CREATIVITY-ENHANCEMENT TECHNIQUES FOR PROFESSIONAL DESIGN STUDENTS: AN INTEGRATED APPROACH

by

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TABLE OF CONTENTS

Page

APPENDICES

LIST OF TABLES

Chapter 1

INTRODUCTION

> "A society that fosters creativity provides its citizens with four basic freedoms—the freedom for study and preparation, the freedom for exploration and inquiry, the freedom of expression, and the freedom to be themselves."
>
> Stein (1975)

Background of the Study

The United States is undergoing an unprecedented transformation. This transformation is the result of sweeping changes occurring in our base of knowledge, economy, attitude toward education, and international competition. Our professions are experiencing dramatic and uprooting adjustments. Included among these are the design professions whose ideas and products influence our way of life. To effectively cope with these changes, traditional problem-solving techniques are being reexamined, and a renewed interest in creativity and innovation is taking place.

Among the most profound of these changes are the following:

1. We are moving from an "industrial society" to an "information society." (Toffler, 1980).

2. Our capital-intensive, physical-resource-based economy is shifting to one that is knowledge-intensive, and human-resource based. (Botkin et al, 1984).
3. Knowledge is expanding at an exponential rate. (Jones, 1980; Raudsepp, 1983).
4. The number of college-educated working Americans has increased significantly. (Lynton, 1982; Kanter, 1983).
5. "Professional" status in our society is now highly regarded, and as a result, academic institutions are under great pressure to modify or establish curricula that cultivate these "professionals." (Harriman, 1984; Huber, 1986).

The impact of these trends can be seen in bookstores lined with publications heralding innovation and creative management techniques. (Ouchi, 1981; LeBeouf, 1982; Peters and Waterman, 1982; Keil, 1985; Naisbitt & Aburdene, 1985; Peters and Austin, 1985; Pinchot, 1985; Leavitt, 1986; Albrecht, 1987; White, 1987; Peters, 1987).

The emphasis on innovation has affected international business vocabularies as well. Expressions such as "Skunkworks" and "Quality Circles" have surfaced—outgrowths of professional organizations fostering creative, problem-solving teamwork. (Quinn, 1979; Torrance, 1982; Wolff, 1987). Harriman (1984) reports that as the trend toward "professional" employees grows, these workers will be directly involved in decision-making processes, will demand more control over company operations, and will be relied on by their employers for their creativity and problem-solving skills. In a recent survey, Kiplinger (1987) concluded that employers in the 1990's will seek employees with "imagination, ingenuity and creativity."

Internationally, countries such as Japan have already recognized and integrated these qualities into their businesses. The Soken Research Institute (1983) reports that a national industrial survey of Japanese companies showed that 68.8 percent of those responding listed creativity as an "especially important characteristic desired in their employees"—the highest percentage of any quality listed. Most companies responding to the survey provided some kind of creativity-development training.

Concerned with international competition, Presidents Kennedy, Carter and Reagan ordered investigations into American policies and procedures regarding the role of government in stimulating innovation and creativity. (Deroche, 1968; Clark, 1980; Botkin, 1986).

In the mid 1960's, a Massachusetts conference examined the engineering profession and focused on how this profession was academically preparing university students in the creative processes of invention and innovation. The conferees discussed the opportunities for encouraging creative activities in engineering schools and the possibilities for developing and supporting creative engineering education.

<u>The conference participants concluded the following:</u>

1. "Invention and innovation are the essence of technological change, which are the business of creative engineering.

2. The art of creative engineering has been orphaned in our engineering schools.

3. The creative requisites of invention and innovation can be taught.

4. Improvement in the climate for creative engineering education requires positive encouragement for faculty and students.

5. Greater cooperation among industry, foundations, professional groups, universities and government is necessary for the development and support of creative engineering education."

(De Simone, 1968; Romualdi, 1983).

The conclusions were clear. Unfortunately, they resulted in little or no broad-based support from academia.

More recently, the national Accreditation Board for Engineering and Technology (ABET) has given increased attention to engineering curricula—particularly the design components of these curricula. In establishing the general criteria for evaluating engineering programs, ABET indicates that the design components should "develop student creativity." (Beaufait, 1986).

Statement of the Problem

The problem addressed in this study can be stated as follows: Is it possible to enhance the creative thinking skills of students, in a professional design curriculum, with twelve-hours of exposure to specific creativity-enhancement materials?

Need for the Research

This research was undertaken for the following reasons:

1. Existing knowledge-based education must be complemented with skill development in creativity and innovation if we wish to (a) find better solutions to increasingly complex problems, (b) remain internationally competitive, and (c) maintain our present standard-of-living.
2. The vast majority of institutions of higher education, including many of those providing professional design degrees, presently provide little formal training in the area of creativity-development.
3. Future employees in the professional design community must be adequately prepared to respond to the rapidly shifting needs of society.

Harman & Rheingold (1984) express deep concern about our future as an industrialized society: "The old solutions and procedures for dealing with ...problems no longer appear to work. Hope seems to lie in beginning to seek new creative solutions, new approaches and breakthroughs for the global dilemmas we now face."

Similarly, Getzels (1975) said: "...whether one is concerned with the timeless dilemmas of individual fulfillment or the existential requirements for social amelioration, with understanding the products of mankind's highest aspirations or the processes of mental functioning in more mundane pursuits, creative thinking is a subject of study of almost unparalleled significance for human welfare."

Discussing the issues raised by Harman, Rheingold and Getzels, Parnes (1975) makes the connection between these issues and the role education can serve. He said: "...a person cannot forsee exactly what knowledge he will need five or ten years from now to meet life's problems. He can, however, develop attitudes and abilities that will help him meet any future challenge creatively by finding better solutions to problems. He learns to associate in new ways the knowledge and experience he possesses, as well as the new knowledge and experience he acquires throughout his education and his life. Thus he becomes better able to apply his learning to problems he meets as he progresses through school and into the future."

Jones (1972) states that in a technological society, the most valuable person will not be the one who has absorbed knowledge and mastered techniques, but one who is creative, inventive, and mentally flexible. He goes on to say that "...to regard education as a means of training the intellect only is old-fashioned; new information about the creative process gives an educational objective which is much richer and more comprehensive."

Gowan et al (1981): "The development of more creative talent in our country is not an education frill, but a central issue in the preservation of our culture. This is a task which educational institutions have thus far shirked in large measure, but it must be firmly addressed in future years if the United States is to retain its position in world affairs."

Focusing on schools preparing future design professionals, Kline (1985) observes that "...For the most part, we do not teach our engineers to innovate or invent. We teach them how to analyze and do research. We do not even give engineering students a clear picture of the importance of invention and innovation; rather most of the time we stress analysis and practice, and for graduate students, research. Nor do we teach engineers...that sociotechnical systems are the physical foundations of all human societies and that innovation in such systems is a part of our evolutionary and cultural heritage."

Harris (1971) expressed that "...engineering education should encourage students to strive for the mastery of fundamentals, the discovery of the relatedness of things, and the cultivation of excellence. But all the while it should also be a creative experience, stimulating the imagination of students and helping them to prepare themselves for the unresolved contests and the new challenges of an imperfect world."

Creativity, once considered a "frill" or "garnish" to the basic educational curriculum, is now seen as the very core of the curriculum itself, and the basis for learning and self-realization. (Isaksen & Parnes, 1985). Further, the longer a person has lived without discovering and turning on his or her inner creative processes, the stronger the prediction that he or she will continue to use only noncreative processes in various functions, while creative potentials remain dormant. (Taylor & Ellison, 1975).

A number of recent studies have investigated the educational process in the United States. Responding to one of the most critical of these studies, A Nation at Risk: The Imperative for Educational Reform, The Education Commission of the States urged American educators to institute curricular reform to include: (1) problem-solving strategies, (2) decision-making on the basis of incomplete information, (3) synthesis, and (4) creativity. (Roberts & Roberts, 1987).

During the same time period as the Nation at Risk study, the Panel on Undergraduate Engineering Education (1986) reviewed education and related cooperative programs for engineering students. They surveyed academic goals and industry goals, and concluded that skills in creativity, creative expression, problem-solving, and originality were major objectives in these goal categories.

Harshly critical of our failure to include creativity training in our educational curricula, Gowan (1977) offered this observation: "We should study creativity directly in high school and university classes. Almost no schools at the present time have courses on this subject. The 21st century will find this lack incomprehensible."

A decade later, in perhaps the most comprehensive study conducted on the subject, McDonough and McDonough (1987) surveyed 1504 four-year accredited colleges and universities to determine how many of these institutions offered formal courses in creativity. Higher education, in their opinion, by its educational franchise, is the primary developer of tomorrow's leaders—and if these leaders are required by circumstances or pressures to exercise creativity in their leadership roles, then colleges and universities should be expected to develop and conduct courses in creativity to respond to this need. Their position holds that by the time many individuals reach college age, they've ceased to be aware of their creative ability—and that the passage of time and the pressures to conform to standards and routines will have obscured its existence. They maintain that by the time students enter college, most need to re-awaken their dormant creative ability and learn new ways to enhance that ability. (Of the 1504 programs surveyed, 1188 or 79 percent responded. In the final tabulation, only 76 programs—6 percent of the respondents—offered formal courses in creativity).

Groch (1969) expresses the academic imperative for formal training in creativity: "...rapid technological progress and accelerating social change require a creative society, better prepared to plan, innovate, and adapt to new circumstances. In the past the privilege of creative enterprise was reserved for a relatively small group of potentially gifted people. We no longer can afford to waste the resources of those who either by birth or other circumstances, are denied the opportunity to develop and contribute their aptitudes..."

In order for design professionals to effectively respond to the rapidly changing issues described herein, it seems academically imperative that institutions of higher education develop course and curriculum strategies to enhance creative-thinking skills.

Research Objective

The primary research objective of this study was to discover if in twelve hours, utilizing specific materials dealing with the subject of creativity, the creative-thinking skills of students enrolled in a professional design curriculum could be measurably enhanced.

Chapter 2

REVIEW OF RELATED LITERATURE

Definitions of Creativity

The expression "creativity" is derived from the Latin creare: to make—and from the Greek krainein: to fulfill. (Young, 1985). A consensual definition of creativity has never been formulated. Contributing to this lack of consensus is the complex criteria used in categorizing the subject. Generally, research on creativity has been grouped into four broad areas: the creative person, process, product, and press. (Rhodes, 1961; Dellas & Gaier, 1970). Many of the early definitions focused on the creative process, based on the notion that anything resulting from this process could be called creative. (Amabile, 1982, 1983a). Despite the emphasis on person and process, most definitions have used the product as the distinguishing sign of creativity.

In a review of twenty-two sources presenting definitions, Welsh (1980) formed a composite definition: "Creativity is the process of generating unique products by transformation of existing products. These products, tangible and intangible, must be unique only to the creator and must meet the criteria of purpose and value established by the creator." (In Isaksen, 1987).

Creativity has also been previously categorized by achievement, ability and attitude. In an extensive review of creativity, intelligence and personality, Barron & Harrington (1981) established two criteria used in bodies of research: (1) creativity as socially recognized achievement in which there are novel products (inventions, theories, buildings, laws, institutions, etc.), and (2) creativity as ability manifested by performance in critical trials (tests, contests, etc. where individuals can be compared on precisely defined scales).

Perkins (1981) states that creativity should be seen as a "trait" made up of five ingredients: abilities, style, values, beliefs and tactics. Kenny (1987) feels that creativity involves dealing with information and experiences in such a way that new perceptions, ideas, relationships, and meanings are generated that result in awarenesses new to the individual and not necessarily new to the world.

The most generally agreed upon definition of creativity is that which involves divergent thinking and the production of unique and useful products.

Donald MacKinnon states that creativity "...involves a response or an idea that is novel or at the very least statistically infrequent" and that "...it must also to some extent be adaptive to reality. It must serve to solve a problem, fit a situation, or accomplish some recognizable goal." (In Taylor 1975).

In a study involving 107 engineers, Sprecher (1959) discovered that "novelty" and "worth of ideas" are important factors in creativity. Stan Gryskiewicz, in his work at the Center for Creative Leadership, interviewed 240 managers in functions such as marketing, research and development. The resulting, composite definition of creativity from these managers is similar to Sprecher's: "Novel ideas that are useful." (Gryskiewicz, 1983; Gordon & Zemke, 1986).

J.P. Guilford expresses reservations about the novelty and worth hypothesis. He feels that from a scientific, psychological point of view, the requirements of novelty and usefulness go too far. He states that "...A science does not deal with social values; it only observes and reports, with resulting reflections and conclusions. It does regard novelty as a key characteristic of creative thinking, but restricts this feature to the thinker's own mental life; the creative idea is one that the thinker never had before; it is new to that person." (Guilford, 1977).

Rosten (1963), taking a broader view, defines creativity as "...a shuttle between fancy and discipline, between imagination and system, between freedom and control, between reverie and evidence, between imagination and analysis." He sees it as "...a counterpoint, a kind of roaring internal dialogue in which one part of the self tries to communicate with other parts of the self, in which the self tries to break the restraints, the conventions, the crippling restrictions of what is proper or reasonable or sensible."

Prince (1970) expresses creativity as seeming contradictions: "...An arbitrary harmony, an expected astonishment... a difficult delight, a predictable gamble...a unifying difference...a miraculous expectation.

Commercial illustrator Bernie Fuchs describes this process as "controlled looseness." (Gangel, 1973). Perkins (1988) compares creativity to a Beethoven symphony which involves the sensitive process of: "...searching and trying out until something shows potential." Meyer (1985) simply defines creativity as "directed intuition."

Recently, hybrid definitions have emerged. The Aluminum Company of America coined the expression "imagineering," which means letting the imagination soar and then engineering it down to earth. (Le Beouf, 1980). Similarly, Parnes (1987) developed the expression "visioneering," which expresses the engineering necessary to translate dreams into reality.

As early as 1900, Theodule Ribot described creativity as a process of association in which mental states become joined together so that one state tends to invoke the other. (Mackler & Shontz, 1965; Taylor, 1975). Mednick (1962), in developing his Remote Associates Test (RAT), sees this as "...the forming of associative elements into new combinations which either meet specified requirements or are in some way useful. The more mutually remote the elements of the new combination, the more creative the process or solution." Koestler (1964) describes a concept called "Bisociation" which he feels underpins every creative process—instead of depending on random associations, creativity should involve the deliberate connecting of two previously unrelated 'matrices of thought' to produce new insights or inventions.

In the associationistic tradition, Rothenberg (1971, 1979) developed a similar view of creativity that describes the tendency of creative people to think in negations, opposites and contraries. He adopted the Roman deity Janus (having two faces and looking two ways at once) and coined the expression "Janusian thinking"—the capacity to conceive and utilize two or more opposite or contradictory ideas, concepts, or images simultaneously.

Paul Torrance (1974a), striving for a global definition of creativity involving the natural human process, describes it as "...a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on: identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies: testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results."

Torrance argues that his definition enables researchers to operationally define the kinds of abilities, mental functioning, and personality characteristics that facilitate or inhibit the process. Further, he feels it "...provides an approach for specifying the kinds of products that result from the process, the kinds of persons who can engage most successfully in the process, and the conditions that facilitate the process."

Stages in the Creative Process

"Creative people have a sense of problem bracketing. That is, they know that when an issue is fundamental but cannot be settled, they must put it aside – bracket it—at least for a while, and concentrate on the work that can be done."
Gardner (1981)

Many investigators have tried to understand the creative process by dividing it into various stages. Physiologist Helmholtz and mathematician Poincare were two of the earliest to attempt this approach. (Arieti, 1976).

Poincare outlines seven stages in the creative experience:

1. The suddenness of the illumination.
2. The insight may occur, and to some extent must occur, against what we have to cling to consciously in our theories.
3. The vividness of the incident and the whole scene that surrounds it.
4. The brevity and conciseness of the insight, along with the experience of immediate certainty.
5. Hard work on the topic prior to the breakthrough.
6. A rest, in which the "unconsciousness work" has been given a chance to proceed on its own and after which the break-through may occur.
7. The necessity of alternating work and relaxation, with the insight often coming at the moment of the break between the two, or at least within the break.

(Cited in May, 1975).

In 1910, American philosopher John Dewey investigated the problem-solving sequence and identifies the following stages:

1. A difficulty is felt.
2. The difficulty is located and defined.

3. Possible solutions are suggested.

4. Consequences of those solutions are considered.

5. A solution is accepted.

(Cited in Guilford, 1977).

One of the earliest theories applied to the creative process, similar to Poincare's and imitated many times since its inception, is Graham Wallas' (1926) four-stage proposal:

1. Preparation: Information is gathered.

2. Incubation: Information is allowed to simmer or ripen.

3. Illumination: Solutions emerge.

4. Verification: Solutions are tested and elaborated.

Wallas studied mostly writers and scientists. (Cited in Arieti, 1976; Guilford, 1977; Harman & Rheingold, 1984).

Alex Osborn (1953), the originator of the "Brainstorming" method, expanded Wallas' model from three to seven stages:

1. Orientation: Pointing up the problem.

2. Preparation: Gathering pertinent data.

3. Analysis: Breaking down the relevant material.

4. Ideation: Piling up alternatives by way of ideas.

5. Incubation: "Letting up," to invite illumination.

6. Synthesis: Putting the pieces together.

7. Verification: Judging the resulting ideas.

Joseph Rossman (1931) studied the creative processes of 710 inventors. Using a questionnaire, he defines the stages in the creative process as follows:

1. Observation of a need or difficulty.
2. Analysis of the need.
3. A survey of all available information.
4. A formulation of all objective solutions.
5. A critical analysis of these solutions for their advantages and disadvantages.
6. The birth of the new idea—the invention.
7. Experimentation to test out the most promising solution, and the selection and perfection of the final embodiment by some or all of the previous steps.

(Cited in Arieti, 1976).

Busse and Mansfield (1980) studied highly creative scientists' self-descriptions of their own work. They focused on scientists with common levels of training and expertise and identified virtually the same stages that Rossman had uncovered fifty years earlier.

William J.J. Gordon (1956), in his studies utilizing analogical methods, advances six themes in what he terms "operational creativity:"

1. Involvement-detachment.
2. Speculation.
3. Deferment.
4. Autonomy.
5. Purposiveness.
6. Use of the commonplace.

Morris Stein (1974), whose main focus is on industrial and scientific examples of creativity, describes four stages which essentially parallel the traditional "scientific method:"

1. Preparation (education).
2. Hypothesis formation.
3. Testing.
4. Communication of results.

Rollo May (1975), suggests that "creativity arises out of the tension between spontaneity and limitations..," and offers the following thoughts regarding stages in the creative act:

1. First, it's an "Encounter."
2. Second, is the "Intensity" of the encounter. (Absorption; being caught up in; wholly involved).
3. Third, is the "process" or "doing" of a person encountering or interrelating with the "world." ("World" is the pattern of meaningful relations in which a person exists and in the design of which he or she participates).
4. Fourth, is the characteristic of this experience when the "insight comes at a moment of transition between work and relaxation."

Characteristics of Creative Individuals

During the 1960's MacKinnon and associates, at the Institute for Personality Assessment and Research (IPAR), studied highly creative architects, writers, mathematicians and research scientists. They discovered characteristics of inventiveness, independence, enthusiasm, individuality and industriousness. Their counterparts, identified as less creative, displayed good character, stressed rationality, virtue and concern for others. Additionally, these studies show the highly creative professionals to be theoretical, aesthetic, intuitive, perceptually open, tolerant of tension related to solving problems, and somewhat introverted. (MacKinnon, 1962, 1964, 1967, 1968, 1978, 1983; Golann, 1963).

Frank Barron, also during the 1960's, analyzed the personal characteristics of architects, scientists, writers and mathematicians. He concludes that they have a preference for complexity, are self-assertive, have complex personalities, are independent in judgment, impulsive and dominant. (Rekdal, 1979).

In an extensive review of 31 studies, Stein (1974) forms the following conclusions regarding creative individuals:

1. An achieving person.
2. Motivated by a need for order.
3. A need for curiosity.
4. Self-assertive, dominant, aggressive, self-sufficient.
5. Rejects repression, less inhibited, less formal, less conventional, bohemianly unconcerned, radical, low on measures of authoritarian values.
6. Persistence of motive, liking and capacity for work, self-discipline, perseverance, high energy-output, thorough.

7. Independent and autonomous.

8. Constructively critical, less contented, dissatisfied.

9. Widely informed, wide ranging interests, versatile.

10. Open to feelings and emotions, feeling is more important than thinking, more subjective, possesses vitality and enthusiasm.

11. Aesthetic in judgment and value orientation.

12. Low in economic values, poor businessperson.

13. Possesses freer expression of what has been described as feminine interests and lack of masculine aggressiveness.

14. Little interest in interpersonal relationships, does not want much social interaction, introverted, lower in social values, reserved.

15. Emotionally unstable but capable of using instability effectively, not well-adjusted by psychological definition but adjusted in the broader sense of being socially useful and happy in work.

16. Sees himself/herself as creative.

17. Intuitive and empathic.

18. Less critical of self.

19. Makes a greater impact on others.

Stein points out that these findings do not characterize any single individual and that no creative individual possesses all of these characteristics—but a creative person will probably possess more of them than does a less creative person.

Glover, et al (1983) developed a list of traits similar to Stein's composite:

1. Strong sense of humor.
2. Self-amusement.
3. Determined.
4. Tolerance for ambiguity.
5. Fantasy life.
6. Unusual problem-solving strategies.
7. Perception of complex relationships.
8. Redefining and elaborating problems.
9. Inventive.

The Creativity-Intelligence Distinction

Creativity is frequently confused with logic, intelligence and "scientific method." The literature reveals the common misconception that in order to be creative, or pursue a career in a field requiring high levels of creativity, a person must possess high or extraordinary intelligence. This thinking might be assumed to include professional designers whose daily tasks involve creative problem-solving activities, and for this reason, it is important to clarify the connection between creativity and intelligence.

Irving Taylor (1959): "Intelligence is very much an invention of Western culture. It selects and stresses the values important to our society, which are revealed in the way we measure intelligence. One will find upon examination that intelligence tests essentially concern themselves with how fast relatively unimportant problems can be solved without making errors—certainly the values of our society."

Judith Groch (1969): "Although it had been suggested as early as 1898, and sporadically thereafter during the next forty years, that the relationship between creativity and intelligence might not be as close as assumed, this view remained buried in the professional journals of psychology." Groch argues that intelligence tests inspect a narrow range of intellectual performance and place heavy emphasis on the ability to recall, to recognize, to solve certain kinds of problems, while ignoring other, equally important aspects of intelligence: discovery, innovation, imagination, and the ability to recognize what is relevant.

In a study investigating creativity and academic achievement, Bentley (1966) adopts the theoretical "Structure-of-Intellect" model advanced by Guilford (1959, 1970). In this model, Guilford proposes five "operations" (cognition, memory, divergent production, convergent production, and evaluation), six "products" (units, classes, relations, systems, transformations, and implications), and four "content" areas (figural, symbolic, semantic, and behavioral). The results of Bentley's study indicate that academic achievement consists of many different abilities, only a few of which are measured by traditional tests, and that "divergent thinking," as outlined by Guilford, contributes favorably to academic success.

Hattie and Rogers (1986) assert that research during the past 20 years has shown that (1) creativity and intelligence are separate aspects of ability, and can be measured as such, and (2) there is a threshold above which creativity and intelligence are distinct and separate attributes.

Getzels and Jackson (1962) pioneered a study demonstrating Hattie and Rogers' first assertion—that a cognitive dimension in students, which could be described as creativity, is separate from general intelligence. Not questioning the value of the I.Q. as a measurement, the study investigated other variables affecting school achievement—variables summarized by the term "creativity." The principal conclusion is that at a fairly high level of intelligence (120 to 130 and above), creativity and intelligence are sufficiently independent to discriminate between the two. (Cited in Jones, 1972).

Getzels and Jackson further demonstrate that "...a group of individuals whose measured creative ability was in the top 20% of their school and whose measured intelligence was in the lower 80% was equivalent in achievement to a group whose measured intelligence was in the top 20% and whose measured creativity was in the lower 80%." (Cicirelli, 1965). Their study also discovered that teachers preferred high I.Q. students over highly creative students, even though these creative students achieved as well scholastically. (Foster, 1968; Ferguson, 1973).

Hattie and Rogers' second assertion—that there is a threshold above which creativity and intelligence are distinct attributes—is corroborated by Yamamoto (1964, 1965). His studies, involving 272 American high school students (1964) and sets of fifth grade students (1965), show that correlations between I.Q. and scores on creativity tests decreased in size as I.Q. increased. Yamamoto's findings are consistent with MacKinnon's conclusions (based on work with architects, creative writers, mathematicians and research workers) that "...a certain degree of intelligence, and in general a rather high degree, is required for creativity but above that point the degree of intelligence does not seem to determine the level of one's creativeness." (Cited in Crockenberg, 1972).

Mansfield and Busse (1981) argue that a high I.Q. does not usually differentiate creative from less creative professionals in the same field, and that a threshold effect seems to operate for I.Q., such that, above a certain level required for mastery of a field, I.Q. is not correlated with creativity.

In a major study involving writers, scientists, architects, engineers and others, the Terman Concept Mastery Test was used to correlate intelligence and creativity. The results indicate that a certain amount of intelligence is required for creativity--but beyond that point, being more or less intelligent is not a crucial determinant of the level of individual creativeness. (MacKinnon, 1961).

Barron (1969) concludes: "...for certain intrinsically creative activities a specifiable minimum I.Q. is probably necessary in order to engage in the activity at all, but that beyond the minimum, which often is surprisingly low, creativity has little correlation with scores on I.Q. tests."

Amabile (1983b) states that at low levels of intelligence there appears to be an almost uniformly low level of creativity and that at high levels of intelligence, all levels of creativity are found.

Rekdal (1977) points out that most evidence of the relationship between intelligence and degrees of creativity support the belief that an average I.Q. is more highly correlated with creative achievement than any other group.

Several studies have shown that beyond an I.Q. of 120, measured intelligence appears to be a negligible factor in creativity. (Barron, 1969; Dellas & Gaier, 1970; Gowan et al, 1981).

In the Wallach and Kogan (1965) study, the results indicate that highly intelligent, but rather non-creative subjects, have a disinclination rather than an inability to use their imagination. Further, subjects are reluctant or fearful of being original, rather than unable to be original. (Cited in Parnes, 1972).

Historical Studies of Creativity

Interest in the subject of creativity can be found in the recorded thoughts of Plato and Aristotle. Plato claimed that the source of creativity was divine, inexplicable and mysterious in nature. Aristotle, insisted that natural laws fully explained the creative process. (Fritz, 1979).

Creativity became an object of scientific study primarily because of the general interest in individual differences—the investigation of which was subsequently divided into three overlapping categories: (1) "genius," (2) "giftedness," and (3) "creativity." (Getzels, 1975).

Scientists Lombroso and Galton postulated that genius and creativity were connected. Lombroso tried to establish a link between genius and pathological disturbance; Galton tried to establish that genius was an inherited capacity. (Rothenberg, 1971).

The study of creativity gained momentum with the early works of Sigmund Freud and Ernst Kris, and the advent of psychoanalysis. Freud describes creative thinking as an "interaction between primary and secondary process thinking." Kris describes it as "involving regression in the service of the ego;" i.e., voluntary relaxation of ego controls. Kris develops his ideas from wide familiarity with art biography, art history, and aesthetic theory—as well as clinical observations. (Rothenberg, 1971; Meichenbaum, 1975).

"In the first half of the twentieth century, creativity research suffered from the assumption that creativity was largely a function of intelligence, definable by the intelligence test. Therefore, creativity received little separate attention. It was presumed that one could cultivate intelligence, but reap creativity. Although reports appeared which suggested that extreme intelligence and creative giftedness were not identical, the ideas was not given serious consideration in the area where such notions count: the schools." (Groch, 1969).

The systematic study of creativity began somewhat recently. J.P. Guilford's Presidential Address to the American Psychological Association in 1950 on the "Structure-of-Intellect-Model," with emphasis given to neglected "divergent thinking abilities" (no set solutions; poorly-defined problems), marked the onset of serious attempts to study creativity separately from intelligence. (Guilford, 1967; Khatena, 1976; Keating, 1980).

In 1952, L.L. Thurstone initiated the investigation of "creative talent," by extracting 20 primary factors from measures of intelligence —concluding that creativity is a distinct cognitive ability. (Glover, et al, 1983). In 1953, Alex Osborn introduced the concept of "brainstorming" to creative problem solving.

Fueled by the writings of Maslow ("the self-actualizing person"), Rogers ("the fully-functioning person"), and other humanistic psychologists, creativity has become an ideal of democratic living and institutions. (Maslow, 1959, 1968; Rogers, 1961).

In the 1960's, creativity as a measurable construct was highly controversial. Debates centered around issues that threatened the hitherto undisputed ascendence of I.Q. Scholarly discussions focused on problems of theoretical rationale, dimensionality, validity, reliability and related issues of testing conditions. (Khatena, 1982).

William J.J. Gordon introduced the analogical "Synectics" concept to problem-solving settings in 1961. In 1962, Paul Torrance pioneered studies in the research and development of creative thinking abilities, assessment and nurture. At the same time, J.W. Getzels and P.W.

Jackson were focusing on the distinction between creativity and intelligence. Their work was followed in 1965 by Wallach and Kogan and their studies regarding the relationship between levels of intelligence and creativity. The development of the "Creative Problem Solving Model" occurred in 1967—spearheaded by the earlier work of Osborn. This model was subsequently refined by Parnes, Noller and Biondi (1977) and later by Isaksen & Treffinger (Treffinger, 1986).

During the latter part of the 1960's and early 1970's, several structured programs for fostering creative thinking and problem solving abilities were developed. This period saw the onset of the Productive Thinking Program (Covington, Crutchfield, Davies & Olton), the Purdue Creative Thinking Program (Feldhusen, Treffinger & Bahlke), and the Cognitive Research Trust CoRt Thinking Skills Program (de Bono). Various testing instruments were developed in parallel with these programs. According to Treffinger (1986), approximately 60 different instruments presently exist—none uniformly accepted by researchers in the field of creativity.

Parnes and Noller (1971) report a bibliographic search of programs teaching students to improve their fluency, flexibility, originality, elaboration, sensitivity, and related abilities. Approximately 90% of these programs indicate significant increases in the subjects' creative-productivity levels. Ristow (1988) reports similar research findings—that the direct teaching of creative skills can produce better, more creative thinkers.

In a study of freshmen at Carnegie-Mellon University, Altemeyer (1966) concentrated on majors in fine arts and engineering. He investigated if students would show measurably different styles of thinking over their four years of education. He hypothesized that engineering students might learn increased logical and analytic styles of thinking, and that fine arts students might learn increased intuitive and imaginative styles.

The results indicate that freshmen engineering students scored well above national norms on the analytic tests he administered. On the battery of tests, seniors scored the highest and freshmen the lowest. On tests of imagination, the reverse occurred—with freshmen scoring the highest and seniors the lowest. The opposite results were obtained for the fine arts students. Fine arts seniors had significantly higher scores on tests of imagination than the freshmen and significantly lower scores on the analytic tests.

Though Altemeyer was unable to follow his original plan of tracking the freshmen through their academic careers, he concludes that four years of education in engineering seem to generate improved analytic problem solving skills with a concomitant loss in imaginative thinking. The fine arts students, while thinking more imaginatively, seem to forget or repress their earlier analytic proficiency.

Leavitt (1986), observing Altemeyer's research, concludes: "...The typical engineering course drives toward convergence. By the end of it, all good students should give about the same answer to the same question. The arts courses drive in large part toward divergence.

By the end of them, every good student, given the same task, should come up with a somewhat different answer."

In an experiment at West Virginia University, Kvashny and Sears (1978) compared creativity variables of fluency, flexibility, originality, and elaboration in three student groups of graduating seniors: (1) engineering, (2) landscape architecture and (3) a non-engineering population of education and pre-veterinary medicine students. The investigators used the Figural Forms of the Torrance Tests of Creative Thinking as the instrument in their research.

Prior to creativity training sessions, pre-tests showed that the engineering students had originality scores statistically higher than the landscape architecture students. At the conclusion of the training, the reverse was true—the landscape architecture students had significantly higher originality scores. The post-test results also showed that the engineering and landscape architecture students had significantly higher scores on originality and elaboration than the non-engineering population. The researchers concluded that creativity in students, in a design field, can be enhanced with appropriate creativity training.

McCormack (1975), in a five-year study, investigated the inclusion of creativity training in general education science courses. He established five experimental and control groups. Lectures for both groups were identical, but laboratory and related homework was different. Using the Torrance Tests, the results indicated improved fluency, flexibility and originality. (Cited in Dice, 1976). In a report of this research, McCormack (1974) concluded the following:

1. "A university general education science course can be modified to include training in creative thinking, and student performance...can be significantly improved as a result.
2. The modified course is neither more, nor less, effective than the usual course in developing understanding of principles of science.
3. Modified-course students and regular-course students perceive their attitudes toward science concepts to be at equivalent levels.
4. Students who have experienced the modified course perceive their attitudes toward science to be significantly more positive.
5. Modified-course students have significantly more favorable attitudes toward their science course than do standard-course students."

Keating (1980) argues that "creative thinking" should be regarded as only one of several important components in creative activity and feels that programs designed to foster it should be undertaken in conjunction with solid content-oriented programs.

The Torrance Tests have built on the early works of Guilford. Guilford identified creativity as an essential component of intellectual functioning. In describing creative thinking, Guilford (1957, 1959, 1962) stressed the following cognitive characteristics:

(1) generalized sensitivity to problems (an evaluation ability), (2) fluency in thinking, (3) flexibility, (4) originality (the ability to produce uncommon responses or associations), (5) definition (the ability to reorganize what one knows in new ways), and (6) elaboration (the capacity to use two or more abilities for construction of a more complex product).

Long-range predictive validity studies indicate that the performance of students on the Torrance Tests is significantly related to adult creative achievements (as determined 12 years later), and that creativity tests administered during the high school years can predict real-life adult creative achievements. Further, the Torrance Tests have shown no racial or socioeconomic differences, that creative abilities are not inheritable, and that educators can expect to be able to do more to modify creative abilities than they can the abilities assessed by intelligence tests. (Torrance, 1972b, 1975, 1980a).

Creativity and Higher Education

The present shift from an industrial society to an information society is having an overwhelming effect on our formal educational system. Naisbitt and Aburdene (1985) assert that the present system was never meant to serve the needs of this new society. They contend that it was custom-made to fit the industrial period, when it made sense to treat everyone the same. Previously, uniformity, control, and centralization were the ideals of the industrial society, and schools were modeled in these values. As Toffler point out, schools were organized like factories in order to socialize people to work in factories. (Toffler, 1980).

McCabe (1985) asserts that our educational institutions are still dedicated to standardization and regularity. He argues that schools inhibit the capacity for spontaneous invention and fantasy by favoring methods that are predictable, efficient, practical and measurable. Likewise, Poole (1979) suggests that in our educational system we turn out conformists, stereotypes and individuals whose education is "completed," rather than creative and original thinkers. Raudsepp (1983) supports the same position: "The educational and developmental processes most people go through, while ostensibly preparing them for the responsibilities of adulthood, nevertheless manage to conventionalize them to the point where lively curiosity and wonder almost cease to exist. In addition to, or perhaps as a consequence of this, many adults have a deep distrust of originality, imagination, and fantasy."

Rosten (1963) argues that our educational system does not teach people how to think well, how to handle new concepts, or how to solve problems. He feels that this occurs not because our system is poor in imaginative techniques, but because these are the only models we have.

Naisbitt and Aburdene (1985) state that our formal educational system has methodically eliminated the intuitive in favor of the rational, and that what little intuition remains after high school is drummed out later. They feel that intuition is increasingly more valuable in this new information society precisely because there is so much data.

Reviewing reform and the future of higher education, Werdell (1974) states: "Every indication is that experiences designed to help a student develop his creative ability...and ability to act, support and stimulate cognitive learning as much as the traditional curriculum."

Critical of higher education, Taylor and Ellison (1975) maintain that most institutions are slow in awakening to creativity research findings, and are having difficulty responding to methods already occurring in primary and secondary programs.

Perkins (1984) contends that schooling generally presents knowledge as a given, rather than as the product of a creative effort to accomplish something—and that schooling generally poses tasks that do not exercise or even allow creative effort.

Vernon (1964) submits that our whole educational system tends to favor: (1) the conformist mentality, (2) the student who is good at amassing facts, (3) the student who accepts what the teacher says, and (4) thinking and writing that goes along conventional lines. Naisbitt and Aburdene (1985) agree by suggesting that, "...young people brimming with creative potential are run through a system that recognizes and deals only with the linear, logical, rational side of human and social reality."

Groch (1969) contends that creativity is trampled to death by formal and informal educational procedures which drill compliance and conformity. de Bono (1972a) asserts that education has always regarded its prime duty to be the "transfer of knowledge," and in this transference, teachers are keenly aware that the only valid criterion of success is for the pupil's output to match the teacher's input. This emphasis, he argues, not only makes it unnecessary to think, but is also dangerous for the unfortunate pupil who comes up with an unacceptable, new point-of-view. He further argues (de Bono, 1972b) that it is not the fault of the people involved, but rather a direct result of the thinking system we've outgrown. The academic idiom, he maintains, was established to look backward and preserve the past, rather than to look forward to create the future.

Equally critical, Cyert (1986) states that a university has great pressures from the world pulling its faculty, departments and colleges away from university innovation and towards preserving the status quo—and that there is probably no other organization that has the same pressures for decentralization and conservatism with respect to change. Huber (1986) agrees with this position: "...While universities clearly possess change-resistant characteristics, society possesses change-inducing forces of sufficient strength to overcome some of these characteristics."

In a review of universities, students, and grading systems, Axelrod (1968) concludes that successful students currently moving through college and university programs, into leadership positions in society, operate most comfortably in highly-structured situations. They enjoy solving problems that are largely prestructured, known to be solvable, expressable in quantitative terms, and are immediately applicable to some visible situation. He continues by saying that in a highly developed society, these individuals must deal with problems that are not prestructured, not known in advance to be solvable, not expressible in purely quantitative terms, and do not have local and immediate applicability. These problems, he feels, demand the most creative minds the nation's colleges and universities can educate.

Torrance writes that current grading and evaluation systems encourage memory, neatness, accuracy and cautiousness, while rarely calling upon independent or speculative abilities to deal with situations in which answers are not known. (Torrance, 1965). He asserts that all educational levels will become more and more self-directed as we move further into the information age. (Torrance, 1980a, 1980b). Expressing caution, Norman (1980) emphasizes that we expect students to learn, yet strangely, we seldom teach them anything about learning. Likewise, we expect them to solve problems, yet seldom teach them about problem solving.

Similar sentiments have surfaced in professional design programs. In the American Society of Engineering Education report, Future Directions For Engineering Education, (Cited in Harrisberger, 1977), the authors conclude that "...Engineering students have been well equipped with critical and analytical tools to work on externally defined problems. They are substantively less skillful at defining problems, synthesizing and designing."

Feldner (1987) reports similar findings: "Despite all that has been written and said about problem solving and critical thinking, most engineering schools are still going about business as usual, relying on the traditional lecture-homework-quiz format of well-defined problems and single correct answers. Unfortunately, while efficient, this format has never been shown to be effective at producing the critical, innovative thinking skills needed to solve difficult technological problems." He feels that if we are to develop creative skills, we must provide opportunities to exercise these skills, a classroom atmosphere conducive to such exercises, and recognition and encouragement for those who display such talent. Feldner argues that we must do so within our regularly-scheduled courses so that these skills come to be thought of routinely.

Sullivan (1963) hypothesizes that creativity is not encouraged in the university classroom because of the contemporary view of failure. He asserts that since failure is certain in the creative process, and that the idea of failure is not entertained in the classroom, creativity is therefore discouraged.

Torrance (1965) advances another argument. He feels many educators simply look upon creative thinking in the school as threatening and dangerous.

Bugliarello (1987) maintains that in spite of the problems posed, teaching methods in universities must be reexamined and creativity must be encouraged in the classroom.

In 1964, Taylor reported that there was almost no evidence of creativity experimentation in university admissions practices, teaching programs, and evaluation of achievement. A quarter of a century later, little has changed.

One of the negative spin-offs of the present academic climate is the heavy loss of creative talent through dropouts. Heist (1968) discovered that in a review of several universities, the proportions of identified creative students withdrawing ranged from approximately 50% to 80%. In roughly 70% of the programs reviewed, a significantly higher proportion of the creative students on campus left than did dropout students not identified as creative. He concludes that the students who are ranked as creative, or identified by measured characteristics of creativity, either leave some colleges more frequently than or as frequently as all other students not so identified. (Cited in Parnes, 1972).

The subject of intelligence versus creativity has been presented earlier in this chapter. But in a related study involving senior engineering students, MacKinnon (1961) asks the question: "Is it possible that the intellectual promise and creative potential of students of engineering are conceived too narrowly and identified in the minds of their instructors with academic achievement in engineering subjects?"

Instructors, in this study, rated the students' originality and creativity. The ratings possessing significant correlations included: (1) grade point average (.73), (2) faculty rating of scientific productiveness (.77), (3) scholastic performance (faculty rating plus GPA) (.82), and (4) faculty rating of scientific competence (.84).

MacKinnon concludes that for the engineering faculty, the creativity of their students is not distinguishable from and, therefore, is largely equated to their achievement in engineering courses. He states: "It would appear that students are selected on the basis of their engineering aptitude and achievement and it is for this that they are rewarded in the course of their training." It would appear that the instructors in this study freely intermixed the concepts of intelligence and creativity—interpreting them to be the same.

The educational viewpoint of any teacher may be conducive or detrimental to creativity. In a nationwide study involving several hundred practicing professionals, Chambers (1973) asked them to identify the qualities of their former teachers that facilitated or inhibited their creative development.

Chambers summarizes their responses (in order of importance):

<u>Facilitating influences</u>:

1. Treated students as individuals.
2. Encouraged students to be independent.
3. Served as a model.
4. Spent considerable amount of time with students outside of class.
5. Indicated that excellence was expected and could be achieved.
6. Enthusiastic.
7. Accepted students as equals.
8. Directly rewarded student's creative behavior or work.
9. Interesting, dynamic lecturer.
10. Excellent on one-to-one basis.

Inhibiting influences:

1. Discouraged students (ideas, creativity, etc.)
2. Was insecure (hypercritical, sarcastic).
3. Lacked enthusiasm.
4. Emphasized rote learning.
5. Was dogmatic and rigid.
6. Did not keep up with field; generally incompetent.
7. Had narrow interests.
8. Not available outside the classroom.

   (Cited in Amabile, 1983a).

Similar to Chambers' findings, Isaksen (1983) summarizes the suggestions of Torrance, Myers and others regarding the development of an academic atmosphere conducive to creative growth:

1. Respect an individual's need to work alone; encourage self-initiated projects.
2. Permit the curriculum to be different for various individuals; voice the beauty of individual differences.
3. Tolerate complexity and disorder, at least for a period.
4. Use mistakes as positives to help individuals realize errors and meet acceptable standards in a supportive atmosphere.
5. Allow time for individuals to think about and develop their creative ideas. Not all creativity occurs immediately and spontaneously.
6. Create a climate of mutual respect and acceptance among individuals so they will share, develop and learn from one another as well as independently.

7. Criticism is killing—use it carefully and in small doses.

8. Encourage and use provocative questions; move away from the sole use of convergent, one-answer questions.

Finally, Torrance (1962) lists the following changes that must take place before colleges can effectively nurture creativity in students:

1. Develop and use instruments and procedures to supplement present devices for selecting and guiding students.
2. Change the objectives of courses to include the development of skills in creative thinking about course content.
3. Institute curriculum changes that will permit students to learn creatively many of the things now taught by authority, and give experience in creative application of scientific information.
4. Develop methods and materials that will stimulate students to learn creatively and will foster creative growth.
5. Develop instruments for assessing achievement in courses that involve creative thinking.
6. Develop concepts of teacher-student relationships and principles for rewarding creating thinking (other than through grades).

(Cited in Taylor, 1964).

Chapter 3

METHODS AND PROCEDURES

Subjects

The subjects in this study were twenty-seven seniors in the Architectural Engineering undergraduate program at Kansas State University. The group consisted of twenty-one males and six females, with a mean age of 21.9 years. (Ages ranged from 21 years to 27 years).

All subjects were enrolled in two courses entitled Architectural Engineering Design I (Fall semester) and Architectural Engineering Design II (Spring semester). Each of the subjects had completed a common core of prerequisite courses prior to enrolling in these two, required studios. This core included courses in instrument-aided drafting, freehand sketching, and two courses in elements of architectural design.

All twenty-seven subjects participated in this study, and no new subjects were added during the two-semester sequence. No student absences occurred during any of the scheduled "Special Exercise" sessions described herein.

Research Design

Creativity-development materials were presented in each of the two semesters. This material was organized into four, three-hour sessions. (See page 52). To provide for effective program evaluation, a traditional experimental group/control group model was adopted.

The Torrance Tests of Creative Thinking, Figural Forms A and B (Torrance, 1966, 1974b) were selected as the criterion for evaluating the outcomes of the creativity-development sessions. The Torrance Tests were chosen for the following reasons:

1. The availability of equivalent, alternative forms of the Torrance Tests.
2. The test-retest reliability of the instrument.
3. The reliability of scoring the tests.
4. The content, construct, concurrent and predictive validity of the tests.
5. The availability of normative data and composite scores.
6. The availability of professional scoring services from Scholastic Testing Service, Inc., in Bensenville, Illinois.

Additionally, the Figural Forms of the Torrance Tests were selected in the belief that they would be most appropriate for students with common skill-development courses in art and drawing.

Torrance (1974a) states that creative ability is not a "univariate" phenomenon, and that a person can behave creatively in an almost infinite number of ways. He believes that it is impossible to provide all researchers and potential users of tests of creative thinking satisfactory evidence of instrument validity. He suggests that the concept of an overall validity coefficient for tests of creative thinking ability is very inappropriate and states that it is "much more useful to think in terms of a variety of kinds of criteria of creative behavior and of a variety of kinds of creative thinking ability involved in these criterion behaviors."

In an effort to make the problem of validity approachable, and in response to some researchers who question the validity of these tests relative to creative thinking ability (Yamamoto, 1965; Wallach and Kogan, 1965; Treffinger, Renzulli & Feldhusen, 1971; Mansfield, Busse & Krepelka, 1978), Torrance suggests that creativity should be viewed as a "process." With this approach, he maintains that creativity can be seen as the kinds of abilities necessary for the successful operation of the process, the production of various kinds of products, and the qualities of products resulting from the process.

To ensure content validity, Torrance has made a deliberate effort to base test stimuli, test tasks, instructions, and scoring procedures on the best theory and research available. According to Torrance, "analysis of the lives of indisputably eminent creative people, the nature of performances regarded as creative, and research and theory concerning the human mind" have been considered in decision-making regarding the selection of test tasks. Also, the tests have been devised to reflect different aspects of creative behavior—the kinds of cognitive-affective functioning that facilitates effective creative behavior.

A large number of investigators throughout the United States and foreign countries have conducted experiments designed to teach creative thinking and improvement in creative functioning. A survey of 144 of these studies (Torrance, 1972a) showed that 106 of them had used the Torrance Tests of Creative Thinking as criteria. Each study was rated according to the percentage of the criteria on which statistically significant growth or improved functioning occurred. Seventy-one percent of the efforts were successful, displaying evidence of construct validity of the Torrance Tests. In 1985, Torrance further reported than an additional 500 studies had disclosed the same pattern of results (Cited in Parnes, 1987).

Definition of Terms

Figural Tests, Forms A and B, of the Torrance Tests of Creative Thinking were obtained for pre and post testing. These tests measure four figural scores: fluency, flexibility, originality and elaboration and are defined as follows:

1. Fluency: The ability to produce a large number of idea with words or figures.
2. Flexibility: The ability to produce a variety of kinds of ideas, to shift from one approach to another, or to use a variety of strategies.
3. Originality: The ability to produce ideas away from the obvious, commonplace, banal or established.
4. Elaboration: The ability to develop, embroider, embellish, carry out or otherwise elaborate on ideas.

Hypothesis

The major hypothesis tested in this study was:

No significant differences in creative thinking skills, as measured by the Torrance Tests of Creative Thinking, will be found between Architectural Engineering Design students exposed to specific creativity-enhancement techniques and Architectural Engineering Design students not exposed to specific creativity-enhancement techniques.

The hypothesis was further refined, as follows:

Students in the Architectural Engineering Design studios exposed to twelve hours of specific creativity-enhancement techniques will not differ from students who do not receive exposure to the same techniques, as measured by the following Torrance Tests factors:

1. Figural fluency.
2. Figural flexibility.
3. Figural originality.
4. Figural elaboration.

Statistical Analysis

The research hypothesis was tested by computing a t-test for independent samples (two-tailed test), for each of the four factors, from scores obtained from Figural Forms A and B.

Administration of the Torrance Tests of Creative Thinking

During the first week of the Fall semester design studio, the Torrance Tests of Creative Thinking, Figural Test, Form A, was administered to all twenty-seven subjects, in one room, at the same time.

During the last week of the Spring semester design studio, the Torrance Tests of Creative Thinking, Figural Test, Form B, was similarly administered to all twenty-seven subjects.

The directions contained in the Directions Manual and Scoring Guide (Torrance, 1974c) for administering the tests were explicitly followed in both cases.

Scoring of the Torrance Tests of Creative Thinking

Completed copies of Figural Forms A and B of the Torrance Tests were sent to Scholastic Testing Service, Inc. in Bensenville, Illinois. This organization provides scoring services for researchers using the Torrance Tests.

Procedures

Students in the Architectural Engineering program at Kansas State must complete both design studios to satisfy graduation requirements.

During this two-semester sequence, the students are assigned approximately fourteen projects, ranging from three hours to four weeks in duration. Nine projects are assigned in Design I and five projects are assigned in Design II. All projects are evaluated using the Project Evaluation Form shown in Appendix "A."

Historically, both design studios have been divided into two separate groups, of approximately the same size, meeting nine hours per week, at identical time periods, assigned to different classrooms. Two instructors, following the same schedules and assignments, coordinate student activities. Instructors freely exchange ideas with students in both classrooms in a team-teaching fashion. Students are encouraged to exchange viewpoints with other students in both classrooms.

During this study, the students were randomly assigned to two groups with one, principal instructor per group. One group of students (n=14) became the experimental group while the other (n=13) became the control group. The experimental group consisted of 10 males and 4 females; the control group consisted of 11 males and 2 females. The mean ages of the groups were: experimental, 21.4 years; control, 22.5 years. Each group consisted of the same population for the entire two-semester sequence. Class assignments and schedules, other than the content of "Special Exercises," were identical for both groups.

Two instructors participated in the administration of creativity-enhancement techniques. One instructor presented techniques to the experimental group in the Fall semester, while the other instructor guided the activities of the control group. At the semester break, the instructors switched roles and groups.

In Design I, both experimental and control groups were assigned three, three-hour, "Special Exercise" sessions. These sessions were distributed over the entire semester and occurred between major project assignments. The experimental group was exposed to specific creativity-development techniques while the control group viewed slides, sketched design projects, or engaged in field trips.

In Design II, both experimental and control groups were assigned one, three-hour, "Special Exercise" session which occurred at about the one-third point in the semester. Class activities during this day were similar to those in Design I. (Two "Special Exercise" sessions were originally planned for Studio II—but were subsequently reduced to one due to scheduling difficulties).

Students were not told what the other class was assigned during "Special Exercise" sessions, and no effort was made to quarantine each class to prevent possible contact and discussion of exercise content.

Students in the experimental group were given approximately 65 handouts during "Special Exercise" sessions, and at random times throughout both semesters. The control group received no handouts. These handouts, labeled "Brainstorms," contained a broad array of reprinted ideas, articles, charts, techniques, and quotes related to the topic of creativity (See Appendix "B" for representative example). Except for brief, related comments during "Special Exercise" sessions, no formal discussions of the handouts occurred following their dissemination.

During a one-week period in Design II, concurrent with an assigned project, the experimental group was exposed to "The Five Day Course in Thinking" (de Bono, 1967). Students were given handouts and related assignments from this course, on each of five successive days. Completion of these assignments was optional. The control group was not exposed to this material.

During Design I, each of the students in the experimental group received a "memo," (Appendix "C") describing day-to-day classroom objectives (including the goal of a psychologically-secure, non-threatening atmosphere). This list of objectives paralleled a summary of findings from 30 creative problem-solving courses surveyed by the Stanford Research Institute (Edwards, 1966, 1968). Students in the control group did not receive this "memo."

As Davis (1971) states: "Perhaps the most obvious yet most critical guideline for stimulating creative thinking lies in creating an atmosphere of receptiveness and encouragement for the free expression of ideas. This follows Rogers (1961, 1962) thinking that the concepts of "psychological safety" and "psychological freedom" must exist in the classroom. Groch (1969) identified the ideal climate for creativity as "...one which provides both stimulation and reasonable security, in which an open environment challenges the individual and at the same time indicates that his work is needed. The chance of innovation improves if innovation is expected."

Students in both experimental and control groups were required to develop and submit "Creative Notebooks" at the completion of Design I and Design II. These notebooks were to include: class handouts and assignments; photocopies of building projects they found interesting; articles, quotes, exercises, games, cartoons, and other materials related to course objectives and topics; photos or slides from books and magazines; notes describing their personal decision- making processes; diaries of specific assignments; sketches and doodles; or any other materials they wished to include. The notebooks were reviewed solely by the instructors, were not graded, and the contents were not shared with other students. Students were free to include or exclude any materials they desired.

Implementation of the Creativity-Development Techniques (Experimental Group Only)

The first of the four "Special Exercise" sessions dealt with uniqueness, individuality and self-esteem. It presented ways of looking for alternative solutions to problems. The topics of brain hemisphericity, education, academic achievement and I.Q., types of blocks, negativity, fear, and criticism were discussed. (Appendix "D").

The second "Special Exercise" session exposed the students to pattern predictability, definitions of creativity, profiles of creative people, conditions that stimulate creativity, the creative process, blocks to creativity, creative stimulation through checklists, guided imagery, and visualization. (Appendix "E").

The third "Special Exercise" session was organized around various blocks to the creative process—perceptual, emotional, associational, cultural, professional, intellectual and environmental. Various problem-solving techniques such as "brainstorming," "morphological analysis," "forced connections," "attribute listing," and "Bisociation" were discussed. (Appendix "F").

The fourth "Special Exercise" session dealt exclusively with the concept of "lateral thinking." Following an extensive discussion and hands-on exercise, the students viewed two segments of the videotape, Thinking in Action: The de Bono Thinking Kit (de Bono, 1982a, 1982b, 1982c). (Appendix "G").

During each of the four "Special Exercise" sessions, material was presented by the instructor, handouts were discussed, and students actively participated in a large number of exercises. These exercises included both individual and team techniques.

Limitations of the Research

The recognized limitations of this study were:

1. Sample size: With a total subject size of twenty-seven, limitations were placed on the type and power of appropriate statistical analysis.
2. Single instrument investigation: The use of a single testing instrument limited the statistical measurement possibilities. Previous, similar studies utilizing the Torrance Tests have included Verbal as well as Figural Forms.

3. <u>Material integration and scheduling:</u> During the two-semester studio sequence, a variety of learning activities occurred. These activities included focused lectures on highly technical safety and building codes, informal discussions regarding building systems and components, field trips investigating existing environmental conditions, formal presentations of project solutions, model-building, and intense individual and group critiques of assigned projects. Assignments varied in scope from relatively simple, three-hour sketch problems to highly complex, four-week team projects.

These class activities, coupled with events scheduled by the university, affected how creativity material was eventually organized and presented. Large blocks of time dedicated to holiday breaks, spring break and university open house activities, complicated the scheduled integration of creativity material.

Five "Special Exercise" sessions were originally scheduled over the two-semester period. Eventually, these were reduced to four, three-hour sessions due to conflicts which developed in the Spring semester. Three of the sessions occurred in the Fall semester and one occurred in the Spring semester.

4. Administrator imbalance: The reduction of "Special Exercise" sessions from five to four brought about a corresponding imbalance of presentations by the two instructors involved. Originally planned as a three plus two presentation format—the new format became a three plus one. This offered a greater potential of bias influence by the presenters.

5. Cross-group interaction: Although efforts were instituted to minimize classroom activities between the experimental and control groups, isolation was impossible and cross-group interaction was inevitable. The design studios for both groups met at the same time, in close proximity to each other. Students had individual keys to these rooms and 24-hour accessibility.

   Both groups were merged occasionally for general lectures and critiques, and students commonly engaged in conversations in each other's studios. Most of the students had similar departmental classes together—resulting in discussions of what was occurring in the opposite design studio.

6. Post-test timing: The administration of the post-tests occurred during the last week of the Spring semester—immediately prior to final examinations—and shortly after a major, assigned project was due. This appeared to be the only available time for post-testing the groups, even though anxiety was high.

Chapter 4

RESULTS AND ANALYSIS OF DATA

Comparison of the Project Groups

Four null hypotheses were formulated and tested. These hypotheses are stated as follows:

1. Students in Architectural Engineering Design exposed to twelve hours of specific creativity-enhancement techniques will not differ from students who do not receive exposure to the same techniques, in figural fluency, as measured by the Torrance Tests of Creative Thinking.

2. Students in Architectural Engineering Design exposed to twelve hours of specific creativity-enhancement techniques will not differ from students who do not receive exposure to the same techniques, in figural flexibility, as measured by the Torrance Tests of Creative Thinking.

3. Students in Architectural Engineering Design exposed to twelve hours of specific creativity-enhancement techniques will not differ from students who do not receive exposure to the same techniques, in figural originality, as measured by the Torrance Tests of Creative Thinking.

4. Students in Architectural Engineering Design exposed to twelve hours of specific creativity-enhancement techniques will not differ

from students who do not receive exposure to the same techniques, in figural elaboration, as measured by the Torrance Tests of Creative Thinking.

A t-test for independent samples (two-tailed test) was computed for each of the four factors utilizing Figural Forms A and B of the Torrance Tests of Creative Thinking.

The comparison between experimental and control groups for the pre-test measures (Figural Form A) is shown in Table 1. The results indicate no significant differences on all four factors, and the hypotheses were retained.

The comparison between experimental and control groups for the post-test measures (Figural Form B) is shown in Table 2. The results indicate no significant differences on all four factors, and the hypotheses were retained.

Although the changes between Figural Forms A and B were not statistically significant, the final scores in the categories of figural fluency and figural flexibility showed a tendency to increase slightly.

Table 3 provides national norms for similar studies employing the Torrance Tests. Comparing the Mean scores of Figural Form A of the national study with scores of the local study (for both experimental and control groups) shows the national scores exceeding the local scores in all four categories. Comparing the Mean scores of Figural Form B of the national study with scores of the local study reveals that both experimental and control groups exceed the national scores in all categories except figural elaboration.

Tables 4 and 5 provide frequency distributions, means and standard deviations, in each of the four subsets of the hypothesis, for the entire body of subjects involved in the local study.

Table 1

Comparison of the Creativity Scores of Experimental and Control Groups Using Data from Figural Form A

	Experimental Group (n = 14)		Control Group (n = 13)		t
	Mean	S.D.	Mean	S.D.	
Fluency	15.71	4.86	15.46	5.29	0.12
Flexibility	12.57	2.95	13.39	5.56	0.46
Originality	20.57	5.87	23.39	8.25	0.99
Elaboration	52.36	14.64	53.85	18.77	0.22

Table 2

Comparison of the Creativity Scores of Experimental and Control Groups Using Data from Figural Form B

	Experimental Group (N = 14)		Control Group (n = 13)		t
	Mean	S.D.	Mean	S.D.	
Fluency	17.86	4.69	16.00	6.97	0.78
Flexibility	13.64	3.27	12.54	4.97	0.66
Originality	32.86	9.42	35.77	15.82	0.56
Elaboration	61.57	17.11	62.23	22.31	0.08

Table 3

Means and Standard Deviations for Figural Forms A and B -- College, Undergraduate Students *

	Figural Form A (n = 1048)		Figural Form B (n = 639)	
	Mean	S.D.	Mean	S.D.
Fluency	18.3	5.8	14.8	6.0
Flexibility	14.8	4.4	12.4	4.7
Originality	27.8	10.5	19.9	11.0
Elaboration	84.7	33.1	68.8	29.6

* From the Norms-Technical Manual, Torrance Tests of Creative Thinking, 1974 Edition.

Table 3 provides national norms for both Figural Forms A and B of the Torrance Tests. The testing services scoring these Forms provide both raw scores and standard scores (including national percentile rankings for each subject). The figures shown in Tables 1, 2 and 3 indicate raw scores. Tables 4 and 5 reflect standard scores and are included to show the frequency distributions, means, and standard deviations for the entire body of subjects involved in this study. Both frequencies and percentages of subject responses, by standard score intervals, are displayed.

Table 4

Frequency Distributions for Figural Form A

TORRANCE TESTS OF CREATIVE THINKING -- FIGURAL   FORM: A

SCHOOL: KANSAS STATE UNIV.   (11225) GRADE: CO   SECTION: REPORT DATE: 07/88

GROUP SUMMARY: FREQUENCY DISTRIBUTIONS

STAND SCR INTERVALS	FLUENCY FREQ	FLUENCY PERC	FLEXIBILITY FREQ	FLEXIBILITY PERC	ORIGINALITY FREQ	ORIGINALITY PERC	ELABORATION FREQ	ELABORATION PERC	AVERAGE FREQ	AVERAGE PERC
159 -										
156 - 158										
153 - 155										
150 - 152										
147 - 149										
144 - 146										
141 - 143										
138 - 140										
135 - 137										
132 - 134			1	4						
129 - 131										
126 - 128	1	4								
123 - 125	1	4								
120 - 122										
117 - 119			1	4	1	4				
114 - 116			1	4					1	4
111 - 113	2	7			1	4				
108 - 110	2	7	2	7	1	4			2	7
105 - 107	1	4	3	11					2	7
102 - 104	1	4			2	7	1	4		
99 - 101			2	7	1	4				
96 - 98	2	7			3	11			2	7
93 - 95					2	7	4	15	1	4
90 - 92	2	7	5	19	1	4	2	7	4	15
87 - 89	4	15	2	7	2	7	3	11	2	7
84 - 86	2	7			1	4				
81 - 83			3	11	3	11	3	11	5	19
78 - 80	3	11			3	11	1	4	4	15
75 - 77	3	11			2	7	4	15	1	4
72 - 74			4	15	1	4	2	7	1	4
69 - 71			2	7			5	19	2	7
66 - 68	1	4			3	11	1	4		
63 - 65	1	4					1	4		
60 - 62										
57 - 59										
54 - 56	1	4	1	4						
51 - 53										
48 - 50										
45 - 47										
42 - 44										
- 41										
SUMMARY STATISTICS	MEAN =	90.7	MEAN =	91.7	MEAN =	88.8	MEAN =	80.9	MEAN =	88.2
	S.D. =	17.6	S.D. =	17.5	S.D. =	13.8	S.D. =	10.0	S.D. =	12.1

NUMBER OF STUDENTS = 27

(SCHOLASTIC TESTING SERVICE, INC.)

Table 5

Frequency Distributions for Figural Form B

TORRANCE TESTS OF CREATIVE THINKING -- FIGURAL FORM: B

SCHOOL: KANSAS STATE UNIV. (11225) GRADE: CO SECTION: REPORT DATE: 07/88

GROUP SUMMARY: FREQUENCY DISTRIBUTIONS

STAND SCR INTERVALS	FLUENCY FREQ	FLUENCY PERC	FLEXIBILITY FREQ	FLEXIBILITY PERC	ORIGINALITY FREQ	ORIGINALITY PERC	ELABORATION FREQ	ELABORATION PERC	AVERAGE FREQ	AVERAGE PERC
159 -					2	7				
156 - 158	1	4								
153 - 155					1	4				
150 - 152										
147 - 149			1	4	1	4				
144 - 146					2	7				
141 - 143					1	4				
138 - 140										
135 - 137					3	11				
132 - 134			1	4	1	4			1	4
129 - 131	1	4								
126 - 128			1	4						
123 - 125			1	4	1	4	1	4		
120 - 122									1	4
117 - 119					4	15			2	7
114 - 116	1	4	3	11	1	4			1	4
111 - 113	1	4	3	11	2	7			3	11
108 - 110	2	7			2	7			1	4
105 - 107	3	11	3	11	1	4			3	11
102 - 104	1	4	2	7	3	11			1	4
99 - 101	3	11			1	4	2	7	1	4
96 - 98	3	11	2	7			1	4	3	11
93 - 95			2	7	1	4			1	4
90 - 92	1	4	1	4			3	11	3	11
87 - 89	1	4					1	4	3	11
84 - 86			4	15			3	11	1	4
81 - 83	1	4	1	4			2	7		
78 - 80	1	4					4	15	2	7
75 - 77	3	11					3	11		
72 - 74	1	4	2	7						
69 - 71	2	7								
66 - 68	1	4					5	19		
63 - 65							1	4		
60 - 62							1	4		
57 - 59										
54 - 56										
51 - 53										
48 - 50										
45 - 47										
42 - 44										
- 41										
SUMMARY STATISTICS	MEAN =	95.6	MEAN =	103.1	MEAN =	125.0	MEAN =	81.9	MEAN =	101.5
	S.D. =	19.9	S.D. =	17.8	S.D. =	20.6	S.D. =	13.4	S.D. =	13.3

NUMBER OF STUDENTS = 27

(SCHOLASTIC TESTING SERVICE, INC.)

Chapter 5

DISCUSSION OF THE RESULTS

Summary

This study investigated the efficacy of measurably enhancing the creative-thinking skills of students enrolled in a professional design curriculum—with twelve hours of exposure to specific materials focusing on the subject of creativity. Figural Forms A and B of the Torrance Tests of Creative Thinking were used in this study and data were obtained by means of pre-and post tests.

The participants in this study were a class of senior students enrolled in two, consecutive Architectural Engineering Design studios at Kansas State University. The students were randomly assigned to experimental and control groups for the two-semester sequence.

Materials dealing with the subject of creativity were carefully integrated into these studio courses. In every instance, material was presented on a day between project assignments when no other activity was scheduled. The intention was to provide an exposure to the material without detrimentally affecting course schedules and project assignments. Project or semester grades awarded to students were not considered in this research, and no attempts were made to correlate grades with results of the Torrance Tests.

This study produced no significant gains on the four factors of figural tests utilized when the experimental and control groups were compared. Though statistically insignificant, the final scores in the categories of figural fluency and figural flexibility showed modest increases.

Conclusion

Based on the findings of this research, it can be concluded that those students involved in this project who received creativity-enhancement training did not benefit significantly over students who did not receive the same kind of training, as measured by Figural Forms A and B of the Torrance Tests of Creative Thinking.

Although the changes were not statistically significant, the scores recorded by the experimental group showed a tendency to increase slightly in the categories of figural fluency and figural flexibility.

Inconsistent with results measured by the Torrance Tests, a substantial number of experimental group students offered anecdotal comments (in notebooks they were required to maintain and submit), that suggested how beneficial the exposure to creativity material had been to them in personal, non-academic matters.

Implications

This study was undertaken to investigate if students in a professional design curriculum could have their creative-thinking skills measurably enhanced with relatively little exposure to materials focusing on the subject of creativity. The object was to integrate this material into a course without detrimentally affecting either the course schedule or assignments.

The data resulting from this study revealed no statistical differences between the experimental and control groups—which implies that the methodology of integration used in this study was ineffective (as measured by the testing instrument).

Surprisingly, analysis of the data from this study revealed disagreement with findings of prior research. This suggests that the procedures used in this research must be altered if statistically positive results are to be obtained.

Recommendations for Future Research

The following suggestions for future research result from this study:

1. Instruments: The use of multiple instruments, over a single instrument, could measure a broader range of dimensions of the subjects.

2. Subject selection: Cross-group influences could be reduced by selecting classes which meet at different times of the day or week.
3. Academic level: A research possibility suggested by this study would be the integration of this material into first year courses, rather than senior level courses. First year courses are typically general in nature, whereas, senior level courses—in professional design programs—are normally highly focused and technically-oriented.
4. Length of study: The integration model used in this study involved two consecutive semesters. This research suggests that the time period was too extensive—particularly when only four presentations were possible in a 30-week time period. It is suggested that future studies be reduced to a single semester, with a minimum of four, three-hour presentations, or six, two-hour presentations. (Student attention levels were high in the three-hour format).
5. Material presentation: Following each of the "Special Exercise" sessions, students returned to normal course activities. Little follow-up discussion of enhancement techniques occurred. Likewise, a substantial number of handouts were dispensed with little additional dialogue or reinforcement.

   Though intentional in this study, it is suggested that a "passive approach" by the administrator(s), and a "self-directed" approach by the students, is ineffective. In future experiments, a more aggressive post-session discussion of enhancement techniques is recommended. Further, if handouts are used as enhancement tools, this study suggests that they should be integrated into day-to-day coursework assignments if the ideas contained within are to be effectively utilized.

6. Pre and post-test timing: Pre-testing during the first week of the semester worked well in this study. The atmosphere was relaxed and the subjects were eager to participate. Conversely, post-testing occurred during the last week of the semester, during a high-stress, high-anxiety period. The students were under pressure to complete projects and prepare for final examinations in companion courses.

   It is suggested that post-testing should be scheduled at least a full week before final examinations.

7. Notebooks: Students were required to maintain and submit "Creative Notebooks" at the end of each semester. This unstructured, supplemental approach permitted the subjects to express personal, confidential thoughts and discoveries. It was well-received by the subjects, and is highly recommended in future studies similarly constructed.

APPENDIX A

Architectural Engineering Design

Project Evaluation

Design Issues	Excellent	Good	Fair	Poor	Failure
1. SITE					
a. Site access/ vehicular circulation/ parking layout.					
b. Pedestrian circulation/ walks/ handicapped accessibility.					
c. Service & emergency access.					
d. Grading & drainage.					
2. BUILDING & SITE FORM					
a. Orientation to climatic influences/ location on site/ energy conservation.					
b. Site preservation/ landscaping.					
c. Building form/ scale/ massing/ proportion.					
d. Sense of entry.					
3. DESIGN LOGIC					
a. Circulation patterns & egress.					
b. Spaces & activities proximities.					
c. Proportions & configuration of spaces for activities/ furnishings/ equipment.					
d. Building operation/ security/ maintenance.					
4. ENGINEERING CONSIDERATIONS					
a. Construction materials selection/ construction systems.					
b. Structural system/ adequate proportions (beams, walls, foundations, etc.)					
c. HVAC/ chases/ plenums/ mechanical rooms/ acoustical separation.					
d. Plumbing & fixture layout/ roof drainage					
e. Lighting (natural and/or artificial).					
5. PROGRAMMED ELEMENTS					
a. Conformance to program requirements/ budget.					
b. Conformance with zoning ordinances/ codes/ regulations/ handicapped accessibility.					
Design Evaluation					
Graphics Evaluation					
Completeness & Clarity of Presentation					
Composite Project Grade	A -	+ B -	+ C -	+ D -	F

APPENDIX B

brainstorms

Editor's Olio

What if...(stories had no headlines)

By DAVID HACKER

What if:
Cats had no sense of balance.
There were no periods to put in sentences.
Humans had no teeth.
Sex had never been invented.
Sunflowers were green.
Dogs had five legs.
The United States was a monarchy.
There were no clarinets.
Women had hair on their chests.
Cats couldn't purr.
Lizards could talk.
Eggs were square.
Humans could breath in water.
There never had been a Greece.
The Mississippi River flowed by Keats.
The veriform appendix needed six ounces of artichoke hearts daily to survive.
There was no oil.
Alcohol was undigestible.
Saucers were convex.
Silkworms ate kumquats.
Spiders had one leg.
Sand was gooey.
Love required a government license.
James Watt became a hermit.
Mirrors didn't reflect anything.
Women couldn't get permanents.
Florida averaged 297 inches of snow a year.
Shoes had no bottoms.
Ronald Reagan had written *Ulysses*.
Most American cars were made in Gillette, Wyo., instead of Detroit.
Birds flew upside down.
Humans had three-fingered hands.
Laughter was forbidden.
Henry Miller had been the archbishop of Chicago.
Ingrid Bergman broke the world pole vault record.
Bing Crosby had been mute.
There was no glue on earth.
Egg yolks didn't stick.
There was only one condominium in Vail, Colo.
Time was a dessert.
Henry Ford had been a chimney sweep.
Thomas Edison had invented ice cream.
The Euphrates River flowed into Wildcat Creek.
High school was one year.
Shadows were three dimensional.
There were no circles.
Tapioca didn't exist.
Cucumbers had ears.
Feet had one toe.
There were no fingernails.
The word *and* didn't begin with an a.
There were 27 letters in the alphabet.
Everyone could read Chinese.
Horses smelled like radishes.
Water was undrinkable.
Humans talked through their pores.
There were 33 hours in a week.
Boats didn't need rudders.
We knew the name of the person who invented galoshes.
There were no religions.
Humans could rotate their heads 180 degrees.
Snow fell in ribbons.
There were no tomato worms.
Bicycle wheels had no spokes.
Somerset Maugham had preferred women.
Milk was drunk only by bees.
Cows produced honey.
You could bid eight no trump in bridge.
There were four strikes in baseball.
Ike Bierwagen had never pitched softball for the South Bend Bendix Brakes.
Albert Einstein had beaten Bill Tilden for the Wimbledon men's championship in 1927.
The square root of 16 was not 4.
Questions were not permitted in schools.
You could eat steel.
There were no fat people in the world.
Everyone knew what piffle meant.
Fulton Sheen had discovered the MacKenzie River in Canada.
Cats didn't have whiskers.
Butterflies weighed 10 pounds.
Nonsense was spelled some other way.

TAKEN FROM:
"THE MANHATTAN MERCURY"

APPENDIX C

KSU
KANSAS STATE UNIVERSITY

Architectural Engineering and Construction Science

College of Engineering
Seaton Hall
Manhattan, Kansas 66506
913-532-5964

I'd like to share with you some of my thoughts regarding Design Studio, and what I hope we experience together.

I suggest the following day-to-day objectives:

1. To establish a psychologically secure, non-threatening atmosphere in which all ideas are welcome.
2. To stimulate each other to recognize and circumvent the inhibiting factors that can block our imaginations.
3. To understand mental ruts or routines, encourage new approaches and see problems in a different light.
4. To help gain self-confidence in our creative abilities by tackling and solving problems of progressively greater complexity.
5. To freely exchange ideas so that we learn from each other.
6. To constantly challenge each other to be open to experience and stimuli of all sorts and to stretch our imaginations as far as possible.

I welcome your ideas!

Allan

APPENDIX D

"SPECIAL EXERCISE" SESSION #1
(3 Hours)

TOPICS	RESOURCES UTILIZED
1. Uniqueness, Individuality and Self-Esteem.	Moustakas (1977) Perls (1969) Dyer (1976) von Oech (1983)
2. Looking for the "Second Right Answer."	von Oech (1983) Adams (1986) de Bono (1985) Least Heat Moon/ Trogdon (1982) Frost (1967)
3. NASA Space Exercise & Selectivity.	Jaques (1984)
4. Lateral Hemisphericity.	Raudsepp (1981) Zdenek (1983) Sagan (1977) Edwards (1979)
5. Creativity, Education and Academic Achievement.	Glover (1980) Dyer (1977) Raudsepp (1985) Schultz & Martin (1979)
6. Pipe & Ping-Pong Ball Exercise. (Types of Blocks)	Adams (1986)
7. Wheelbarrow Exercise. (Positive, Negative & Interesting Solutions).	de Bono (1972b) Campbell (1977)
8. Criticism & Creativity.	Hanks & Parry (1983) Adams (1986) Koberg & Bagnall (1976)
9. Fear and a Creative State of Mind.	Hanks & Parry (1983) Hanks, Belliston & Edwards (1977)

APPENDIX E

"SPECIAL EXERCISE" SESSION #2
(3 Hours)

TOPICS	RESOURCES UTILIZED
1. Predictable "Patterns."	Fosdick (1920) Cole (1972) Campbell (1977)
2. What is Creativity?	Prince (1970) Allen (1975) Sheehy (1981)
3. Profile of a Creative Person.	Haefele (1962) Prince (1970) Waitley (1983)
4. Conditions That Stimulate Creativity.	Beakley & Leach (1967) Hanks, Belliston & Edwards (1977) Roadstrum (1967)
5. The Creative Process.	Osborn (1953) Hill (1970) Campbell (1977) Edwards (1980)
6. Blocks to Creativity. (Emotional, Perceptual & Cultural)	Edwards (1980) Adams (1986)
7. Originality	Campbell (1977)
8. Guideposts to Creative Problem Solving.	Raudsepp & Hough (1977)
9. Creative Checklists.	Olson (1980) Osborn (1953) Hanks, Belliston & Edwards (1977) Hanks & Parry (1983) Baker (1979)
10. Guided Imagery.	Adams (1986) De Mille (1981) Nicklaus & Bowden (1977)

APPENDIX F

"SPECIAL EXERCISE" SESSION #3
(3 Hours)

TOPICS	RESOURCES UTILIZED
1. Additional Blocks in the Creative Process:	
- Perceptual.	von Oech (1983) von Oech (1986)
- Emotional.	Hanks & Parry (1983) Campbell (1977)
- Associational.	
- Cultural.	
- Professional.	
- Intellectual.	
- Environmental.	
2. Methods of Eliminating Blocks:	
- "Brainstorming."	Hanks & Parry (1983) Cowan (1985)
- Morphological Analysis.	Koberg & Bagnall (1976) Edwards (1980)
- Forced Connections.	Gardner (1964) Osborn (1953)
- Attribute Listing.	Rawlinson (1981) Raudsepp (1971)
- Bisociation.	Vervalin (1971) Giurgola & Mehta (1975) Koestler (1964) Papanek (1984) Hacker (1984) Smith (1969) Goodman (1984)/ Appendix "H"

APPENDIX G

"SPECIAL EXERCISE" SESSION #4
(3 Hours)

TOPICS	RESOURCES UTILIZED
1. Lateral Thinking.	de Bono (1969) de Bono (1970) de Bono (1971) von Oech (1983)
2. Videotape - Thinking in Action: The de Bono Thinking Kit.	de Bono (1982a) de Bono (1982b) de Bono (1982c)

Unit #1: "Creativity, Design and Innovation."
Unit #6: "Problems, Crises and Opportunities."

MORPHOLOGICAL SYNTHESIS CARDS

Goodman/ 1984

BUILDING APPROACH **a**	FLOOR PLAN CONFIGURATION **b**	INTERIOR SPATIAL SYSTEM **c**	BUILDING PROPORTION **d**	GROUND CONNECTION **e**	STRUCTURAL CONFIGURATION **f**	STRUCTURAL MATERIAL **g**	EXTERIOR WALL MATERIAL **h**	EXTERIOR OPENING **i**
FRONTAL/ SYMMETRICAL	SQUARE	SYMMETRICAL GRID OF COLUMNS	SQUARE	SUNKEN	FLAT SHED	STEEL FRAME	METAL	SQUARE
FRONTAL/ ASSYMETRICAL	RECTANGULAR	ASSYMETRICAL GRID OF COLUMNS	GOLDEN MEAN RECTANGLE	ON-GRADE	HIP GABLE	WOOD FRAME	WOOD	RECTANGLE
OBLIQUE	TRIANGULAR	SYMMETRICAL PLANAR ELEMENTS	WIDER THAN TALLER	ELEVATED ON-PODIUM	BUTTERFLY GAMBREL	CONCRETE FRAME (CAST-IN-PLACE)	CONCRETE	CIRCLE
SPIRAL	CIRCULAR	ASSYMETRICAL PLANAR ELEMENTS	TALLER THAN WIDER	ELEVATED ON POSTS OR PLANES	CLERESTORY A-FRAME OR PYRAMID	CONCRETE FRAME (PRECAST)	STONE	SEMI-CIRCLE
	L-SHAPED	OPEN (PERIMETER LOAD-BEARING)			DOME ARCH	PLASTIC	PLASTIC	ARCH
	U-SHAPED	RADIAL			SPHERE VAULT		INSULATED PANELS	DIAMOND
	COMPOSITE				TENSILE FREEFORM		GLASS	FREE-FORM
					FOLDED PLATE SPACE FRAME		BRICK	CROSS
					2-WAY TRUSS SCISSOR TRUSS			
					RIGID FRAME PNEUMATIC			

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CREATIVITY-ENHANCEMENT TECHNIQUES FOR PROFESSIONAL DESIGN STUDENTS: AN INTEGRATED APPROACH

by

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AN ABSTRACT OF A MASTER'S THESIS

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