function, b) to determine the extent to which social studies teachers feel these brain concepts should be incorporated into their teaching techniques and activities, and c) to determine the extent to which these brain concepts have already been incorporated into social studies techniques and activities.

I would appreciate it if you would take a few minutes to respond to the questions on the opinionnaire. Your responses will be kept anonymous. The responses will be reported by category only. No individual responses will be identified in any way. A summary of the results will be sent to you through your social studies supervisor. I appreciate your time and anticipate an early response.

(Des Moines teachers: Please return the opinionnaire through district bag mail. Send to me at Roosevelt High School. Urbandale and West Des Moines teachers: Please return to me at the address indicated on the self-addressed, stamped envelope.)

Sincerely,

Kent Frank
APPENDIX B

SAMPLE OPINIONNAIRE
A SURVEY OF TEACHER AWARENESS OF BRAIN CONCEPTS AND THEIR INCLUSION IN SECONDARY SOCIAL STUDIES TEACHING STRATEGIES AND ACTIVITIES

Over the past fifteen to twenty years new concepts have emerged to rival earlier concepts of how the brain works. The purpose of this opinionnaire is to determine the extent to which social studies teachers are aware of these new concepts and the extent to which they have been incorporated into teaching strategies. Each concept is briefly defined, identified by popular label or labels, and linked to key innovators or popularizers of the concept.

Please respond according to your present awareness and attitude about each brain concept and your present appraisal of the applicability of each concept to the secondary social studies teacher's techniques and activities. This can either be in actual activities or the principles guiding teaching style.

KEY TO RESPONSE SYMBOLS:

a. I am not familiar with this concept.
b. I am familiar with the concept, but do not feel that it has any applicability to secondary social studies teaching techniques or activities.
c. I am familiar with the concept, I feel that it is applicable to the secondary social studies teaching strategy, but I do not currently have it in my social studies techniques and activities.
d. I am familiar with the concept, I feel that it is applicable to secondary social studies, it is presently included in my classroom social studies techniques and activities.

CONCEPTS: Please check the box that best describes your present awareness and attitude toward each concept.

1. The "Triune Brain": The human brain has evolved over millions of years in such a way that humans have "Three brains in one". The most primitive is a survival-oriented reptilian brain, called the R-Complex. Surrounding this oldest brain is the emotional old mammalian brain called the limbic system. Last is the Neo-cortex, the thinking human brain. All three parts operate within the same brain system.

INNOVATOR: Paul MacLean, Director of the Laboratory of Brain Evolution and behavior of the National Institute of Mental Health.
2. **Brain Structure concept, "Functional Organization":** There is a dynamic, active nature to the functional units and zones of operation of the brain. The human brain has three functional units: alertness, information processing, and action. Each of these units has three hierarchial zones distributed over various parts of the brain. In the adult mind, the higher Cortical zones dominate. The interaction between zones and functional units is dynamic.

**INNOVATOR:** Alexander R. Luria, until his death in 1977, Professor of Psychology at Moscow University.

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3. **Brain Growth "Spurts":** The brain grows in "spurts". These spurts occur, in the "normal" pattern, between the ages of birth to ten months, 2-4, 6-8, 10-12, and 14-16. New learning is easier for the child during these "spurt" periods, and relatively more difficult during the non-spurt period.

**INNOVATOR:** Herman Epstein.

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4. **Neuro-Chemical processes:** There are significant effects of the chemical processes within the brain and of the nutritional history of the individual. For example:

1. Chronic, prolonged malnutrition during the first two years of infancy can have serious permanent adverse effects on brain development.
2. Chemical defects in the brain may result in aberrant behavior and mental illness as a result of the way the brain uses serotonin.
3. Everyday diet may influence mood, emotions and emotional disorders.

**INNOVATORS:** Many, but some of the better known ones are:

1. Richard Restak, Author of The Brain: the Last Frontier.
2. Frederick Goodwin, National Institute of Mental Health, and Michael Stanley, Wayne State University (Detroit).

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5. **Functional Integration:** Developed by Moshe Feldenkrais, who believes that the total human response is tied to tiny physical adjustments which the body makes to the environment. "Abstract thinking is possible only in conjunction with a special configuration or pattern, or state of the body. The whole nervous system, therefore, participates in every act; whether it is easily observable or not is only a matter of knowing what and how to observe".*

**INNOVATOR:** Moshe Feldenkrais, author of *Body and Mature Behavior*.

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6. **The "Split Brain", Brain Hemisphericity, or the Left Brain-Right Brain concept:** The human brain has two distinctly different processes which exist simultaneously. One process, sometimes called the left hemisphere process because it appears to be centered in the left hemisphere in most right-handed males, is the center for linear, sequential thinking. The other process, usually referred to as the right-hemisphere process, is the seat of intuitive, holistic modes.

**INNOVATOR:** Roger Sperry, Nobel Prize co-winner for 1981.

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7. **Learning Style Preferences:** Different individuals have different learning styles or combinations of learning styles. If the learning situation accommodates this learning style preference, the student will learn more effectively. **INNOVATORS:** Rita and Kenneth Dunn, Barbara Fischer, others.

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8. The Visual Thinking Model: The ability to see visual shapes as images of the patterns of forces that underlie human existence - the functioning of minds, of bodies or machines, the structure of societies or ideas. Karl Pribram has added a dimension to this model with the concept of the "hologram" as applied to the way the brain thinks and remembers.

INNOVATOR: Rudolf Arnheim, author of Visual Thinking.

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9. The Proster Model: The human brain functions like a binary computer. Brain function is organized into "prosters" (program structures) which control the way humans perceive, recognize, evaluate, remember and think. This concept explains human behavior as a two-step cycle:
1. Choosing, from an existing repertoire, a program which best fits an observed situation.
2. Putting the program into effect (no program, no action).

INNOVATOR: Leslie Hart, author of How the Brain Works, and private educational consultant.

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10. Knowledge of General Information on the Brain: Many people have synthesized current concepts of brain function. A few of these popularizers are listed below. The list is only a sample of the currently popular works in the field. There are many books, articles and monographs on the subject. If you have read anything in the way of a survey of current brain research, you will be able to make an evaluation of the general awareness, or the general applicability of brain function to social science teaching.

SYNTHESIZERS: