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THE EFFECT OF PROGRAMMED INSTRUCTION ON THE TEACHING OF

CERAMICS

DISSertation

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Billy Gene Denney, B.A., M.A.

* * * * * *

The Ohio State University

1976

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ACKNOWLEDGMENTS

I would like to extend my appreciation to the many faculty members of the Department of Art Education who spent numerous hours instilling information, ideas, and encouragement in regards to this dissertation and activities leading to its acquisition.

In addition I would like to extend my appreciation to the administrators of the Southwestern School District Office, the art department faculty of Grove City High School, and the Grove City High School ceramic students who participated in the research project.
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INTRODUCTION

General Problem Area

Art in the public schools is both a subject and a series of activities which the teacher organizes to provide experiences related to specific goals. The sequence and depth of these experiences are determined by the nature of the art activity, the objectives desired, and by the interests, abilities, and needs of the students.

Both when he produces works of art and when he contemplates them, man uses the arts to help him understand himself and the world around him. One of the traditional functions of the arts has been to emphasize individual expression. The visual arts today continue to be a means whereby man attempts to give form to his ideas and feelings and to gain personal satisfaction through individual works.

If art education is to contribute effectively to the development of personal expression, aesthetic judgments, cultural understanding, and visual discrimination, then it is imperative that continuous redevelopment and
reassessment occur in respect to curriculum design, instruction, and evaluation. This will hopefully act as a weeding-out process whereby the unessential will be eliminated and replaced by more appropriate designs, teaching methods, evaluative tools, etc. It is of paramount importance that steps be taken to research and verify those aspects of art, and innovations in instructional procedures that may provide new vistas for future endeavors in the arts.

Many of the serious problems confronting endeavors in virtually all realms of education are fostered by a lack of concern for formulating methods by which an individual's imagination can be free to function.

In many educational situations we tend to turn out conformists, stereotypes, individuals whose education is "complete," rather than freely creative and original thinkers. Many of the criticisms of our culture and its trends may best be expressed in terms of an inadequate supply of creativity. Unless individuals, groups, and nations can imagine, construct, and creatively devise ways of relating to complex changes, the lights will go out. Unless man can make new and original adaptations to his environment as rapidly as his science can change the environment, our culture will perish.
To educate for student imagination seems initially to be an impossible task. However, through the haze of ambiguity the fact remains that a method precise in its objective to develop student imagination, yet not restricted in the student exercising his own unique imagination is necessary.

In the research to follow the student's imagination has lead the way in the search for a course of study that is traditional in regards to subject matter yet innovative in instructional process. The course of study deals with Ceramics. It is here that much controversy has prevailed in the utilization of student imagination.

Because of the therapeutic overtones and conventions associated with ceramics we tend to place the instruction in directions developing an individual's neuromuscular capabilities, getting their hands messy, duplicating works, or for not doing Fine Art.

Unknown to many of the most knowledgeable of ceramists is the fact that ceramics is a process comprised of specific concepts, principles and strategies. It is a field of study characterized by generalizations, discriminations and problem-solving. It is these facts, and detailed functions, which can make ceramics an art form capable of
developing new and exciting works which exhibit theceramist's imagination. More quantity has caused ceramics to take on the facade of a craft restricted to traditional forms and conventions.

In order to place ceramics in a Fine Arts frame of reference, it is necessary to devise an instructional plan that is analytical in its development, yet, free enough in its manner of presentation to allow for the development of student imagination.

To fulfill the requirements for such a method I have chosen programmed instruction. The basis for the programs is derived from the methodologies developed by Pressey, Skinner, Crowder, and Gilbert. The main characteristic which brings all of the various methodologies together is that of S-R combinations. In light of these earlier developments in programming, and many of the research findings in relation to their utilization, I have chosen to extend the programming format through modifications. These changes I feel are for the better. Traditional programming techniques have failed in many instances to accomplish their end goal, for one reason or the other. The modifications include: group pacing, utilization of both overt and covert responding, and self-determining
frames in regards to their independence from other frames. The modifications are non-behavioralistic and non-terminal.

It is these features which are only a small portion of a larger instructional plan to develop student imagination, and are not intended to relieve the teacher from any tasks. They are designed to focus more attention on cognitive subject matter than any other; they are designed in such a manner as to elicit a greater amount of knowledge about a subject than just in terminal situations; and they are short. Since the programs do not fit any previous method in totality, they have taken on a "free-form" type of appearance. Granted, there is a goal and specific activities, but the very nature of the program's sequences, if you can call them sequences, do not conform to conversational chaining, discrimination frames, or even constructed response. The programs are truly an endeavor to free programming from its traditional barriers and place them in a situation where they are joined with teacher activities and student activities to become one method that is practical. So many times programming has left an instructional situation in such a state of confusion that its underlying premise was lost. Programming should share the instructional burden with that of the teacher and student. It is a joint effort
to promote learning, and in this case imagination.

**Statement Of Problem**

The *specific intent* of the research is to:

1. Identify those components of the theoretical curriculum model designed with the objective of nurturing student imagination.
2. Identify those aspects of programmed instruction that are applicable to nurturing student imagination.
3. Establish the parameters of the teacher's role as artist/critic.
4. Establish an evaluation scheme that is open-ended in respect to student ideas, yet, specific in it's processes for effectively measuring cognitive attainment, ceramic works, and construction methods.

**Hypotheses/Objectives**

**Hypotheses—**

1. A curriculum model, designed with the primary goal of nurturing student imagination, is more efficient in producing ceramic objects as a fine art, than a
situation where imagination is left to develop at will.

2. Cognitive subject matter is an integral part of the nurturing process in regards to the student's imagination.

3. The teacher's influence as artist/critic is an integral part of the nurturing process in regards to the student's imagination.

4. Programmed Instruction lends itself to acting as a primary stimulus in nurturing imagination when a "free-form" version is utilized.

5. A high level of cognitive attainment is instrumental in the development of imagination, and thereby acts as a measurement of imagination.

6. Student and teacher interaction is essential in establishing critical expertise of works.

Objectives--

1. Students can recall the subject matter over a span of approximately 26-28 days.

2. Students can transfer the information in the mini-programs to their independent construction of ceramic works after the course of instruction.

3. A "free-form" format of programming is practical in its usage.
Assumptions and limitations

1. I am assuming that the styles of programming developed by Pressey, Skinner, Crowder, and Gilbert are valid in respect to eliciting desired responses.

2. I am assuming that all individuals are capable of creating ceramic works if they desire.

Definitions of Important Terms

1. Concept - a. Any object of awareness together with its significance or meaning; anything one can think about that can be distinguished from other "things."
   b. A general meaning, an idea, or a property, that can be predicated of two or more individual items.
   c. Knowledge that is not directly perceived through the senses but is the result of the manipulation of sensory impressions.

   *A concept requires both abstraction and generalization - the first to isolate the property, the second to recognize that it may be ascribed to several objects. A Comprehensive Dictionary of Psychological and Psychoanalytical Terms by Horace B. English and Ava C. English.
2. Program - A plan for action, or for carrying out a task or investigation. *A Comprehensive Dictionary of Psychological and Psychoanalytical Terms* by Horace B. English and Ava C. English.


7. Initial behavior - Consists of the behavioral repertoire the student brings to the instructional situation. The initial behavior brought to the
instructional situation is the raw material out of which the terminal behavior will be shaped. J.P. Lysaught and C.M. Williams, *A Guide to Programmed Instruction*, 1963.


9. Intermediate behavior - Those activities the student performs between the initial repertoire and terminal repertoire which enables him to reach the terminal behavior or degree of subject matter competence specified by a particular program. J.P. Lysaught and C.M. Williams, *A Guide to Programmed Instruction*, 1963.


18. Sensitivity - A deep-seated preference for and appreciation of elegance of form and of thought,


21. Originality - That quality which is the direct opposite of "conformity" in thought and expression. The power of independent thought or constructive imagination as it relates to freshness of aspect, design, or style. Viktor Lowenfeld, "Creativity: Education's Stepchild," Creative Thinking (Sidney J. Parnes, Ed.), 1962.

23. Divergent thinking - Thinking that is unlike other people's: relating to an infinite sequence that does not have a limit. Clifford T. Morgan and Richard A. King, *Introduction to Psychology*, 1971.

24. Imagination - The ability to think creatively. Alex F. Osborn's definition presented to the sixth annual Creative Problem-Solving Institute at the University of Buffalo in 1960.

25. Creativity - Even though there is no "absolute definition of creativity" and what is regarded as creative at any one point in time is a function of many factors operative in the society (Morris I. Stein, 1953) a working definition is the process of forming ideas or hypotheses, testing hypotheses, and communicating the results. Implied in this definition is the creation of something new, something which one has never seen or something which has never existed (E. Paul Torrance, 1959).
The Method

Design - Compromise Experimental Group-Control Group Design

\[ Y_b \times Y_a \quad (Experimental) \]

\[ Y_b \times Y_a \quad (Control) \]

This quasi-experimental design is perhaps that most commonly used design due to the fact that in many experiments there is no assurance that the experimental and control groups are equivalent. This particular design is also utilized when there cannot be random assignment where full control is lacking.

The selection of groups was based on a random decision by the participating teacher and myself. The groups are heterogeneous in regards to sex, age, social class, and so on.

Both experimental and control groups are made up of students in the 9th-12th grades. Both groups are Ceramic II students with the background of Ceramics I as their prerequisite.

Both experimental and control groups will receive the same Pre-test and Posttest. However, the control group
will not be confronted in any fashion with the designed course, which consists of additional exercises on sensitivity, programs covering a wide variety of information on ceramics, or an evaluation scheme consisting of reading of works by the students and teacher, and the benefit of the teacher as an artist/critic. Any interaction between the experimental and control group will be in the normal case of events in school. Any gossip between groups in regards to the instructional differences will fall within the course of events.

The criteria associated with the construction of the ceramic works of the students is based on individual preferences for design, color, and function. To restrict the students, except in practical matters of balance, size, etc., is inviting a situation where the development of the student's imagination will be impaired. On the following pages are presented those devices which are used to either aid in the developing of student imagination or to evaluate it.

Before presenting the devices, it is necessary to make mention of the accountability aspects of the research. The materials, instructional time, and utilization of teacher and student resources, are for all intense
purposes, the same as traditional art classroom items. Other than standard ceramic materials, the only other materials used were paper and pencil. Even though these items are considered in some cases as extras, I feel that the extra expense, if you can call it that, was extremely small in comparison to using such items as audio-visual equipment.

The measurement devices to be utilized are designed in such a manner as to facilitate the developing and/or evaluation of student imagination. As diverse as many of the items initially seem, the underlying purpose is the same.

1. Pre-test/Posttest - Each test consists of 48 items, ranging from blank fill-ins on equipment, to various ceramic processes. The information tested in these items come directly from the mini-programs. The pre-test is intended to set the stage for information covered in class, plus act as an awareness device in opening the student's eyes to that which will follow. The posttest acts as a reinforcer to those who may do well, and as a reinforcer to those who may not do well. In either case, these tests act as large reviews of the information covered.
It is only the prescribed cognitive subject matter that can act as a true indicator of knowledge gained, which in turn will aid the students' imagination and later evaluation.

2. Ceramic Redesign Test - This test, which has a pre-test and posttest function, is one of the indicators of whether or not there has been development of student imagination. In its pre-test function, the test measures the students' imagination before the course has begun. In its posttest function, the test measures the development of student imagination as a result of the process he has participated in. The exact format of the test is rather simple. The student is presented with a series of drawings representing ceramic works which are "complete" in their composition. The task of the student is to redesign these works in drawn form. To redesign the works literally would no doubt result in utter frustration for the students because of the lack of manual dexterity, etc. Utilization of this type of test, and its impact, is dependent on cognitive subject matter that has been learned by the student. Without a
sufficient amount of information to fall back on, the imagination will come to a stalemate with the ceramic examples in the test. If the examples are not redesigned by the student, it will be evidence to support the claim that cognitive subject matter attainment is a major factor in developing the imagination, and conversely if they are all redesigned.

3. Mini-programs - The cognitive subject matter will be initially presented by the "free-form" mini-programs. It is these programs upon which the weight of information attainment rests. Granted, there are lectures and demonstrations which accompany the programs; however, these factors which share a joint-adjunct position, are not tested in the Pre-test or Posttest. It is these activities which the teacher is encouraged to individualize.

Each frame in the mini-programs is designed in such a manner that they can stand on their own. The information presented on each frame, may or may not, call for an overt response; however, each frame does call for covert responses. This apparent lack of active responding is not dependent on a
lack of responses that could have been called for overtly, but dependent upon the inherent nature of the information. If the frame contains an illustration, or is considered as extremely simple piece of information to record into a working short term memory, there is no overt response called for. Hence, if the information is considered difficult, and overt response would be called for. This brings up the question of the validity of such a procedure. The validity can only be viewed in light of student development, and performances on the various tests.

4. Self test - Each mini-program is followed by a demonstration or lecture by the teacher, and a self test. It is the self test which acts as a check point for determining student comprehension, and a review of the information covered in the mini-programs. Here again, the purpose is to aid in developing student imagination.

5. Ceramic Connoisseurship Test - This test, which goes beyond the appreciation of ceramic works to measure the student's understanding of details, techniques, and principles of ceramics, will test the critical
judgment of the students. For the student to demonstrate those critical judgments it is necessary for him to develop specific competencies as dictated by the mini-programs, demonstrations and lectures, and readings of works. These competencies are fostered in the cognitive subject matter areas of the course.

6. Evaluation of Ceramic Works - It is here that the actual works produced by the students will be evaluated. As the students learned to make critical judgments of other works other than their own, conversely their works will be evaluated in a similar manner by two art teachers on the staff. The teacher utilizing the course materials initially will not be included; however, he will supply the course grade, which includes student participation, attendance, performance on the mini-programs, quality of works completed, etc.

Viewing all six areas previously mentioned, the student's imagination will have more than an ample opportunity to be developed through cognitive subject matter competency and to be evaluated. Reviewing the specific areas, we find that cognitive development is heavily emphasized. It is this developmental aspect which hinges
its usefulness on how the student performs on the Ceramic Redesign Test, Ceramic Connoisseurship Test, Pre/Post test, self test, and the mini-programs. The actual works produced by the students will establish the development of the imagination in the productive aspect.
RELATED RESEARCH

Over the past fifteen years there have been literally multitudes of research reported on the usage of certain curriculum models designed around some specific aspect of either creativity, imagination, or both.

The aim of the related research section is to divide that which one must know to understand the complete relevance of this report, from that information which is deemed "nice to know." Obviously much research may be relevant to the study of creativity. But I have had to exclude all but those that are most highly relevant. Some of the more important areas are mentioned in the report and footnotes. Again, much of the information was omitted because more recent data covering essentially the same material were available.

In spite of the high degree of selectivity, there are bound to be repetitions of concepts. And obviously contradictions occur in the expression of certain writers. This is expected in an analyses of creativity and imagination, and especially when it is utilized in reference to
programmed instruction.

What is Creativity

1. Creativity is production of new thoughts, a new idea or process, by a synthesis or analogy with previously known elements.

2. Creativity is essentially an individual process which may be accelerated by interaction with other members of a group.

3. Creativity is part of our general life.

4. The process of creativity is the making of new combinations of thought and/or things.

5. The efficiency of the creative process can be increased by increasing the availability of the thoughts and/or things which are going to be provided.¹

Definitions of Creativity

First Definition: Creative activity through educational experience and inductive reasoning makes it possible

to develop something in addition to the knowledge and design achieved to date.

Second Definition: Creative activity is an aim for perfection, whether it is spiritual, temporal, practical, or functional perfection.

Third Definition: That technique, design, and expression are components of the creative process in that they are for personalities like an onrushing flood picking up objects. As the individual progresses, gathers experience, confidence, and so forth, he retains the more significant and they become a part of him.²

What Creativity Does

1. Creative activity on the part of the individual leads to the production of something new and unique, whether a problem, a product, or a concept.

2. Creativity improves a person's ability to select from a variety of existing factors a solution or an approach that enables man to hold or reach a new position or stage of life.

²Ibid., p. 73.
3. Creative activity can unearth a combination of elements leading towards the utilization of the combination itself.

4. A now relationship is brought about by bringing together components provided by our culture and insight. This problem-solving activity is creative activity. Because of the complexity of our culture, however, our products and our concepts are complex beyond the comprehension of any single individual. The result of this inadequacy of the individual makes it essential that these individual insights, through intercommunication, combine in a chain reaction to provide a solution unforeseen by any single individual.3

Creative behavior, by its very nature, is spontaneous, inner-directed, ordinarily not capable of being elicited at all. Therefore, it is unpredictable and escapes manipulation and control. It is generally not amenable to experimentation. However, the study of creative behavior has not been neglected completely. Creative behavior has been confined to three aspects of creativity: its phenomenal side, productive thinking or problem-solving, and

3 Ibid., p. 75.
the composition of the trait of creativity. Attempts at interpretation are found in all three approaches: in the first, in terms of psychological dynamics (Also known as personality dynamics (1) The interactions among personality characteristics, especially motives; (2) the behavioral expression of personality characteristics in the process of adjusting to the environment); in the second, in terms of mental processes; and in the third, in terms of factor-analysis.

The Hierarchy of Behaviors

Behavior phenomena can be arranged in a hierarchial order, in which those lower in the hierarchy from the prerequisites for those next higher. The following six levels of behavior may be singled out for convenience:

---


(a) vegetative (involuntary bodily functions), (b) reflex, (c) conditioned response, (d) learned behavior, (e) problem-solving, and (f) creative activity. Only the first five levels of behavior have been subjected to extensive study and experimentation, the reason probably being that these levels involve an interplay of measurable input and output.\textsuperscript{6}

Creative Behavior

Creative behavior consists in any activity by which man imposes a new order upon his environment. It is organizing activity. More specifically, it is the original act by which that organization is first conceived and given objective expression.\textsuperscript{7}

Although creative behavior often does not appear as a response to external stimuli, it cannot take place without experiences which precede and trigger it. Since creative


\textsuperscript{7}Ibid., pp. 5-6.
activity consists in imposing organization upon the environment, it is necessary that man perceives the objects which he transforms and organizes, and that they become represented as percepts or concepts in his own inner world before he can do something with them constructively and creatively.\(^8\)

Because creative behavior is characterized by a unique output of its own which, although utilizing the output forms on all lower levels of behavior, displays an added new dimension - namely that of organization - it is suggestive to assume that the input necessary to feed creative activity likewise is different from all forms of input on lower levels of behavior by an additional feature which makes this input acceptable to the creative process.\(^9\)

Creativity, Growth, and Reproduction

An inherent connection between the creative process and the process of growth and reproduction has been hinted at not only by creative individuals on the basis of their subjective experiences, but also has been repeatedly

\(^8\)Ibid., p. 6.
\(^9\)Ibid., p. 6.
stressed by psychologists and biologists who have arrived at similar insights on the basis of studies in their respective fields. Freud claimed that sublimation (to direct the energy of (an impulse) from its primitive aim to one that is ethically or culturally higher) of the sexual urge "forms one of the sources of artistic activity" and that from it is derived the major part of the energy which, in the history of mankind, has been expanded toward the creation of cultures and civilizations. Otto Rank sees in the act of artistic creation a reenactment of the process of birth. William Stern views human creativity as the highest manifestation of the principle of self-expansion which, on the biological level, is expressed in growth and reproduction. This force, Bergson says, "has the choice between two modes of acting on the material world: it can either effect this action directly by creating an organized instrument to work with; or else it can

10 Ibid., p. 6.
12 Rank, O. Das Trauma der Geburt. Leipzig: Internationaler Psychoanalytischer Verlag, 1924.
effect it indirectly through an organism which, instead of processing the required instrument naturally, will itself construct it by fashioning inorganic matter."\textsuperscript{14} Sinnott expresses the same thought in this manner: "Just as an organism takes random matter and builds it into a living bodily pattern, so the man of art takes meaningless canvas, paint, and marble, musical sounds and the more subtle symbols of written and spoken words, and builds them into patterns..."\textsuperscript{15}

**Biological Self-Duplication in Creativity Activity**

In the creative activity of man, the material used for the construction of new forms is taken from the environment external to man, and the process of construction takes place in this same external environment. Since the claim is made here that creativity is a reenactment of the biological process of self-duplication on the behavioral level, it is necessary to demonstrate that in his creative acts man imposes upon his environment an organization

which he borrows from himself, and that in this process he resorts to methods similar to those found on the biological level. 16

All truly creative activity necessitates, as a prerequisite, a process of identification. 17 The elements used in the creative process must, in some way, become part of what is called the "phenomenal self" 18 or what was later known as the "body-image," before man can subject them to the process of creative synthesis, because the products of creativity serve to enlarge the phenomenal self or the body-image. 19


17 Healy, W., and Bronner, A.F. The structure and meaning of psychoanalysis. New York: Knöpf, 1930, p. 248. Freud, who maintained that sublimation is at the root of creativity, was inclined to believe that "sublimation is always preceded and made possible by identification."


19 Schilder, P. The image and appearance of the human body. New York: International Universities Press, 1950, p. 202. The body-image can shrink or expand; it can give parts to the outside world and can take other parts into itself.
In enlarging his body-image, man resorts to the process of self-duplication. It must be pointed out, however, that man's creations are not to be looked upon as copies of himself, but rather as symbolic representations of some of his structural or functional aspects. They are not related to man by identity but by analogy or likeness. Therefore, it is more appropriate to speak in this case of self-transformation rather than self-duplication. In the field of art, poetry, and music, this process of self-transformation is known as self-expression.²⁰

The amount of self-transformation or self-expression involved in creative acts depends on the product created. In the following classification of man-made structures, those lowest in rank involve the least amount of self-expression or self-transformation in their production, those higher in rank an increasingly larger amount:²¹

1. Existential structures - those man-made structures which are of use to man by virtue of their specific


²¹ Ibid., pp. 12-22.
construction or form and their availability in a particular location. Examples of such structures are houses, furniture, bridges, highways, dams, and so on.

2. Operational structures - a structure with which man actively does something or has something actively done for him. They include tools, machines, and instruments.

3. Human social structures - organized groups and institutions. Attention will be given here only to those social structures which have grown or evolved, not to those which have been founded - such as clubs, industrial organizations, and so on.

4. Artistic and symbolic structures - objects representing materializations of visions, of ways in which their creator perceives or imagines whatever his creation represents. These objects, therefore, constitute objectifications, projections or expressions of such visions, ideas, perceptual forms and relationships. The organization of these structures reflects an inner organization of man.
Soma and Psyche

If human activity is an expression of biological creativity on a behavioral level, involving a translation of body organization into organized mental processes— an extraversion of soma (all of an organism, the body) into psyche (soul, self, or mind), so to speak— we must assume a system of communication between soma and psyche. 22

It is relatively easy to show how tools and machines came to represent symbolically certain motor aspects of man, because man can become aware of the movements of his bones and the functions of his muscles. Whatever he does not directly observe with his peripheral sense organs (involving the surface of the body) he can experience through the kinesthetic sense (a sense mediated by end organs located in muscles, tendons, and joints and stimulated by bodily movements and tensions; also sensory experience derived from this sense). 23

To demonstrate a similar communicative link in the creative process leading to the invention of instruments

is far more difficult, because instruments constitute extensions of man's sensory apparatus and nervous system. Although we can acquire knowledge of many of these structures and their functions by observing them in the bodies of others, it is unlikely that, in all those instances where instruments bear striking similarity in basic design with human organs or are analogous in function to them, the inventor of such an instrument had knowledge of that structure in his body which his creation resembled or is analogous to. For example, the similarity between a photographic camera and the eye is not due to man possessing a knowledge "a priori" of his eye, to an "idea" of the idea in the Platonic sense to which man has access because the eye is part of him, but is due to the properties of light, the laws of optics, etc., upon which both structures depend. Such argumentation certainly has much in its favor, and is doubtlessly valid to a considerable degree. On the other hand, we should not dismiss the possibility of a knowledge of ourselves which comes to us through channels other than our sense organs, peripheral or internal. We have no right to exclude the possibility of other channels of communication between psyche and soma.\(^{24}\)

\(^{24}\) Ibid., p. 27.
The Social Need for Creativity

Many of the serious criticisms of our culture and its trends may best be formulated in terms of an inadequate supply of creativity.25

In education we tend to turn out conformists, stereotypes, individuals whose education is "completed," rather than freely creative and original thinkers.

In our leisure time activities, passive entertainment and regimented group action are overwhelmingly predominant while creative activities are much less in evidence.

In the sciences, there is an ample supply of technicians, but the number who can creatively formulate fruitful hypotheses and theories is small.

In industry, creation is reserved for the few - the manager, the designer, the head of the research department - while for the many life is devoid of original or creative endeavor.26

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26 Ibid., Rogers "Conditions Fostering Constructive Creativity," 1954.
There is general recognition, on the part of those outside the academic fold, at least, of the importance of the quest for knowledge about creative disposition. I can cite recent evidences of the general interest in the discovery and development of creative talent. Large industries that employ many research scientists and engineers have held serious meetings and have had symposia written about the subject.27

In various branches of the government employers are asking how to recognize the individuals who have inventive potentialities. The most common complaint I have heard concerning our college graduates in these positions is that while they can do assigned tasks with a show of mastery of the techniques they have learned, they are much too helpless when called upon to solve a problem where new paths are demanded.28

For years there has been little concern for the use of creative individuals outside of the arts. This must change.


The Creative Process

The general outline of the creative process, including problem-solving, has been described by Graham Wallas as occurring in four stages: Preparation, Incubation, Illumination, and Verification. This theoretical formulation has been tried and found applicable by Patrick in three investigations of the creative process. Many other studies of creativity have also found Wallas' formulations useful. The stages can be briefly described as follows:

1. **Preparation.** In "Preparation" the person finds out about the problem situation; finds out what the problem is, what the difficulties are, what methods have been tried and have failed, asks what other people have done in the situation, reads up on what has been done before, and talks with people who have worked on it. The "Preparation" may consist of the person's total previous experience with a particular

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object or problem, with or without special study. This previous experience may be large, as with everyday objects. Or, it may be very slight, as with objects or situations experienced only once or twice before in a lifetime.

2. Incubation. "Incubation" is a very peculiar stage in creativity. It consists of the interval between the time when the person has completed "Preparation" and the time when a good idea comes to the person, or, as it is said, "Illumination" occurs. This time interval before a good idea appears is sometimes only a few minutes, sometimes overnight, as when a person "sleeps on a problem," and may be a week, or even several months. Incubation is an active period according to Wallas and Patrick, although the person does not report much conscious activity. The person seems to be preoccupied and abstracted. Incubation may go on during sleep. Or, the new, good idea may appear as if from nowhere while the person is doing some routine activity.

3. Illumination. This is the appearance of a good idea or good solution to the problem. All of the parts fall into a pattern that looks as if it would be
successful. The "incubation" stage ends when "Illumination" occurs.

4. Verification. This is the process of trying out and testing the good idea that is called the "Illumination."

Four Approaches To The Identification Of Creative Talent

There seems to be four significantly different approaches to the problem of identifying creative talent, depending on which of four aspects of the problem a person uses to gain his initial hold, i.e., the aspect of

(1) the product created, or
(2) the process of creating, or
(3) the person of the creator, or
(4) the environment in which creation comes about. 31

(1) The approach through products created is likely to be favored by those who are taking responsibility for the consumer's or society's welfare, such as the administrator of a business or of a public institution. It is the product of creation which can be shared among people. The

31 Mooney, Ross L. An address presented to the Research Conference on the Identification of Creative Scientific Talent held by the University of Utah on August 17-20, 1957. It appears in the conference report, published by the University of Utah Press.
way to proceed in selecting talent is to first get criteria for creative products and then move back from that to the identification of those who produce them.\(^{32}\)

(2) The approach through the process of creating is likely to be favored by those who are themselves creative individuals, e.g., painters, novelists, dramatists, musicians, sculptors. It is from sharing in intimate understanding of how other creative persons handle themselves during creation that an individual creator can gain some added wisdom for the heightening of his own creative capacity. To such a perspective, the ultimate criterion is therefore the psychological frame of mind which best serves the creator in handling himself productively during the process of creation. The way to proceed in selecting talent is to first get clear on the necessary frame of mind and then to find persons who show capacity for using and cultivating that frame of mind.\(^{33}\)

(3) The approach through the person of the creator is likely to be favored by those who are responsible for picking individuals to fit particular positions. The

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\(^{32}\)Ibid., Mooney, 1957.
\(^{33}\)Ibid., Mooney, 1957.
ultimate criterion, in this case, is the pattern of extrinsic signs which marks the creative person. The way to proceed in selecting talent is first to get clear on the pattern of discernible signs which will empirically separate one person from another in the direction of creative talent, to continually refine that pattern and use it to select persons.\textsuperscript{34}

\textit{(4) The approach through the environment is likely to be favored by those who are responsible either for the continuing care and cultivation of personnel, or for the explanation of changes taking place in persons because of cultural or physical surroundings. The ultimate criterion is the pattern of circumstances necessary for releasing creative production. The way to proceed in selecting talent is to first get clear on the environmental pattern required and then either provide environments with such patterns so that persons can become creative within them or go find already made environments having such patterns, wherein there will already be creative persons.\textsuperscript{35}}

\textsuperscript{34} Ibid., Mooney, 1957.
\textsuperscript{35} Ibid., Mooney, 1957.
These four approaches are not only different but, apart from high levels of sophistication, they also tend to be antagonistic to one another. None of the various approaches can agree on a central element, or group of elements, that will unite them in some manner. The need is for a way of taking hold of all these perspectives at once so that each can serve and support the others rather than threaten the others. To accomplish this goal, it is necessary to come to a perspective which is large enough to encompass all four within one system and deep enough to establish the interlocking function of all four.36

The Intra- And Inter-Personal Process in Creativity

The creative work is a novel work that is accepted as tenable or useful or satisfying by a significant group of others at some point in time.37

Novel in this context means that the creative product did not exist previously in precisely the same form. It stems from a reintegration of already existing materials.

36 Ibid., Mooney, 1957.
or knowledges, but when it is completed, it contains elements that are new. The novelty of the work depends on the degree to which it deviates from what exists. It is a measure of the distance between what has been achieved and what existed previously.\textsuperscript{38}

While novelty is a critical feature of creativity, if we attend solely to it we overlook the fact that creativity is not a single act but a process. Creativity results from both intra-personal\textsuperscript{39} and inter-personal processes.

As you have read previously, Wallas was one of the first to describe the processes involved in the development of creative ideas in terms of (a) Preparation - the stage in which the problem is investigated from all directions, (b) Incubation - the stage during which the individual is not consciously thinking about the problem, (c) Illumination - the stage during which the idea occurs, together with the psychological factors that immediately preceded and accomplished its appearance, and (d) Verification - in which the validity of the idea is tested, and the idea

\textsuperscript{38}Ibid., p. 311.

is reduced to exact form. The psychoanalyst Kris (1952, 1953) described the process as consisting of two major phases, inspiration and elaboration. During the inspiration phase the creative individual is described as "driven; he is in an exceptional state. Thoughts or images tend to flow, things appear in his mind of which he never seemed to have known." The second phase, elaboration, is characterized by labor, concentration and endeavor. Reichenbach, (1938) the philosopher, distinguished between the context of discovery and the context of justification to differentiate between "the thinker's way of finding his theorem and his way of presenting it before a public." Stein, on the other hand, describes the creative process as consisting of three major phases, hypothesis formation, hypothesis testing and the communication of results. He states that whether "stages" or synonymous terms are utilized to describe the

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40 Wallas, G. The Art of Thought, New York, Harcourt, Brace, 1926.
42 Reichenbach, H. Experience and Prediction, Chicago, Univ. of Chicago Press, 1938.
creative process they acknowledge the fact that the characteristics of the process are not separate or distinct but they overlap.\textsuperscript{43}

As far as personality and other psychological characteristics that the individual manifests as he proceeds through the course of the creative process is concerned, the early stages of the process are characterized by individual experiences that are a state of disequilibrium. The creative individual may actively seek to disturb the equilibrium he previously attained or he may be responsive to disequilibria already existing in the environment.\textsuperscript{44}

The creative individual also has the capacity to tolerate ambiguity. He has the capacity to exist in a state in which he does not comprehend all that he perceives or feels. He continues to seek solutions of the problem confronting him.\textsuperscript{45}

The creative individual possesses permeable boundaries between the regions within the self. This permeability is


\textsuperscript{44}Ibid., pp. 311-322.

related to his capacity for developing a series of hypotheses for future testing. Just as there needs to be communication between the individual and his environment to initiate the creative process so there needs to be communication between the inner personal regions if the creative process is to be continued. This permeability may be self-induced by a process that the psychoanalysts call "regression in the service of the ego," by selecting specific working environments, by taking drugs, drinking liquor, or it may occur when the person is distracted or devoting himself to activities other than those that are specifically relevant to his creative work. 46

Creative individuals have utilized a variety of such techniques. Levey (1940) reports that "...in order to produce a state of inspiration, Schiller kept rotten apples in his desk; Shelley and Rousseau remained bareheaded in the sunshine; Bossuet worked in a cold room with his head wrapped in furs; Milton, Descartes, Leibniz and Rossini lay stretched out; Tycho Brahe and Leibniz secluded themselves for very long periods, Thoreau built his hermitage,

Proust worked in a cork-lined room, Carlyle in a noise-proof chamber, and Balzac wore a monkish working garb; Grétry and Schiller immersed their feet in ice-cold water; Guido Reni could paint, and de Musset could write poetry, only when dressed in magnificent style; Mozart, following exercise; Lamennais, in a room of shadowy darkness, and D'Annunzio, Farnol and Frost only at night. The aesthetician, Baumgarten, advised poets seeking inspiration to ride on horseback, to drink wine in moderation, and, provided they were chaste, to look at beautiful women.\

In discussing Picasso's creative process Read (1948) states that his only wish has been desperately to be himself; in fact, he acts according to suggestions which come to him from beyond his own limits. He sees descending upon him a superior order of exigencies, he has a very clear impression that something compels him imperiously to empty his spirit of all that he has only just discovered, even before he has been able to control it, so that he can admit other suggestions. Hence his torturing doubts. But this anguish is not a misfortune for Picasso. It is just this

which enables him to break down all his barriers, leaving the field of the possible free to him, and opening up to him the perspectives of the unknown. 48

In respect to a hypothesis having some type of direction, even though it appears haphazard and disorganized, and example given by Wertheimer (1945) of Einstein's thought processes while working on the theory of relativity is a classic one. As Wertheimer reflects before the discovery that the crucial point, the solution, lay in the concept of time, more particularly in that of simultaneity, axioms played no role in the thought process - of this Einstein is sure. (The very moment he saw the gap, and realized the relevance of simultaneity, he knew this to be the crucial point for the solution.) But even afterward, the final five weeks, it was not the axioms that came first. "No really productive man thinks in such a paper fashion," said Einstein. Later, he added:

"During all those years there was a feeling of direction, of going straight toward something concrete. It is, of

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course, very hard to express that feeling in words; but it was decidedly the case, and clearly to be distinguished from later considerations about the rational form of the solution. Of course, behind such a direction there is always something logical; but I have it in a kind of survey, in a way visually.\textsuperscript{49}

During the time that criticism and evaluation are characteristic of the creative process, the creative individual assumes a new role. In addition to creator he is also audience. As Freud has stated in this respect, the hysteric is undoubtedly a poet, though he represents his phantasies essentially by mimicry, without considering whether other people understand them or not. The ceremonials and prohibitions of obsessional patients force us to conclude that they have created a private religion for themselves; and even the delusions of the paranoiac show an unwelcome external similarity and inner relationship to the systems of our philosophers. We cannot get away from the impression that patients are making, in an asocial

manner, the same attempts at a solution of their conflicts
and an appeasement of their urgent desires which, when
carried out in a manner acceptable to a large number of
persons, are called poetry, religion and philosophy. 50

When the final product has been accepted as tenable,
useful, or satisfying by a group of significant others, it
provides the creative individual with significant psycho­
logical feedback. By accepting the product and by regarding
it as creative the group indicates that it accepts and im­
plicitly approves of the needs which initially motivated
the creative person to deviate from accepted patterns and
to probe the unknown. In the process of accepting the
creative product the group manifests similarity and identi­
fication between its own wishes and those of the creative
individual 51 and that it has, in a sense, joined the individ­
ual in the creative process and become co-creator. 52 For

50 Freud, S. Preface to T. Reik, Ritual - Psychoanalytic
51 Loe, H.B. "The Values of Order and Vitality in Art," in
G. Roheim, Ed. Psychoanalysis and the Social Sciences,
New York, International Univ. Press, 1950, Vol. II.,
and Sachs, H. The Creative Unconscious, 2nd ed.,
52 Kris, E. Psychoanalytic Explorations in Art, New York,
International Univ. Press, 1952.
the group the creative product has fulfilled or given expression to certain needs. The creative product "says" things that the group has wanted to say but has been unable to. The creative product may also give new direction to the experience and behavior of the group.  

A culture fosters creativity to the extent that it encourages openness to internal and external experience. Orientations that result in rigid inner personal boundaries and that lead to passivity and the expectation that ready-made solutions are available for new problems hamper creativity depends on autonomy and independent inquiry.  

Society also encourages creativity to the extent that its value system includes a positive regard for change and novelty. And, it discourages creativity to the extent that social pressures to conformity are so intense that deviations are punished directly or indirectly through social isolation and ostracism. Similarly creativity is fostered

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54 Ibid., pp. 311-322.
by affording creative individuals high status and by rewarding them in a fashion congruent with their pursuits and not in a manner that may cause them to leave their specific lines of endeavor. In so doing, creative individuals are encouraged to continue their inquiries and they become models to younger generations as they embark on their own developments. Creativity, in the final analysis, is a function of the transactional relationships between the individual and the environment in which he lives.55

Obstacles To Creativity

The obstacles to creativity are many and varied in their concerns. Below is a list of obstacles that have been found to be a prime importance. Granted, there are more obstacles that may be more appropriate to a particular situation; however, these obstacles are those considered to be of a nature that elicits dullness, routine and dissatisfaction in respect to learning and performance:56

55Ibid., pp. 311-322.
1. When the productive goals are set by others.
2. When operating techniques are standardized.
3. When detailed operations are routinized.
4. When the work product is not seen as meaningful in a larger social context.
5. When the individual sees himself as almost useless.
6. When experimentation is specifically discouraged.
7. When the emphasis is upon quantity vs. quality of the end product.
8. When the differences in individual talents and the quality of individual talents is made irrelevant by standardization.
9. When problems which arise during the course of production are settled by authorization from superiors.
10. When the production of such works are seen by the individuals as being socially depreciated by others, especially by fellow participants.

Essential Themes

There are six themes or phases that can be observed whenever creativity is at work. These phases occur in group as well as personal processes of artistic invention or scientific invention. The themes or phases are:
(1) involvement-detachment, (2) speculation, (3) deferment, (4) autonomy, (5) purposiveness, and (6) use of the commonplace.

"Involvement-Detachment"

The process of creation requires both involvement and detachment, but neither can be allowed to prevail over the other. Rather, there must be a continual shifting back and forth between them.

Therefore, a painter contemplating the scene of a young boy fishing from the bank of a stream can involve himself by thinking in terms of the boy as that one boy, or he can detach himself by thinking in terms of the boy as representing the larger world. Unless he can identify his thoughts with the boy's thoughts, his picture will be cold and unsympathetic; it will have no power to stir the emotions. But unless he also can stand back and see the universal "boyness" of the boy (this is strictly a Platonic notion), his picture will degenerate into mere attractiveness or even sentimentality; it will have no depth of meaning. In the process of painting, he will oscillate between these two attitudes and, if successful, the result
will reflect both.\textsuperscript{57}

"Speculation & Deferment"

The speculative nature of the creative process affirms that what is not yet actual is possible. Since the creative process is vectored toward novelty, the actual is only the starting point from which to leap to new ideas. To remain with actuals would be to repeat, and repetition opposes creativity.

In the example of painting, the actual scene is a little boy fishing, but the artist does not accept this at face value. He speculates; and as his imagination runs free, the image of the small boy in contrast to the background of great hills and forests evokes a feeling of loneliness - at first tentative, then compelling. Actually, the boy may be as happy as a hog in a cornfield, but the artist transforms him by adding a new insight of his own that was not there before.\textsuperscript{58}

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\textsuperscript{58} Ibid., Gordon, 1956.
"Autonomy & Purposiveness"

In the process of creation the object being worked on begins to have an autonomous, independent life of its own. It makes suggestions to the creator; so to speak, it takes a hand in fashioning itself.

An artist starts to apply some paint to canvas with anything in mind from a vague notion to a nearly completed image. At a certain point, he becomes aware that a change has occurred. When he began to state his thoughts in paint, the canvas was blank. He was active; it was passive—something to be worked on. Now that a little paint and a little thought have gone into it, the canvas itself has become active and influential. It may lead him on to complete the picture in a form quite different from what he originally contemplated.59

"Use of the Commonplace"

Odd as it may seem, mediocre (ordinary) notions are important ingredients of the creative process, in the sense that every brilliant synthesis must have its beginnings in the commonplace. The artist who stumbled across the boy

59 Ibid., Gordon, 1956.
fishing sat down to familiarize himself with a scene as trite as a calendar picture. But this embodiment of mediocrity was what evoked the artist's leap into the concept of loneliness, and the loneliness idea destroyed the trite starting point.  

Creative forms of Imagination

According to college presidents Donald Cowling and Carter Davidson, our mentality includes these seven essential capacities:

1. Ability to concentrate.
2. Accuracy in observation.
3. Retentiveness of memory.
4. Logical reasoning.
5. Judgment.
7. Creative imagination.

Functionally, these faculties overlap. Creativity calls

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60 Ibid., Gordon, 1956.
for concentration as well as observation. Logical reasoning, especially synthesis, calls for imagination; and judicial judgment falls short unless it thinks up the "what-elses" and "what-ifs." 62

From a functional standpoint, those seven capacities can be roughly grouped into four mental powers, with concentration playing a large part in each: 63

1. **Absorptive power** - the ability to observe, and to apply attention.

2. **Retentive power** - the ability to memorize and to recall.

3. **Reasoning power** - the ability to analyze and to judge.

4. **Creative power** - the ability to visualize, to foresee, and to generate ideas.

Admittedly, however, such classification is merely an approximation to facilitate understanding. The fact is that far too much is still to be discovered about the workings of the human mind. 64

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64 Ibid., p. 109.
Creative thinking

The creative thinker, whether artist, scientist, or inventor, is trying to achieve something new. He may be trying to solve a particular mathematical problem, or trying to express an idea in novel ways, or trying to achieve new and pleasing combinations of forms, colors, or word sounds.

Creative thinking in the arts has been the subject of much comment. The ideas often seem to "bubble up" in a seemingly spontaneous manner. This sort of thinking is similar to insight, and it seems likely that the ideas rise to consciousness after much unconscious rearrangement of symbols.\textsuperscript{65}

A great deal of controlled research is being done on creativity. For instance, attempts have been made to obtain objective measures of it.\textsuperscript{66} Using such tests, it has been found that creativity is not necessarily highly related to conventional measures of intelligence - that


is, to intelligence test scores.\(^67\) It seems to be a dimension of intellect not tapped by conventional intelligence testing. Other studies have been made of the stages of creative thinking (the creative process) and the personality traits of creative people. Basically, however, little about the cause of creativity is known.

**Personality Traits of Creative Thinkers**

There is evidence to show that creative people share common personality characteristics. Some evidence, obtained from objective and projective personality tests, indicates that they do. They are as follows:\(^68\)

1. Original persons prefer complexity and some degree of apparent imbalance in phenomena.
2. Original persons are more complex psychodynamically and have greater personal scope.
3. Original persons are more independent in their judgments.
4. Original persons are more self-assertive and dominant.

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5. Original persons reject suppression as a mechanism for the control of impulse. This would imply that they forbid themselves fewer thoughts, that they dislike to police themselves or others, that they are disposed to entertain impulses and ideas that are commonly taboo.

A knowledge of these important differentiating traits may enable us someday to find the antecedent conditions in early life which give rise to them and to the predisposition toward creative thinking. It can only be hoped that research will uncover some of the characteristics of family life which produce creative thinkers.69

Intelligence and creativity

A question often asked about intelligence is whether or not it is the same thing as creativity. One would think that they would be related, and they are in principle, for creativity is regarded as being an important component of intelligence. In practice, however, it turns

out that our way of constructing intelligence tests causes items to be discarded that measure creativity. Intelligence tests measure **convergent thinking** - thinking that is like other people's thinking - yet creativity is a matter of **divergent thinking**, which is unlike other people's.

Considerable research has been done on creative thinking. Out of it have come several batteries of tests designed to measure creativity. With tests such as these, researchers have set out to determine how closely creativity and intelligence are related. One such study is as follows:

Tests of intelligence and creativity were administered to 500 public school students in grades 6 through 12. A rather low correlation was obtained between the two types of tests. Then the experimenters selected a group of students who were in the upper 20 percent on creativity but not in the upper 20 percent on intelligence. These were compared with a group consisting of

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70 Ibid., p. 334.
students in the top 20 percent on intelligence but not in the top 20 percent on creativity. The two groups, despite a difference of 23 points in mean IQ, performed about equally well in school. However, students in the high-intelligence group were more highly approved by their teachers and considered to be more "achievement oriented." Students in the high-creativity group, on the other hand, were rated by teachers as showing more originality, more humor, more playfulness (and more violence) than those in the high-intelligence group.

From studies like this we have learned that creativity and intelligence as measured by tests are not highly correlated, at least above an average level of intelligence. Creativity and intelligence, as they were measured, are not the same thing. Individuals may be quite creative, performing well in school and contributing innovations to society, without being highly intelligence.

Creative personality is then a matter of those patterns of traits that are characteristic of creative persons. A creative pattern is manifest in creative behavior, which includes such activities as inventing, designing, contriving, composing, and planning. People who exhibit these types of behavior to a marked degree are recognized as
being creative.\textsuperscript{73}

**Traditional Measures of Creativity**

If school grades were efficient predictors of creativity, the identification of persons with outstanding creative potential would be simple. Not only certain school grades, but school grades in general, have been shown to have low validity in predicting creative performance.\textsuperscript{74,75}

Mere accumulation of knowledge does not appear to be sufficient for creative performance; it does not guarantee that the incubation and insight stages of the creative process will occur. One can easily cite examples in the academic world of people who are extremely learned in their fields, but who have demonstrated little creative behavior.\textsuperscript{76}

\begin{itemize}
\item \textsuperscript{73} Guilford, J.P. "Creativity," The American Psychologist, Vol. V, No. 9, September 1950.
\item \textsuperscript{74} Taylor, C.W. University of Utah Research Conference on the Identification of Creative Scientific Talent. Salt Lake City: University of Utah Press, 1958, pp. 3-19.
\end{itemize}
Evidence is gradually accumulating that traditional intelligence tests, at best, reveal only minor variations in creative performance; they do not directly involve the ability to create new ideas or things. In factor-analysis studies by many research workers, the factors involving the ability to sense problem areas, to be flexible in each of several ways, and to produce new and original ideas tend to be unrelated or to have little relation to tests used to measure intelligence. 77, 78 Chorness (1956) studied civilian Air Force personnel who had suggested ideas that were officially accepted by their organizations. He found that their approximate IQ scores (from the information scales of the Wechsler-Bellevue Intelligence Scale) were spread across the entire range of the IQ's of the sample of civilian personnel. 79

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D.W. Taylor (1958) found that the Terman Concept Mastery Test (designed specifically as an adult-intelligence measure for Terman's follow-up studies) had no significant correlations with supervisory ratings of scientists on creativity, productivity, or originality. Every other intellectual test in this study showed at least some significant validities with these criteria, but it could be argued that there was some restriction of range in the study.  

Getzels and Jackson (1959) and Torrance (1959) reported that if an intelligence test is used to select top-level talent, about 70 percent of the persons with the highest 20 percent of the scores on a "creativity" battery will be missed. Eighty percent, just 10 percent more, would be missed if the intelligence and "creativity" scores were completely unrelated. Torrance has replicated these findings with less restricted groups in yet unpublished studies. The two so-called creativity batteries, however, were not identical in composition, and might more safely be called "divergent-thinking" batteries until they are more adequately validated against suitable external criteria of

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The same type of naming problem still exists for the so-called intelligence tests. Among the nearly 60 dimensions of the mind discovered to date, more than 50 should now be described as nonintelligence intellectual dimensions, according to C.W. Taylor (1961), even though intelligence has often been very broadly defined.83

Guilford and Allen selected some 28 dimensions of the mind that they felt were relevant to success in the physical sciences. Using clearly stated descriptions as well as a sample item from a best test for each of these 28 intellectual characteristics, they asked each of a number of scientists of various types to rank these 28 characteristics for importance in his individual job. Nineteen of the top 20 were nonintelligence intellectual characteristics. Rated below the twentieth were several characteristics usually included in commonly used intelligence

The list of research projects designed to test creativity could go on and on. The main point to keep in mind is that numerous procedures have been developed, which to many are valid in their results, and to some totally invalid. Many of the approaches were multivariable or single-test studies. Nevertheless, there is still need for exploration and development of multiple criteria of creative performance. It is clear from the large criterion study of Taylor, Smith, and Ghisellin (1959) that no single criterion of performance is adequate or desirable, since some criteria are relatively independent of one another. In this study, approximately 50 criterion measures of the creative and other contributions of 166 Air Force scientists were obtained and factor-analyzed to yield 14 meaningful factors. Nearly one-half of these factors included aspects of creativity. One factor involved originality in writing; another entailed supervisory ratings on creativity (as well as on flexibility and independence); a third included two creativity ratings

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by higher-level supervisors; a fourth showed that the self-rating on creativity had the highest loading. Two other factors included patent rate in their clusters, and another may entail some form of creativity in administrative work, since organizational awards had its highest loading with that factor. 85

Creative Abilities

The best way known at present for determining what are the different kinds of abilities in an area is that of factor analysis. Each unique ability is found as a separate factor from the way in which test scores from a group of individuals intercorrelate. A good factor-analytic study begins with some guesses as to what unique abilities exist in an area and what kind of ability each one is. This means setting up some hypotheses. The factor analysis is then conducted in a way that should give the answer as

to whether each hypotheses is probably correct or not correct.

The initial hypotheses were as follows:

1. Individuals differ with respect to their ability to sense problems that call for solution.
2. Individuals differ with respect to the rate with which they can produce ideas. Also known as fluency.
3. Individuals differ in respect to flexibility of thinking. The creative person is an original thinker.
4. Creative individuals are superior in their abilities to analyze information and particularly to synthesize information.
5. Individuals may differ in their ability to redefine things; to transform the meaning or use or function of an object so as to give it a new role.

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87 Ibid., Guilford, 1950.
The results were as follows:

1. The results supported the existence of a separate ability to be aware of problems and it is called sensitivity to problems.

2. The hypothesis of a trait of fluency of thinking was more than amply supported, in that we have found four abilities, all of which can be regarded as kinds of fluency. Prior factor-analytical results had partially prepared us for this outcome. Word fluency was discovered by L.L. Thurstone some 20 years ago (1930). Ideational fluency calls for tests involving the rapid listing of meaningful words in a specified category or the listing of ideas to meet meaningful requirements. Associational fluency is the ability to list words that bear some relation to a given word. Expressional fluency is the ability to put words into organized phrases and sentences.

3. In the investigation of the hypothesis of flexibility of thinking we have found two different

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88 Ibid., Guilford, 1950.
abilities. One of these is spontaneous flexibility and the other is adaptive flexibility. The reason for these particular qualifying adjectives, "spontaneous" and "adaptive," is that in the first case the thinker is flexible even when he has no need to be, whereas in the second case he would fail to solve a problem if he were not flexible.

4. For the measurement of originality, quite a variety of tests will work. In every case some standard of quality has to be set up for acceptable responses or the task has very novel requirements for the examinee.

5. Two hypotheses of excepted factors were definitely not supported in spite of ample opportunity for such support. We found no unitary ability to analyze and none to synthesize.

Most of the creative abilities of fluency, flexibility, and originality, come in the category of divergent thinking. For texts of such abilities, there is no right answer and a variety of answers gives a good score. In terms of the model, ideational fluency is interpreted as the ability to produce divergently a number of semantic (meaningful)
units (ideas). Spontaneous flexibility is reinterpreted as the divergent production of classes.\textsuperscript{90}

\textbf{Creativity and the IQ}

All teachers must have made the observation that not all students with high IQs are creative and on the other hand, not all the creative students have high IQs. It is said that Thomas A. Edison was by no means a genius from an academic point of view. Shakespeare and other creative geniuses had little schooling, although it is not known what their IQs were.\textsuperscript{91}

I think it can be safely said that IQ tests have been concentrated on a very few factors in the structure of intellect. Whatever the strong components of an IQ test, they are probably very much confined to the cognitive category. Certainly, there is usually almost nothing involved in the way of divergent thinking or of transformations (placing something known into something else not


\textsuperscript{91}Ibid., Guilford, 1950.
previously known). A high IQ may help a student to show excellence in the way of creative performances but it is not a sufficient condition. 92

**Intelligence and Art Ability**

The history of research investigation concerned with intelligence and art ability raises some important questions concerning the present concept of intelligence, as it is represented by the common tests now in use in the grade schools, high schools, and colleges of our nation. These studies have a bearing, because of the research done in the field of art education, on the extent to which tests of intelligence are measuring creativeness. 93

After 1925, a number of important researches were done with large populations, and the measures of intelligence and art ability employed appear to be, insofar as it is possible, of an objective nature. The intelligence tests used were established and standardized measures, and the criteria employed in determining art ability were, for

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92 Ibid., Guilford, 1950.

the most part, reasonably objective in character. Methods such as counting the number of items which appear in a drawing were often employed, or in the case of aesthetic criteria, a number of qualified judges were used. The extent to which they agreed, regarding the works judged, helped establish the reliability of the evaluations made. In these researches, criteria were employed as well as trained judges. Carefully prepared visual scales were also employed in some of these studies. For the most part, these studies confined themselves to the elementary grades, where the evaluation of the art works could be based upon existing knowledge of the developmental characteristics of child art.\textsuperscript{94}

At the elementary level the best-known study done with children's drawings is that of Florence Goodenough. Her Draw-a-Man Test is still being used. She found close relationships between the conceptual development shown in children's drawings and their general intelligence up to about the age of ten. After this age, there is a sharp decrease in this relationship. She felt the drawings appeared to take on characteristics of special ability in

\textsuperscript{94}Ibid., pp. 246-247.
adolescence in which aesthetic considerations might be thought of as becoming increasingly of more importance.\textsuperscript{95} The high scores on her test reveals that the test mainly measures the child's powers of observation and memory. Her research tended to show very low correlations of intelligence with art ability after the third-grade level. In 1926 Goodenough stated her conclusion, "Art ability is a negligible factor at these ages as far as influencing the score is concerned."\textsuperscript{96}

In 1936 Tiebout and Meier did a follow-up study to the Goodenough. They used a sample of a hundred children in each grade from the first through the seventh. Each subject made three paintings to be judged on the basis of aesthetic quality achieved. The judgments were made upon the carefully prepared visual scale developed by Tiebout. Tiebout and Meier conclude:

"Thus while a close relationship does not exist between ability to achieve aesthetic quality in compositions and general intelligence, as is the case with drawings used as a general means of expression at the younger


\textsuperscript{96}Ibid., p. 82.
ages, there is a tendency toward some relationship in the lower grades in contrast to the upper where the correlations are approximately zero."\(^97\)

These findings were later supported by Bird,\(^98\) Hurlock and Thomson,\(^99\) and many others.\(^100, 101\)

**Creativity and the Nature-Nurture Problem**

On the academic question as to whether individual positions on the primary intellectual abilities are determined by heredity or by environment there is opinion all the way between the two extremes. On the one hand there are those who will tell you that a creative genius is entirely due

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to a lucky accident of a certain unique combination of
genes. At the other extreme there are those who say that
the primary abilities are generalized, learned habits or
skills, produced by certain kinds of practice.\textsuperscript{102} Heredity
probably does determine limits, both upper and lower, with­
in which development can occur. Experience or learning may
have considerable room within which to operate and to pro­
duce results. The finding of a very large number of dis­
tinct intellectual abilities definitely means that the
combined effects of heredity and learning do not produce
uniform results in all areas of mental functioning.\textsuperscript{103}

No one knows as yet how we can best educate for
creativity. The better teachers have probably always
made some contributions in these directions, often without
being able to say explicitly just what they did or why.
On the other hand, it is suspected that poor teaching has
actually many times put the brakes on development toward
creativity, or, at best, has had no net effect one way or
the other. It is likely that the normal conditions of mass

\textsuperscript{102} Ferguson, G.A. "On Learning and Human Ability," Canadian
\textsuperscript{103} Guilford, J.P. "Creativity," \textit{The American Psychologist,}
education are on the whole inhibiting to the development of creative individuals, for creativity is highly individualistic. A few general suggestions can be ventured, without adequate empirical support for many of them.\textsuperscript{104}

The same is true with my research. In the sections covering examples of student work, Student Questionnaire, and Teacher Questionnaire it is obvious that there are a great many contradictions, however, the exact reason for these developments can only be guessed at empirically, and hardly proven even when observing the actual instructional situation. Even though the problem is a vital one to bringing about success, the answer still seems far from view.

\textsuperscript{104} Ibid., Guilford, 1950.
PROGRAMMED INSTRUCTION

The following section encompasses basic information about programmed instruction. Even though the information is more of a literary search, it does present ideas that have a direct bearing on the utilization of programs in art. The items covered are as follows:

1. Brief History of Programmed Instruction
2. Characteristics of Programmed Instruction
3. Some Comments on These Characteristics
4. What Programmed Learning Is Not
5. Uses of Programmed Instruction
6. Should Art Instruction Be Programmed?
Brief History of Programmed Instruction

One of the earliest programmers was Socrates, who developed a program for geometry, which was recorded by Plato in the dialogue, *Meno*. It was Socrates' habit to guide his followers to knowledge by conducting them conversationally along a path from fact to fact and insight to insight. The similarity between his method and the contemporary use of programming is easy to observe.

The newest arrival upon the programming scene is the tutorial method. This was perfected by the colleges of the great English universities and taken up by many of this country's colleges in one form or another. The continuous exchange of questions and answers between the tutor and his student, the unfolding of information and explanations, and the constant selection of new material on the basis of the student's mastery is indeed a forerunner of programmed instruction.

The antecedents of current programming practices could be explored indefinitely; however, it is clear that the origins of programming are not essentially new. The method as it is now employed may be considered to derive from dynamic efforts begun in the 1920's.
In 1926, Sidney L. Pressey, an Ohio State University psychologist, made public his pioneer studies on the first recognized teaching machine. Pressey's model originally conceived as a testing machine that presented a series of questions to a student and informed him immediately whether his reply was right or wrong. Despite the promise of his experimental results and his interests, along with others, in encouraging further research, the movement in behalf of such devices lost its impetus. There are at least two explanations for this. First, no provision was made for systematic programming of materials to be used in these machines, and, second, the onset of the depression and its impact on social conditions and education offered an unfavorable environment for an "industrial revolution".


in the nation's schools.

In 1934, James K. Little, an associate of Pressey who used the unsophisticated programs and rudimentary machines available at the time, concluded that students profited markedly when informed immediately of the accuracy of their response to individual test items. His was the first systematic study of the impact on learning of auto-instructional methods and devices. Subsequent studies from 1948 to 1950, all learning on the test approach of Pressey's original work but not yet employed material organized in the sense of later reinforcement theory, substantiated the view that prompt knowledge of results enhanced the capacity of the student to learn.

\[109\] Little, op. cit. (Lumsdaine and Glaser, pp. 59-65).


\[113\] Briggs, L.J. "The Development and Appraisal of Special Procedures for Superior Students and an Analysis of the Effect of "Knowledge of Results,"
By 1954 greater knowledge in the science of behavior, especially about the analysis of learning behavior, and a demand for education on an unprecedented scale that strained every educational resource, created a vastly different set of circumstances. In this fresher climate, two Harvard psychologists, B.F. Skinner and James G. Holland, devised auto-instructional methods which have served the current generation as the bases for its own excursions into programmed instruction.

Approximately ten years later came the first experimental results reflecting reinforcement theory. At both second- and sixth-grade levels, Douglas Porter observed that pupils learning spelling with the assistance of programmed material and teaching machines achieved more than pupils taught by the more conventional method. Holland also reported the success he had with programmed material which he and Skinner employed in courses in behavioral psychology at Harvard. Even after expanding the number

of items in the program from 1400 to 1800, as a consequence of evaluating student responses to the program, errors by students were cut by almost half, and the total time required to complete the subject matter was reduced.116

Toward the close of the fifties and the start of the sixties the number of studies increased. Most of them, if not all, have verified the previously mentioned generalizations about programmed instruction. John Blyth summarized his experience in teaching logic on a programmed basis at Hamilton College in this way: "We waste no class time on routine checking or drill. In the classroom we could presuppose a common background of experience. We could usually count on a working command of basic concepts and principles. There was a great increase in interest and improvement in morale."117 Against this background of student preparation, Blyth reported greater achievement — higher grades, fewer failures, and a decrease in the actual


time spent in class by the students.

Some research found that programmed materials used in a high school physics course added significantly to achievement when employed as a supplement, and that such materials could be counted on to supply instruction independent of lectures and recitations.\(^{118}\)

Other educational systems followed the schools, colleges, and universities into new fields of programmed instruction. Industrial training specialists concerned with educating adults found ways to apply learning programs to their problems. Today such companies as Bell Telephone, Polaroid Corporation, Corning Glass Works, Reynolds Aluminium, and Hughes Aircraft Company are actively involved in the writing and utilization of programmed materials.\(^{119}\)

Similarly, public agencies, civilian and military, local, state, and national, have investigated the benefits to be obtained from programmed instructional materials in their own training activities. Among the major benefits are such items as cost reduction in respect to training


employees, reduction of training time, more efficient training programs and a greater standardization of the knowledges and skills needed in the particular job.

It would seem fair to say that research in the use of programmed instruction has affected every part of the American educational structure. From elementary students to adult trainees, from college classrooms to Air Force installations, experiments have probed the potentialities of programmed instruction. But this research is only a beginning. Much more has to come before it comes possible to assess the method adequately.120

Characteristics of Programmed Learning

A program utilizes the principles of reinforcement to make certain that learning actually does occur.121

Successful programs should embody a number of common characteristics which, taken together, are the identification mark of programmed instructional materials.


121 Those points were suggested first by David J. Klaus of the American Institute for Research in comments he made in October 1960, in "Some Observations and Findings from Auto-Instructional Research," Pittsburgh, Pa.: American Institute for Research, 1960, mimeo.
1. **Assumptions stated clearly in writing.** A program writer has to make certain assumptions about the student to whom his program is directed. One of these is that he reads within a particular vocabulary level that is consistent with the language of the program. A second pertains to the student's background in the subject matter. Together, these and whatever other assumptions must be considered for the clear presentation of a specific subject should be put down explicitly in writing before the program writer begins to arrange his learning material.

2. **Explicitly stated objectives.** The program writer must determine the goals - or objectives - of the program. These include the defining of those knowledges, skills, and attitudes that the student is expected to acquire through completion of the program. As far as possible, all the objectives should be defined in operational, observable, measurable terms in order to facilitate the construction of the program and its subsequent evaluation.

3. **Logical sequence of small steps.** Subject matter, broken down into fragments of information, is
arranged in an orderly sequence of growing difficulty so that the student may progress steadily from one point in the program to the next. Not only does this logical, deliberate development of the learning material simplify the acquisition of knowledge, it also tends to reduce the number of student errors because the previous steps have prepared the student to respond correctly to the new stimuli. Small steps emphasize the gradual nature of the increase in complexity and the smoothness of the transition from one item to the next. Moreover, the change is one of quality as well as quantity, for the information grows in both depth and amount at each step.

4. Active responding. Programmed learning requires interaction between the student and the program. In the first few items of any program, the stimuli usually are so arranged that the responses they seek are quite simple. As the student complies and receives reinforcement for doing so correctly, he establishes a pattern of stimulus-response interaction.

5. Immediate feedback of information. As soon as a student makes each response, the program informs him of his correctness or incorrectness. The more rapidly this check— or feedback— follows his response
the more effective becomes reinforcement or extinction, as the case may be. This is of vital importance because reinforcement theory stresses that a student learns from the consequences of his responding, not from the making of responses itself. At each step the student is thus informed of how well he is doing. The check keeps him from compounding error.

6. Individual rate. For a long time educators have recognized that students learn any single unit of material at different rates. These differences in the rate of learning—and all that they imply about needed review, repetition, and additional materials have been taken into account in the theoretical aspects of learning. Because a program usually permits a student to hover over a single item as long as he desires, because it contains built-in items for review, and because the several techniques of programming allow a student to proceed rapidly or slowly according to his own accomplishments, programming can be said fairly to accept and take advantage of individual differences in the rate of learning.

7. Constant evaluation. The use of programmed materials
enables a teacher to keep two constant gauges on learning activity. The first concerns the program. From examining the student responses to the items he can obtain an approximation of the program's success. Large numbers of errors, particularly large amounts of mistakes on specific individual items or sequences, signify that the program writer has taken too much for granted, or has not confined himself to small steps, or has not developed the content with sufficient clarity. The teacher thus gathers objective data upon which to improve the program.

The second gauge is on the student's progress. Not only can the teacher keep track of each student's position in relation to the entire program, but he also can pinpoint his assistance whenever one member of his class runs into difficulty. This more exact knowledge about the progress of every student allows him to plan other learning experiences of a meaningful and helpful kind.

Some Comments on These Characteristics

Although agreement is general on the principles and
characteristics of programmed learning, there is certainly no unanimity on how they should be applied in actual programming. For instance, in examining the selection of a paradigm for programming, differing analyses appear as to what constitutes a small step. There is agreement that responding by the student should be active, but disagreement on the degree of activity that is essential to assure learning. For example, is selection of a response from a listing of alternatives sufficiently active, or must the student construct his answers without benefit of a multiple-choice grouping? These and similar questions confront programming at all levels.

**What Programmed Learning Is Not**

In relation to establishing some facts as to what programmed learning is it is equally important to have a good idea of what programmed learning is not.

Programmed learning is not an audio-visual aid. Because of the wide interest in the teaching machine, programmed instructional materials often have been considered part of the scheme. Such categorizing may cause many educators to consider programmed learning as another audio-visual aid, like films, projectors, recording instruments, and slides
developed for classroom use. Most audio-visual aids are either response or stimulus devices, whereas programmed learning is an effort to complete the total educational model - stimulus, response, reinforcement.

Programmed learning is not a test. Initially, a programmed sequence has the appearance of a test, but there the similarity ceases. It is a teaching method, not a testing method. Programmed material seeks to supply understanding. To construct a test and call it a program places all the burden for learning on the student, whereas an effective program assumes the major portion of that responsibility, enabling any normal student to master its content.

Programmed learning is not a panacea. Programmed learning is not a cure-all for educational problems. It is a method for imparting knowledge and insight. It is not the only method.

Programmed learning per se is not a solution to the shortage of capable teachers nor an answer to an inadequate school budget. Occasionally one hears that teaching machines and programs will replace teachers. This is wrong. The program is intended to supply the student with the basic information of a given subject and free the
The teacher from the drill-type exercise he must engage. This is not intended to imply that programs can supply only the rote kind of information. While the student acquires a foundation in a subject to be ready for the far more important consideration of causes, relationships, and applications, the teacher will be released to undertake more creative assignments with students who have been prepared for the challenge. 

Uses of Programmed Instruction

Although programs have proved their usefulness in every phase of education, over a period of time they very well might affect the internal arrangement of instructional procedure. Experiments already have raised significant questions about the conventional order and structure of the educational scheme.


There are basically four ways in which programmed instruction can be utilized. These particular uses are not necessarily restricted to the method of instruction traditionally known as programming. It should be understood that programming borrows many of its principles and theory from traditional methods of instruction. Programming is an endeavor to take the best of each method and utilize it in a manner that is highly related to the development of student learning outcomes. The uses are as follows: 124

Complementation. Both commercial programs and units developed by individual teachers can be used to complement instruction. In other words, for a given objective a programmed segment can replace the customary form of instruction. The sequence may be employed for a few minutes a day for a brief period of time.

Another means of complementing instruction is to introduce a brief sequence that exercises valuable skills not normally challenged by the curriculum.

introduction of such programs does not interfere with the continuing instructional process while it contributes significant information and experience. Nor are mastery and retention of this knowledge likely to be affected by the other contents of the course.

**Enrichment.** Enrichment units relate to the regular curriculum and provide enhanced understanding of it. They accord expanded learning opportunities for qualified students while allowing the teacher to give individual attention to all the students in his class. They do not pose any problems to the organization of the standard curriculum. Enrichment units might include both advanced subject matter and more problem-solving opportunities in the context of the regular curriculum.

**Remediation.** Another approach to introducing and utilizing programmed materials in the classroom is in the form of remedial exercises. An area of difficulty can be programmed to give learners encountering trouble with the conventional instructional procedure another opportunity to attack the subject matter. One possible benefit of such units is that over a period of time they might be revised and used for the initial
instruction, and prevent the need for corrective measures.

Review. Although review may be regarded as supplying assistance of a remedial type to students, there are times when a teacher does not know beforehand how much repetitive material to include in his instructional plans. In such cases, a review of portions of previous instruction illuminates the situation. Programmed sequences work well at these moments. Pressey has urged the consistent, coordinated use of programs as an adjunct to regular instruction; that is, all students would use auto-instructional materials as a review in the normal operation of the curriculum.\(^{125}\)

Should Art Instruction Be Programmed?

The question of whether or not art instruction should be programmed, is for all intense reasons, in the same position as other instructional matters where the exact implementations and implications have not been thoroughly explored in any meaningful depth. However, the major question as stated

by Ecker is "...whether art instruction can be programmed; and, if the answer is "yes," whether art ought to be pro-
grammed. The assumption that there must be a correct
answer—-that there is a right way of practicing art—is
the question to be answered..."126

Psychological studies have shown that learning is the
most efficient when (1) the subject matter is studied in
logical order, and (2) when the student is actively involv-
ed in the learning process.127 These two facets, which are
basic components of programming, can be interpreted in
many ways. Their individual treatment is determined by the
writers personal views of programming, and his ideology in
respect to instructional philosophy and methodology.

Probably one of the most specific listings of reasons
for the use of programmed instruction in art is the list
given by Guy Hubbard of Indiana University.128

1. Devices may release instructors from the time consuming tasks. Teachers will be freed to concentrate on the less concrete, less easily definable yet probably more important problems in art teaching.

2. An appropriate body of verbal concepts could well be programmed into teaching machines in such a way that the art teacher could dispense with that part of his task.

3. In teaching art history, factual and visual knowledge could be presented... the student could work at an individual rate.

4. The classifying of arts of entire civilizations and the drawing of fine comparisons between works of the same artists could be presented.

5. The student could be directed toward an ever increasing scrutiny of detail.

6. The study of discrete topics that reoccur in the history of art, such as the treatment of the Madonna could be presented.

7. The debt that contemporary design owes to historical precedent could be illustrated.

Hubbard concludes his statements regarding the value of programmed instruction in the following manner:

"... during conventional learning practices the teacher
may have a similar idea but he has no clear indication of the response of his students until he gives a test. By the time he does this, the impact of the learning is gone and much is forgotten. The student also loses because he receives no support or correction for his thinking and learning. The instructional machine tests as it teaches and so contributes to the process in a most important way, namely to inform the student of his progress as it occurs."\(^{129}\)

On the other end of the question are those who believe that instruction in art cannot, or should not be programmed. In Luca and Kent (1968) it is stated that "...many art teachers feel threatened and fight off any attempt at using machines in systematized ways."\(^{130}\) In this particular view of programming there seems to be an over concern with the use of machines. However, the primary concern of programming is not in the hardware used, but in the program within the machine.

Smith and Smith (1966) go on to state that "...arbitrarily limited teaching programs do not provide a varied

\(^{129}\) Ibid., pp. 145-147.

enough feedback context to assure generalization and transfer...the novelty effect wears off after a period of time. Routine programs become boring."\footnote{131} The statement can be best summed up by Force (1970) when she stated that "...programmed instruction cannot be substituted for classroom experience."\footnote{132}

As far as the major problem facing the actual development of programs, Hubbard (1967) has reported that "...learning occurs best within the content that has meaning for the student...the machine is devoid of the features of normal daily environment...the limitations lie in (1) extreme artificiality of the learning situation; (2) in the difficulty of analyzing art so that a testing program can be devised."\footnote{133}


\footnote{132} Force, Lorraine S. "An Experimental Study to Examine the Response of Sixth Grade Students to Programmed Instruction In Art Designed to Correspond to Selected Ability Trait Variables," \textit{Studies in Art Education}, 11:45, Winter 1970.

Introduction

In only a few instances has a curriculum been utilized, or even considered, with the major emphasis placed on the cultivation of individual imagination. Generally, all curriculum models are characterized by strict behavioral outcomes, on-the-job training, or personal developments beyond the range of practical usage. As Carl Rogers stated, "Many of the serious criticisms of our culture and its trends may best be formulated in terms of an inadequate supply of creativity."

In education we tend to turn out conformists, stereotypes, individuals whose education is "completed," rather than freely creative and original thinkers.

Unless individuals, groups, and nations can imagine, construct, and creatively revise new ways of relating to complex changes, the lights will go out. Unless man can make new and original adaptations to his environment as rapidly as his science can change, our culture will perish. These remarks adapted from Rogers can be focused mostly on the part of the schools destructive tendencies toward
imagination, and a general lack of interest in the area.

**Purpose**

The major purpose of a curriculum model developed around an individual's growth through imagination is to create instructional situations where, not only creativity, but a type of sensitivity and connoisseurship can exist on a neverending continuum in respect to learning tasks and insights.

In the model itself, imagination serves as the overall purpose in the development or consideration of the philosophical foundations, diagnosis of individual needs, evaluation, and content selection and organization. None of these areas can exist on their own without taking on a distorted facade, and therefore weakening the model throughout.

Imagination is placed at both ends of the major categories to create an overall philosophical base from which all of the categories join to create a unit. It is this union which makes this model unique in light of vast separations in most curriculum models between categories.
Practical Implications

The model itself is designed in a fashion to be utilized with any type of instructional situation where education, and not training, is the prime goal. Generally speaking, areas where specific tasks are being taught for on-the-job applications, or vocational jobs, the model does not exhibit much promise if imagination is not their purpose.

As with some curriculums, the instructional procedures dictate to a large degree the entire process; however, in this model the instructional procedures and model categories are in essence the same in nature. Therefore, there is not a contradiction in goals and practices.

Categories

1. Philosophical Foundations - In this category, the conducting of a conceptual analysis and development of appropriate learning theory are the major components. The conceptual analysis searches out those ideas and concepts of a particular learning theory, and puts it to task in regards to logic and conceptual framework. Searching out the ordinary usage of language is the ultimate feature.

2. Diagnosis of Individual Needs - These needs, which
supersede, and to a great extent encompass those of society, can be broken down into two areas: that of a need-to-know and a sensitivity to the area of concern.

The need-to-know is the initial component in the area of needs. In ceramics, a need to have knowledge of a particular aspect is determined by the level of individual competency at any one particular time with the development of ceramic knowledge.

In conjunction with the need-to-know is the sensitivity to the area of concern, in this case ceramics. Here the student comes to a oneness with the materials, environment, and instruction. Metaphorically, the student does become the clay. However, he becomes even more in light of new ideology and philosophies of ceramic construction. It is the development of the student's sensitivity which holds one of the keys to imagination. It is this sensitivity which can only be developed internally. Teaching sensitivity can be done, but the final say is within the student's own mental conditioning.

3. Evaluation - In respect to developing student imagination, it is vital to remember that only cognitive subject matter can be truly evaluated in the traditional sense. For it is impossible to evaluate attitudes and skills
beyond an elementary level of competency. Ones attitudes toward the study of ceramics can only be reflected in his work. Also, the skills cannot be readily evaluated. Skills are a neverending process of change, even from day to day.

The major emphasis comes when the final work is presented before the teacher, who in this realm has become more of an artist/critic, and a developer of connoisseurship in his students, rather than a judge of what is "good" or "bad." Here the critic is responsive to his own educational procedures and practices, as well as those of the students. As with the development of connoisseurship, the critic through readings of ceramic works, instills within the students the art of perception that makes the appreciation of such complexity possible. What results from such connoisseurship is the application of a very complex intellectual net which is used reflectively by the connoisseur (the student) as they attend to experiences with the works that have been encountered. Connoisseurship is the art of appreciation and criticism is the art of disclosure.134 Hence, the result is students developing a

connoissourship of ceramic works while being evaluated in a critical frame of reference. In this way imagination can flourish in a healthy manner.

4. Content Selection and Organization - An overview of all relevant subject matter reveals that concept formation and later concept learning are the basis for all ideas within human learning in the cognitive arena. Granted, there are those areas where the study of concepts seem to blend into the woodwork; however, a closer examination reveals that there are always those concepts from which various information has emerged.

In regards to ceramics, concepts are quite vivid in their presence. For example: ceramic objects have form, line, color, and aesthetic value. It is those types of concepts which can create for the student a wide range of stimuli from which imagination can be elicited.
CURRICULUM MODEL

IMAGINATION

Philosophical Foundations

Diagnosis of Individual Needs

Evaluation

Content Selection and Organization

IMAGINATION
EVALUATION

Education is becoming increasingly valued as a means to meet the social and economic as well as the intellectual needs of society. To help educators meet their new responsibilities numerous private and public organizations are providing support.¹³⁵

Without question, educators are responding to requirements for evaluation. While educators have been busy doing evaluations, the fruits of their efforts have not provided the information needed to support decision-making related to the programs being evaluated. Many of the completed evaluation reports contain only impressionistic information. Though such information may be pertinent to the concerns of decision-makers, it usually lacks the level of credibility required by decision-makers to defend their

decisions, and seldom can such information be of material use in making important decisions. 

Defining Educational Evaluation

Usually educators have defined evaluation as the science of determining the extent to which objectives have been achieved. The first step in operationalizing this definition is to state program objectives in behavioral terms. Then one must define and operationalize criteria for use in relating outcomes to the objectives. Operationalizing such criteria includes the specification of instruments for measuring outcomes and standards for using assigned values to the measured outcomes. Standards may be either in absolute or relative terms. An absolute standard might be that students on the average should achieve at least some specified score on a selected achievement test. A relative standard might be that the group of students receiving a new program should achieve scores on a selected achievement test which on the average are higher than scores achieved by an equivalent group of

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136 Ibid., p. 5.
137 Ibid., p. 10.
students which received some alternative program. Such data are useful for making judgments about a project after it has run full cycle.\textsuperscript{138}

On the surface, the application of experimental design to evaluation problems seems reasonable, since traditionally both experimental research and evaluation have been used to test hypotheses about the effects of treatments. However, there are four distinct problems with this reasoning. They are as follows:\textsuperscript{139}

1. The application of experimental design to evaluation problems conflicts with the principle that evaluation should facilitate the continual improvement of a program.

2. It is useful for decision-making decisions after a project has run full cycle but almost useless as a device for making decisions during the planning and implementation of a project.

3. It is well suited to the antiseptic conditions of the laboratory but not the septic conditions of the classroom.\textsuperscript{140}

\textsuperscript{138}Ibid., p. 11.
\textsuperscript{139}Ibid., pp. 13-15.
While internal validity may be gained through the control of extraneous variables, such as achievement is accomplished at the expense of external validity.

There are four kinds of evaluation. They are: context, input, process, and product. The major objective of context evaluation is to define the environment where change is to occur, the environment's unmet needs, and the problems underlying those needs. Input evaluation is used to determine how to utilize resources to meet program goals and objectives, it is necessary to do an input evaluation. Its objective is to identify and assess relevant capabilities of the proposing agency, strategies which may be appropriate for meeting program goals and designs which may be appropriate for achieving objectives associated with each program goal. Once a designed course of action has been approved and implementation of the design has begun, process evaluation is needed to provide periodic feedback to teachers, administrators, etc.,

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who are responsible for continuous control and refinement of plans and procedures. Its objective is to detect or predict, during the implementation stages, defects in the procedural design or its implementation. **Product evaluation** is to operationally define and measure criteria associated with the objectives of the activity, to compare these measurements with predetermined absolute or relative standards, and to make rational interpretations of the outcomes using the recorded context, input, and process information.

Evaluation is best looked at as a form of educational intelligence for the guidance of curriculum construction and pedagogy. Evaluation to be effective, must at some point be combined with an effort to teach so that the student's response to a particular process of teaching can be evaluated.

The essence of evaluation is that it permits a general shaping of the materials and methods of instruction in a fashion that meets the needs of the student, the criteria of the scholar from whose discipline materials have been derived, and the needs of the teacher who seeks to stimulate certain ways of thought in his or her students.

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143 Ibid., p. 164
144 Ibid., pp. 164-165.
COMPETENCY

In viewing the question of competency in education and art education, it is evident that research studies need to be performed to establish the best type of program suited for particular levels of development. Some existing views, in art education, support a program which stresses exploration and experimentation with a large variety of media and materials – what may be called a "breadth" approach to teaching. Others suggest that the maximum sensitivities of individuals may be developed by limiting the program and concentrating the activities to a few related media, a "depth" approach.\textsuperscript{145,146}

Even though these two philosophical stands are at the very under pinnings of the competency question, they do not


\textsuperscript{146} Mattil, Edward L. "The Effect of a 'Depth' vs. a 'Breadth' Method of Art Instruction at the Ninth Grade Level." \textit{Studies in Art Education}, V. III, 1 (Fall 1961), pp. 75-87.

115
in themselves take to task the totality of the matter. Deeper than the subtopics of research, assessment, evaluation, and accountability, is the matter of establishing, or mapping the logic of the traditional concept of education. 147

To gain a better insight into competency, the types of research presently being conducted are of major importance. It is these studies which will establish those areas of concern which are receiving the emphasis.

Basically there are four types of studies being conducted. First, is the policy oriented studies, which are designed to determine whether the educational returns from PBTE/CBTE programs are greater than those from traditional programs, whether the costs associated with PBTE/CBTE are greater than those associated with traditional programs, and the relation of costs to benefits in both cases. Second, is the practice oriented studies which focus on the central effectiveness of alternative program structures and procedures in bringing about a specified set of teaching competencies. Third, are the basic studies

which attempt to explore the measurement devices structured around PBTE/CBTE. Fourth, are the documentation studies designed to focus on the development and operation of existing PBTE/CBTE programs.¹⁴⁸

It is these research endeavors which are searching for relevant data to reflect the traditional concept of education in areas relating teacher competency to student outcomes, assessing teacher competency, and criteria for describing and assessing competency based programs.

These endeavors have thrown the competency matter into numerous directions of controversy. Innovative schools and teachers are trying out parts of the new concept within the context of the old concept. The results are no worse than they were before.¹⁴⁹ The fact remains that relevance to the vast and diverse areas of education still needs exploration.

One of the major problems confronting the path of acceptance is that dealing with behavioral approaches. For many art educators, the ideas associated with behavioralism is


tempting. It gives one a sense of power to be able to state explicitly what one wants to achieve. In reality the behavioral approach is a concern with the systematic analysis of learning. In strictly an art education context, it is not simply a way of making art education more efficient; it is a way of thinking about the nature of art, man, and education as well. Behavioralism is based upon the belief that the careful specification of objectives, the analysis of learning activities, the optimal sequencing of learning tasks, and the evaluation of significant artistic learning are both possible and desirable. Rational approaches to education tend to be related in spirit and method to a type of scientific empiricism that pays little attention to the covert, experiential aspects of life. It tends to ask for evidence of success at the end of a teaching-learning unit, success which is to be demonstrated in observable behavioral terms. The potential problem is that in focusing so much upon behavioral evidence and upon the objective assessment of that evidence, significant aspects of experience and personal meaning may no longer be attended to or valued.150

It is obvious within art education and in the humanistic areas of study in general, that there is fear that such a model of evaluation is constantly in danger of oversimplifying the aims of the school and the place of the arts and the humanities within it. There is a pervasive fear that some behavioralist will be assigned the task of writing objectives—objectives that invariably will assess only those learnings where there are overt, observable outcomes, excluding the subtler humane learnings that are not immediately visible. There is the fear that curriculum will be reduced to muscle twitches, grunts, mumbles and rote responses.\(^{151}\)

Another major ramification of competency is that of accountability. Within this area of concern there is also much controversy as to what should be encompassed, and how it should be operationalized. Accountability is generally viewed in respect to cost accounting. Relatively few art educators seem to appreciate that cost accounting is not a remote theoretical proposal but a nearly complete operational system.\(^{152}\)


\(^{152}\)Chapman, Laura H. "Evaluating The Total School Art Program." Papers presented at the National Art Education Study Institute, San Diego, California. April 1973, p. 9.
The major pitfall deals primarily with cost in relation to student work. For quite some time, art educators and art teachers have relied on exhibits as an informal way of accounting for their programs. In light of accountabilities fundamental cost relationship, this situation does not initially seem to be applicable. However, even student exhibits might be complemented by an annual "state of the art program" report. The report might include brief comments about the program from students (Student Questionnaire), a brief outline of the curriculum and its rationale, new acquisitions, and credit to people who have contributed time, money, supplies, and other forms of support to the program.\textsuperscript{153}

The approaches that may be utilized to accomplish the requirements of competency are diverse, and as yet flexible. The problem is one of a scientific approach, or economic approach, versus a humanistic one. Besides a tremendous lack of communication between concerns, there exists a barrier of purpose. To say that competency in one realm is the same as in any other is a question I

\textsuperscript{153} Ibid., p. 24.
feel must be answered before any rational stand can be taken. Combined with the concept of traditional education, competency is required to go through a process of synthesis to relate meaningfully to the emergence of meaningful assessment, teacher competency, student competency, and evaluation.

Competency is characterized by specific knowledges of a high level, or those factors which one is held responsible for knowing in order to be well versed. Imagination is characterized by an act or power of forming mental images of what is not actually present, or the power of creating mental images of what has never been actually experienced. Obviously the two concepts are quite different in their makeup, but the main relationship that does exist between the two concepts is one of how they relate to the student's development.

Competency, in this situation, is viewed as the overall knowledges the student develops in order to utilize his imagination. Granted, the imagination is present in all individuals, to one extent or the other, but in this situation, the imagination is being manipulated in regards to subject matter attainment. Therefore, the relationship between the competency and the imagination is united by a common goal to develop the student in a particular fashion.
To place the relationship in an instructional frame of reference, it can be said that in order to be more imaginative you have to be more competent. Hence, the learning of subject matter, which makes you more competent, will result in more utilization of the imagination.

To ensure the subject matter relevance, the program has established that information which is necessary and sufficient in regards to what is considered to be important to the understanding and making of ceramic works. In the light of programmed instruction's traditional concerns to competency, my particular approach focuses on both the teacher's and student's competencies. Most programs consider competency in regards to performance on a terminal frame or in a terminal situation. Granted, there are self tests and other measures of proficiency, but the terminal nature of each has been removed. The terminal situations were eliminated to the extent that there are no places in the instructional plan where a final result is dictated. Since competency denotes the development of specific knowledge it seems unreasonable to dictate in light of using the imagination. The imaginative basis for the instruction does not allow for traditional concepts of competency to flourish effectively. However, one could say that I am dictating certain cognitive subject matter competencies, not termination.
MEASUREMENT DEVICES AND RESULTS

The following section represents a majority of the measurement tools utilized in the research, plus their supportive data. Included are the following items:

1. PRETEST (Statistics)
2. Ceramic Redesign Test (Test and Statistics)
3. Ceramic Connoisseurship Test (Test and Statistics)
4. SELF TESTS and UNIT TESTS (Statistics)
5. Criteria for Evaluating Ceramic Works (check list)
6. Examples of student work
7. Student Questionnaire (questionnaire and statistics)
8. Teacher Questionnaire (questionnaire and statistics)

NOTE: The remainder of the measurement devices and answer sheets can be found in their appropriate places either in the Teacher's Guide or the Student Book.
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**N = 21**

**Range = 9**

**Median = 4.25**

**Mode = 1**

**Mean = 3.14**

**Variance = 7.67**

**SD = 3.47 = 3.5**
Node Median

Leptokartic (Kurtoses)

Tri-modality

Negatively skewed - not good results
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$N = 18$

Range = 17

Median = 7.00

Mode = 1 and 2

Mean = 7.28

Variance = 29.76

$SD = 6.25$
Ceramic Redesign Test

This test is designed to be an indicator of whether or not there has been development of student imagination. In its pre-test function (Pre-Program), the test measures threshold knowledge, and in the post-test function (Post-Program) as an indicator of knowledges gained that result in the design of works that exhibit student imagination.

The design of the test is such that the cognitive subject matter learned through the mini-programs, and other activities in class, act as spark plugs to the imagination.

The scale utilized for the test (the minimum) represents those areas concerning each design where a dividing line has been drawn between filling basic requirements, and going beyond the basic requirements to areas where the utilization of individual imagination is essential for further design. The numbers on the scale designate the minimum for fulfillment of the requirement, not necessarily the utilization of ones imagination. The more points gained, the more imagination utilized. As far as there being a cut-off point for the exhibition of ones imagination, it is not present. To establish a maximum point would be
To exhibit the openness of the scale, the works exhibited in the Ceramic Connoisseurship Test have been rated on their imaginative elements. Below is that scale.

1. = 8
2. = 6
3. = 6
4. = 5
5. = 4
6. = 7
7. = 7
8. = 4
9. = 5
10. = 5

The results can only indicate to you the complexity of the work, and therefore the degree of imagination used. However, it must be remembered that complexity may not be an indicator of aesthetic quality or vividness of the experience gained from the work. This is exhibited by the results of the Professional group in the Ceramic Connoisseurship Test.

As with the connoisseurship test, a separate group of ceramic students from another high school were checked on this matter. The results of their Ceramic Redesign Test
are as follows:

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The Ceramic Redesign Test is based upon K. Franck's Drawing Completion Test. In the Drawing Completion Test twelve incomplete figures are set out and subjects are asked to sketch some objects or designs "that no one else in the class will think of." Subjects are asked to write in the names of objects they have sketched, or (for the young) have the titles they suggest written in by the teacher or tester.

For the Drawing Completion Test there are two parallel forms. The task is limited to 10 minutes for each form.

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Each figure completed is scored for fluency, flexibility, originality, and elaboration. Fluency is scored by the total number of figures completed, one for each figure. Therefore, a subject completing all ten will score 10. Flexibility is scored one point for each category used in completing figures, showing a flexible use of ideas. Originality, based upon 1,056 subjects from first grade to high school, is scored 1 point where less than 5 percent of the population have made this response and 2 points where less than 2 percent of the population have responded in this way. Elaboration is scored 1 point for every pertinent detail used in each picture completion.

The Ceramic Redesign Test encompasses all of the previously mentioned scoring procedures, however, much simplified. All components of the test receive a score of 1 for being completed. This includes identifying whether the work to be created is functional or non-functional, the construction methods that would be utilized if the

---

work was actually made, surface treatments, and a drawing of how the final piece would look if actually constructed.

The entire scheme is designed to force the student to come to decisions as to exact procedures that are the best for his purposes, the individual creativeness he places on glazing, texturing, etc., and a justification of the work through a drawing which is utilized to force the student to visually exhibit what he has created. Even though it has been stated that to establish a maximum point would be defeatist in nature, I have established that 4 is the minimum points given for the first five redesign assignments, and 5 for the last one. These numbers simply indicate that the student fulfilled the assignment. They do not indicate that the students utilized their imagination to any great extent.
DIRECTIONS: Utilizing each of the shapes below, construct five separate ceramic pieces. In the spaces indicated for each piece, identify whether it is functional or non-functional, the construction methods used, and what types of surface treatments you have utilized (appendages, textures, glazes, or additional forms).

After constructing the five separate ceramic pieces, select at least two of your designs and combine them into one ceramic form. Here again, identify whether the work is functional or non-functional, the construction methods used, and what types of surface treatments were utilized.

SHAPES

#1 - CUBE

#2 - SPHERE

#3 - RECTANGLE
(horizontal or vertical)

#4 - CYLINDER

#5 - HEMISPHERE
#1 - CUBE

1. functional or non-functional (CIRCLE ONE)

2. Construction methods used:

3. Surface treatments used:

4. The design used: (ILLUSTRATE YOUR WORK AS PRECISELY AS POSSIBLE)
#2 - SPHERE

1. functional or non-functional (CIRCLE ONE)

2. Construction methods used:

3. Surface treatments used:

4. The design used: (ILLUSTRATE YOUR WORK AS PRECISELY AS POSSIBLE)
#3 - RECTANGLE

1. functional or non-functional (CIRCLE ONE)

2. Construction methods used:

3. Surface treatments used:

4. The design used: (ILLUSTRATE YOUR WORK AS PRECISELY AS POSSIBLE)
#4 - CYLINDER

1. functional or non-functional (CIRCLE ONE)

2. Construction methods used:

3. Surface treatments used:

4. The design used: (ILLUSTRATE YOUR WORK AS PRECISELY AS POSSIBLE)
#5 - HEMISPHERE

1. functional or non-functional (CIRCLE ONE)

2. Construction methods used:

3. Surface treatments used:

---

4. The design used: (ILLUSTRATE YOUR WORK AS PRECISELY AS POSSIBLE)
#6 - COMBINATION WORK

1. functional or non-functional (CIRCLE ONE)

2. Construction methods used:

3. Surface treatments used:

4. Shapes used:

5. The design used: (ILLUSTRATE YOUR WORK AS PRECISELY AS POSSIBLE)
## Ceramic Redesign Test Data

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### Control (18)

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Ceramic Connoisseurship Test

This test, which goes beyond the appreciation of ceramic works to measure the student's understanding of details, techniques, and principles of ceramics, tests the critical judgment of the students. For the student to demonstrate these critical judgments it is necessary for him to develop specific competencies as dictated by the mini-programs, demonstrations and lectures, and readings of works. These competencies are fostered in the cognitive subject matter areas of the course.

As a base from which to establish those works that are deemed as having the most imagination, it was necessary to survey those individuals in professions that were directly related to ceramic production, aesthetics, art criticism, etc.

The following survey exhibits those works that were found to be the most imaginative. It is from this base that the responses by both Experimental and Control Group are measured. The Professional Group chose ceramic works 1, 3, 5, and 8 over the other works.

In addition to the Professional Group, I gathered data on the Ceramic Connoisseurship Test from a group of similar High School ceramic students from another school in the
district. This data is utilized as strictly background and comparison to aid in the verification of the data gathered from the Experimental and Control Group. Below is that data.

**Professional (22)**

1. $13 = 59.09\%$
2. $11 = 50.00\%$
3. $18 = 81.82\%$
4. $4 = 18.18\%$
5. $15 = 68.18\%$
6. $8 = 36.36\%$
7. $7 = 31.82\%$
8. $18 = 81.82\%$
9. $11 = 50.00\%$
10. $5 = 22.73\%$

**High School (21)**

1. $14 = 66.66\%$
2. $14 = 66.66\%$
3. $13 = 61.90\%$
4. $5 = 23.80\%$
5. $19 = 90.48\%$
6. $18 = 85.71\%$
7. $5 = 23.81\%$
8. $6 = 28.57\%$
9. $7 = 33.33\%$
10. $4 = 19.05\%$

The Ceramic Connoisseurship Test is designed after the Welsh Figure Preference Test. The test developed by Livingston Welsh, was designed on the basis of performances by some 80 painters from New York, San Francisco, New Orleans, Chicago and Minneapolis. The painters showed a marked preference for drawings which were complex, asymmetrical and, in their terms, vital or dynamic. They also
displayed considerable tolerance for drawings which most people would consider chaotic. In general they expressed what can only be called aversion for the figures which were simple and obviously symmetrical.

The same drawings were then presented to doctoral candidates in some dozen teaching departments, primarily in the faculty of science, at the University of California. The candidates were then separated into two groups, the more original and the less original, on the basis of faculty ratings. The results were surprising. The more original scientists expressed preferences very similar to those of the artists.

Behind this inclination to like and to construct what is not too simply ordered there appears to be a very strong need to achieve the most difficult and far-reaching ordering.  

Even though the Ceramic Connoisseurship Test is considered useful in only a select instance, it was valuable in identifying the imaginative level of the professionals, as opposed to the various groups of students and their

---

preferences.

The actual selection of the works exhibited in the test were derived from various sources. Some of the works are from history books, exhibition notices, and simply made up. This random selection of works was necessary in order to maintain an unbiased nature within the test.
Ceramic Connoisseurship Test

DIRECTIONS: Utilizing your knowledge of ceramics, identify the following five (5) works which exhibit, in your opinion, the most imagination. Indicate your answers by circling the number of each example.

1.  
2.  
3.  
4.  

---
<table>
<thead>
<tr>
<th>Pre-Program</th>
<th>Post-Program</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental (18)</strong></td>
<td><strong>Experimental (19)</strong></td>
<td><strong>Difference</strong></td>
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<tr>
<td>1. $10 = 55.55%$</td>
<td>1. $12 = 63.16%$</td>
<td>1. $7.61%$</td>
</tr>
<tr>
<td>2. $10 = 55.55%$</td>
<td>2. $12 = 63.16%$</td>
<td>2. $7.61%$</td>
</tr>
<tr>
<td>3. $9 = 50.00%$</td>
<td>3. $11 = 57.89%$</td>
<td>3. $7.89%$</td>
</tr>
<tr>
<td>4. $11 = 61.11%$</td>
<td>4. $12 = 63.16%$</td>
<td>4. $2.05%$</td>
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<tr>
<td>5. $13 = 72.22%$</td>
<td>5. $14 = 73.68%$</td>
<td>5. $1.46%$</td>
</tr>
<tr>
<td>6. $11 = 61.11%$</td>
<td>6. $13 = 68.44%$</td>
<td>6. $7.33%$</td>
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<tr>
<td>7. $3 = 16.66%$</td>
<td>7. $3 = 15.79%$</td>
<td>7. $-0.87%$</td>
</tr>
<tr>
<td>8. $10 = 55.55%$</td>
<td>8. $10 = 52.63%$</td>
<td>8. $-2.92%$</td>
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<tr>
<td>9. $9 = 50.00%$</td>
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<td><strong>Control (18)</strong></td>
<td><strong>Control (18)</strong></td>
<td><strong>Control (18)</strong></td>
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<td>1. $14 = 77.77%$</td>
<td>1. $5.55%$</td>
</tr>
<tr>
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<td>2. $10 = 55.55%$</td>
<td>2. $0.00%$</td>
</tr>
<tr>
<td>3. $14 = 77.77%$</td>
<td>3. $14 = 77.77%$</td>
<td>3. $0.00%$</td>
</tr>
<tr>
<td>4. $4 = 22.22%$</td>
<td>4. $4 = 22.22%$</td>
<td>4. $0.00%$</td>
</tr>
<tr>
<td>5. $14 = 77.77%$</td>
<td>5. $15 = 83.33%$</td>
<td>5. $5.56%$</td>
</tr>
<tr>
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<td>7. $3 = 16.66%$</td>
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<td>7. $11.11%$</td>
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</tr>
<tr>
<td>9. $6 = 33.33%$</td>
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<td>9. $0.00%$</td>
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<tr>
<td>10. $8 = 44.44%$</td>
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<td>10. $0.00%$</td>
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### Percent Differences

<table>
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<th>Control to Professional</th>
<th>High School to Professional</th>
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<td>1. 7.57%</td>
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<tr>
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<td>2. 5.55%</td>
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<tr>
<td>3. 31.82%</td>
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<td>3. 19.92%</td>
</tr>
<tr>
<td>4. 42.93%</td>
<td>4. 4.04%</td>
<td>4. 5.62%</td>
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<tr>
<td>5. 4.04%</td>
<td>5. 9.59%</td>
<td>5. 22.30%</td>
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<tr>
<td>6. 24.75%</td>
<td>6. 2.52%</td>
<td>6. 49.35%</td>
</tr>
<tr>
<td>7. 15.16%</td>
<td>7. 15.16%</td>
<td>7. 8.01%</td>
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<tr>
<td>8. 26.27%</td>
<td>8. 20.71%</td>
<td>8. 53.25%</td>
</tr>
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<td>9. 16.67%</td>
<td>9. 16.67%</td>
</tr>
<tr>
<td>10. 6.07%</td>
<td>10. 21.71%</td>
<td>10. 3.68%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experimental to Control</th>
<th>Experimental to High School</th>
<th>Control to High School</th>
</tr>
</thead>
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<tr>
<td>1. 16.67%</td>
<td>1. 11.11%</td>
<td>1. 5.56%</td>
</tr>
<tr>
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<td>4. 1.58%</td>
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<tr>
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<td>5. 12.71%</td>
</tr>
<tr>
<td>6. 22.23%</td>
<td>6. 24.60%</td>
<td>6. 46.83%</td>
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<tr>
<td>8. 5.56%</td>
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<td>8. 32.54%</td>
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<tr>
<td>9. 16.67%</td>
<td>9. 16.67%</td>
<td>9. 00.00%</td>
</tr>
<tr>
<td>10. 27.78%</td>
<td>10. 2.39%</td>
<td>10. 25.39%</td>
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</tbody>
</table>
SELF TESTS and UNIT TESTS

The following data represents those results derived from the self-tests located after each mini-program, and the unit tests located at predetermined intervals after the appropriate self-tests.

The data is presented in such a manner as to inform first of the experimental groups results and then the control groups. By viewing the Median, Mode, and Mean of each set of data, you will be able to gain insight into how each group compared to the other.

The tests for this particular group of data is found in the Student Book (Ceramics As An Art).
**SELF TEST #1 - Vocabulary Test (Experimental) 25 possible**

<table>
<thead>
<tr>
<th>RAW SCORE</th>
<th>f</th>
<th>t</th>
<th>X1</th>
<th>X1^2</th>
<th>X1-1/n</th>
<th>(X1-1/n)^2</th>
<th>Apparent Intervals</th>
<th>Class Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
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<td>5</td>
<td>25</td>
<td>625</td>
<td>2.04</td>
<td>4.16</td>
<td>21-25</td>
<td>20.5-25.5</td>
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<tr>
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<td>1</td>
<td>3</td>
<td>25</td>
<td>625</td>
<td>2.04</td>
<td>4.16</td>
<td>11-15</td>
<td>10.5-15.5</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>2</td>
<td>25</td>
<td>625</td>
<td>2.04</td>
<td>4.16</td>
<td>10-14</td>
<td>9.5-14.5</td>
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<td>1</td>
<td>1</td>
<td>25</td>
<td>625</td>
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<td>4.16</td>
<td>8-12</td>
<td>7.5-12.5</td>
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<td>625</td>
<td>2.04</td>
<td>4.16</td>
<td></td>
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</table>

Range = 15

Median = 25

Mode = 25

Mean = 22.96

Variance = 21.50

**SD = 19.7**

\[ \sum x_1 = 528 \quad \sum x_1^2 = 12,574 \quad 0.08 \quad \frac{494.52}{\text{}} \]
Positively skewed

Leptokartic (Kurtoses)
SELF TEST #1 - Vocabulary Test (Control) 25 possible

<table>
<thead>
<tr>
<th>RAW SCORE</th>
<th>f</th>
<th>f</th>
<th>x_i</th>
<th>x_i^2</th>
<th>x_i - \bar{x}</th>
<th>(x_i - \bar{x})^2</th>
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<tbody>
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<td>18</td>
<td>23</td>
<td>529</td>
<td>6</td>
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</tr>
<tr>
<td>22</td>
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<td>17</td>
<td>22</td>
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<td>256</td>
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\[ \sum x_i = 306 \quad \bar{x} = 17.00 \]

Range = 14
Median = 17.5
Mode = 14

Mean = 17.00
Variance = 13.22
SD = 3.8
Leptokurtic and Platokurtic (Kurtoses)  Median

Bi-modality
# SELF TEST #2 - Ceramic Examples (Experimental) 12 possible

<table>
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<tr>
<th>RAW SCORE</th>
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<th>$f^2$</th>
<th>$x_i$</th>
<th>$x_i^2$</th>
<th>$(x_i - \bar{x})^2$</th>
<th>Apparent Intervals</th>
<th>Class Intervals</th>
</tr>
</thead>
<tbody>
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<td>12</td>
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<td>14</td>
<td>12</td>
<td>1.36</td>
<td>1.85</td>
<td>10-14</td>
<td>9.5-14.5</td>
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<tr>
<td>11</td>
<td>3</td>
<td>10</td>
<td>12</td>
<td>1.36</td>
<td>1.85</td>
<td>9-13</td>
<td>8.5-13.5</td>
</tr>
<tr>
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<td>5</td>
<td>7</td>
<td>12</td>
<td>1.36</td>
<td>1.85</td>
<td>8-12</td>
<td>7.5-12.5</td>
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<td>$\frac{2}{2}$</td>
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<td>1.36</td>
<td>1.85</td>
<td>7-11</td>
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</table>

Range = 3

Median = 10.5

Mode = 10

Mean = 10.64

Variance = 1.09

SD = 1.00
Leptokurtic (Kurtoses)

Bi-modality
SELF TEST #2 - Ceramic Examples (Control) 12 possible

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<th>cum</th>
<th>x</th>
<th>x^2</th>
<th>x_i-x</th>
<th>(x_i-x)^2</th>
<th>Apparent Intervals</th>
<th>Class Intervals</th>
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<td>11</td>
<td>121</td>
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<td>9-13</td>
<td>8.5-13.5</td>
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<td>8-12</td>
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<td>121</td>
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<td>7-11</td>
<td>6.5-11.5</td>
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<td>8</td>
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<td>6</td>
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<td>121</td>
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<td>121</td>
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N=18

Range = 11
Median = 9.5
Mode = 11
Mean = 7.89

\[ \sum x_i = 142 \]

Variance = 15.2\[\sqrt{\bar{x}}=7.89\]

SD = 3.9
Leptokurtic (Kurtoses)  $\bar{x}$  Median  Mode

Bi-modality
SELF TEST #3 - Types of Ceramics (Experimental) 3 possible

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<th>x_i^2</th>
<th>x_i - x</th>
<th>(x_i - x)^2</th>
<th>Apparent Intervals</th>
<th>Class Intervals</th>
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<td>9</td>
<td>1-5</td>
<td>.5 -5.5</td>
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<td></td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>9</td>
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Range = 3
Median = 3
Mode = 3

\[ \sum x_i = 33 \]

Mean = 3
Variance = 9

SD = 3
SELF TEST #3 - Types of Ceramics (Control) 3 possible

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<th>xᵢ</th>
<th>xᵢ²</th>
<th>xᵢ-x</th>
<th>(xᵢ-x)²</th>
<th>Apparent Intervals</th>
<th>Class Intervals</th>
</tr>
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<tbody>
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<td>0</td>
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<td>0</td>
<td>-2-2</td>
<td>-1.5-2.5</td>
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</tr>
</tbody>
</table>

Range = 0
Median = 0
Mode = 0
Mean = 0
Variance = 0
SD = 0

\[ \sum x_i = 0 \]
## Glossary of Ceramic Materials, Processes and Colloquial Terms

### Ceramic Examples, and Types of Ceramics (Experimental)

25 possible

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<th>x²</th>
<th>(x - x̄)²</th>
<th>Apparent Intervals</th>
<th>Class Intervals</th>
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<td>25</td>
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<td>23-27</td>
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<td>21-25</td>
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<td>19</td>
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</tr>
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<td>400</td>
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<td>17-21</td>
</tr>
<tr>
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Median = 18

Mode = 18

Variance = 15.80

SD = 4.76

Mean = 17.24
UNIT TEST #1 - Glossary of Ceramic Materials, Processes and Colloquial Terms, Ceramic Examples, and Types of Ceramics (Control)

25 possible

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Mode = 15

Mean = 13.38

Variance = 3.31

SD = 2.28
SELF TEST #4 - Kinds of Clay (Experimental) 13 possible

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Mean = 10.91
Variance = .99

SD = 9.9
**SELF TEST #4 - Kinds of Clay (Control) 13 possible**

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\[ \Sigma x̅ = 7 \]

\[ \Sigma (x̅ - x̅)² = 6.25 \]
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Range = 7

Median = 9

Mode = 10, 9

\[ \sum x_i = 103 \]

\[ \bar{x} = \frac{103}{12} = 8.58 \]

Mean = 8.58

Variance = 3.41

SD = 2.37
## SELF TEST #5 - **Keeping Clay In Condition** (Control) 10 possible

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- **Range = 6**
- **Median = 2.5**
- **Mode = 2**
- **Mean = 2.89**
- **Variance = 3.54**
- **SD = 2.46**
### SELF TEST #6 - Fundamental Considerations (Experimental) 10 possible

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- **Range** = 3
- **Median** = 10
- **Mode** = 10
- **Mean** = 9.27
- **Variance** = 1.29
- **SD** = 1.53

\[
\Sigma x_i = 102 \quad \Sigma x_i^2 = 960 \quad \Sigma (x_i-x)^2 = 14.15
\]
SELF TEST #6 - Fundamental Considerations (Control) 10 possible

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UNIT TEST #2 - Kinds of Clay, Keeping Clay In Condition, and Fundamental Considerations (Experimental) 20 possible

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Range = 15
Median = 11.5
Mode = 13 and 10
Mean = 11
Variance = 20
SD = 4.5
UNIT TEST #2 - Kinds of Clay, Keeping Clay In Condition, and Fundamental Considerations (Control) 20 possible

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<th>( (x_i - \bar{x})^2 )</th>
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<th>Class Intervals</th>
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Range = 12

Median = 4.5

Mode = 0

Mean = 4.78

Variance = 21.29

SD = 4.5
SELF TEST #12 - Texturing (Experimental)  5 possible

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<th>Class Intervals</th>
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<td>3-7</td>
<td>2.5-7.5</td>
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Range = 5
Median = 5
Mode = 5
Mean = 5
Variance = 0  \( \Sigma x = 65 \)  \( \Sigma x^2 = 325 \)

SD = 0
### SELF TEST #12 - Texturing (Control) 5 possible

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<th>( x_i^2 )</th>
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<th>( (x_i - \bar{x})^2 )</th>
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- **N** = 18
- **Range** = 1
- **Median** = 0
- **Mode** = 0
- **Mean** = .11
- **Variance** = .10
- **SD** = .03

\[
\Sigma x_i = 2, \quad 2, \quad .02
\]

\[
1.74
\]
SELF TEST #13 - Wrapping and storing unfinished works (Experimental) 1 possible

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<th>( (x_i - \bar{x})^2 )</th>
<th>Apparent Intervals</th>
<th>Class Intervals</th>
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<td>( \Sigma (x_i - \bar{x}) = 10 )</td>
<td>( \Sigma (x_i - \bar{x})^2 = 2.10 )</td>
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Range = 1
Median = 1
Mode = 1
Mean = .7
Variance = .21
SD = .456
SELF TEST #13 - Wrapping and storing unfinished works (Control) 1 possible

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<th>$x_i^2$</th>
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<td>-1.5-2.5</td>
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Range = 0
Median = 0
Mode = 0
Mean = 0
Variance = 0
SD = 0
UNIT TEST #8 - Texturing, and Wrapping and storing unfinished works (Experimental)

5 possible

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<th>(x_i^2)</th>
<th>(x_i - \bar{x})</th>
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Range = 5  
Median = 4  
Mode = 4  
Mean = 3.38  
Variance = 2.04  
SD = 1.4

\[ \Sigma x_i = 71 \]

\[ 283 \]

\[ .02 \]

\[ 42.86 \]
UNIT TEST #8 - Texturing, and Wrapping and storing unfinished works (Control)

5 possible

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<th>Class Intervals</th>
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Σx_i=3

192
### SELF TEST #14 - Glazes (Experimental) 14 possible

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<th>(x&lt;sub&gt;i&lt;/sub&gt; - x)</th>
<th>(x&lt;sub&gt;i&lt;/sub&gt; - x)&lt;sup&gt;2&lt;/sup&gt;</th>
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Range = 2

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Mode = 14

Mean = 13.27

Variance = .56

SD = .07
**SELF TEST #14 - Glazes (Control) 14 possible**

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Range = 5
Median = 0
Mode = 0
Mean = .94
Variance = 2.05

\[ \Sigma x^2 = 17 \]
\[ \Sigma x = 53 \]
\[ SD = 1.4 \]

\[ \Sigma (x-\bar{x})^2 = .08 \]
\[ 36.88 \]
Self Test #15 - Coloring Oxides (Experimental) 5 possible

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Mean Median Mode
SELF TEST #15 - Coloring Oxides (Control) 5 possible

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<th>Class Intervals</th>
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Range = 1
Median = 0
Mode = 0
Mean = .39
Variance = .24
SD = .05

Σx̄ = 7

.02 | .24
**SELF TEST #16 - Glazing Methods (Experimental) 10 possible**

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<th>(x_i - \bar{x})^2</th>
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<th>Class Intervals</th>
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Range = 1

Median = 10

\[ \Sigma x_i = 78 \quad \bar{x} = \frac{78}{7} = 11 \]

Mode = 10

Mean = 9.75

Variance = .19

SD = .04
Median

Mode

Mean
SELF TEST #16 - Glazing Methods (Control) 10 possible

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<th>Class Intervals</th>
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Range = 4
Median = 2.5
Mode = 0
Mean = 1.89
Variance = 2.76
SD = .16

\[ \sum x_i = 34 \]
\[ \sum x_i^2 = 114 \]
\[ \bar{x} = 49.74 \]
UNIT TEST #9 - Glazes, Coloring Oxides, and Glazing Methods (Experimental)

20 possible

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Range = 20
Median = 10
Mode = 0
Mean = 9.94

\[ \sum x_i = 179 \quad \sum x_i^2 = 3,185 \]

Variance = 76.05
\[ \text{SD} = 8.3 \]
UNIT TEST #9 - Glazes, Coloring Oxides, and Glazing Methods (Control)

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<th>Class Intervals</th>
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Range = 9
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Mode = 0

\[ \sum x_i = 41 \]
Mean = 2.28

Variance = 9.76

SD = 3.87
SELF TEST #17 - Types of Kilns (Experimental) 5 possible

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Range = 1

Median = 4.5

Mode = 5, 4

Mean = 4.5

Variance = .25

SD = .05

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Mode  Median  Mean
7 3
211
SELF TEST #17 - Types of Kilns (Control) 5 possible

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Range = 2
Median = 0
Mode = 0
Mean = 0.28
Variance = 0.42
SD = 0.64

ΣXi=5 9 0.04 7.64
SELF TEST #18 - Types of Firings (Experimental) 5 possible

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<th>Apparent Intervals</th>
<th>Class Intervals</th>
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<td>Variance = .73</td>
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<tr>
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SELF TEST #18 - Types of Firings (Control) 5 possible

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<th>(xi-\bar{x})²</th>
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<th>Class Intervals</th>
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N=16

Range = 3
Median = 1
Mode = 3 and 0
Mean = 1.44

\[ \Sigma x_i = 26 \]
\[ \bar{x} = \frac{26}{70} = 0.3714 \]

Variance = 1.8

\[ \sum (x_i - \bar{x})^2 = 32.38 \]

SD = 1.2
UNIT TEST #10 - Types of Firings, and Types of Kilns (Experimental) 10 possible

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<th>(xᵢ-ᵢ)²</th>
<th>Apparent Intervals</th>
<th>Class Intervals</th>
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N=19

Range = 10

Median = 8

Mode = 0

Mean = 5.47

Variance = 16

SD = 4
UNIT TEST #10 - Types of Firings, and Types of Kilns (Control) 10 possible

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$N = 19$

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Mode = 0

Mean = 1.68

Variance = $\frac{\sum(x_i - \bar{x})^2}{N} = 5.4$ $\bar{x} = 32$

$SD = 2.9$
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| N=21 |

Range = 33

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Mode = 0

$\Sigma x_i = 200 \quad 4392 \quad 0.82 \quad 2407.23$

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$\bar{x} = 9.52$

Variance = 118.44

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\( N = 18 \)

- **Range** = 26
- **Median** = 9
- **Mode** = 1
- **\( \sum x \_i = 192 \)**
- **Mean** = 10.67
- **Variance** = 102.89
- **SD** = 11.08
Criteria for Evaluating Ceramic Works

DIRECTIONS: The following categories are intended to give you an overview of those areas where critical decisions are necessary. Whether you respond overtly or covertly to the categories it is essential that each be viewed as of paramount importance in aiding to establish those criteria you have determined as necessary for evaluation to occur. Depending on your personal views of the particular works, it may be necessary to report your evaluation in a narrative format. It must be remembered that the following areas are concerned with only the ceramic work and not the students attitudes, attendance record, amount of works produced, etc.

Craftsmanship Qualities
1. Thickness of the work - Is there uniformity where called for in the work?
2. Neatness - Does the work present a finished appearance?
3. Surface Treatments
   a. Glaze - Is the glaze conforming to the overall design of the work in respect to color, pattern, etc.?
   b. Texture - Does the texture seem natural to the work?
c. Uniformity - Is there uniformity in regards to design, balance, shape, etc.?

4. Technique - Does the student show mastery of the technique? Does the student comply with the technique to avoid cracking, warping, etc.? Is the glaze usage appropriate in regards to using enough glaze, but not an over abundance? How well is the work constructed in respect to the overall uniformity?

5. Function - Does the work serve its function? For example: if the work is to hold a liquid, can the work function in its original design state?

Artistic Qualities

1. Uniqueness - Does the glaze, design, and function work together to form a ceramic work that is either original to the student personally, or original to the entire class?

2. Modification of the surface - Is the glaze, texture, etc. utilized in a manner that makes the work visually pleasing?

3. Modification of the shape or form - Is the basic shape manipulated in such a manner as to make the work visually pleasing?
Examples Of Student Work

The following examples are representative of the works done by both the Experimental and Control Groups for the duration of the course.

1.

2.

3.

4.
QUESTIONNAIRE

NAME___________________________________________ PERIOD______________

*******************************************************************************

QUESTIONS:

1. Do you feel that programs can be effective in teaching certain aspects of art?
   a. Yes (44.44%)
   b. No (11.11%)
   c. Undecided (44.44%)

2. Do you feel that programs have the same human touch as other methods of instruction?
   a. Yes (33.33%)
   b. No (33.33%)
   c. Undecided (33.33%)

3. Which of the following would you prefer in being taught art?
   a. Programs only (33.33%)
   b. Programs plus teacher (11.11%)
   c. Teacher only (33.33%)
   d. Undecided (22.22%)

4. Do you feel that the programs were boring?
   a. Yes (66.66%)
   b. No (11.11%)
   c. Undecided (22.22%)

5. Did the programs call for you to remember too much?
   a. Yes (66.66%)
   b. No (33.33%)
   c. Undecided (00.00%)

6. On whom do you place the blame for any failures within the programs?
   a. On yourself (44.44%)
   b. On the programs (22.22%)
   c. Undecided (33.33%)
7. Were you allowed enough time to complete the programs?
   a. Yes (55.55%)
   b. No (11.11%)
   c. Undecided (33.33%)

8. Which of the following expresses your feelings toward taking the programs?
   a. I was forced into doing them. (00.00%)
   b. I didn't want to do them, but after I got started I didn't mind. (22.22%)
   c. I wanted to try them. (22.22%)
   d. Art cannot be taught with books. You learn about art through experience. (55.55%)

9. Why did you elect to take art?
   a. To learn more about the visual arts. (11.11%)
   b. To get out of another class. (22.22%)
   c. There isn't any homework. (11.11%)
   d. Undecided. (11.11%)
   e. Other (explain) (44.44%)

10. How do you feel about your art teacher?
    a. He is too involved in his own work to help us. (44.44%)
    b. He is tremendous. (11.11%)
    c. He is terrible. (00.00%)
    d. Undecided. (22.22%)
    e. Other (explain) (22.22%)

11. Do you feel your teacher is as knowledgeable as other art teachers you have had?
    a. Yes (55.55%)
    b. No (11.11%)
    c. Undecided (33.33%)

12. Do you feel you have learned enough in art this year to teach a beginning student in art?
    a. Yes (33.33%)
    b. No (44.44%)
    c. Undecided (22.22%)
13. How do you feel about the projects you did in class?
   a. They were the best I could do. (11.11%)
   b. I didn't receive the help I needed. (11.11%)
   c. I felt like I was repeating myself. (22.22%)
   d. They were junk. (44.44%)
   e. Other (explain) (11.11%)

14. Which of the following expresses your effort in art class?
   a. I try very hard. (55.55%)
   b. I do enough to get along. (33.33%)
   c. I don't try, and I don't care. (11.11%)
   d. Other (explain) (00.00%)

15. Explain, in your own words, how you would change the present art program, if you could. (Examples: discussing the art work, doing more varied projects, etc.)

"Leave it the same."

"First don't have all that hard work in Ceramics I,
Second have all art classes clean."

"No comments."
TEACHER QUESTIONNAIRE

1. What particular teaching philosophy do you uphold?
   To offer to the student a variety of ideas and concepts on a given media through first hand experience. To make available adequate equipment and materials to the students, and allow them to experience the media through carefully chosen assignments that offer a maximum of freedom, but yet requires them to do certain processes and work toward quality.

2. How did you utilize the programs?
   The text was added into the experiment group as part of the required work. However, no actual due dates were set on individual self tests other than a certain amount due at the end of each six weeks. This was to allow for individual speed.

3. Did you think the programs helped or hindered your particular teaching style?
   The program was foreign to my particular teaching technique, and in some ways it did hinder me. However, I do feel that such a text has been helpful for some students in the fact that there are those students who relate better to verbal concepts than hands-on experiences.
4. Do you think the students performed better using the information in the programs?
Those who related to the book did; however, due to the nature of ceramics being basically a hands-on experience, some rebelled against the concept of tests and paper work.

5. Did the programs present any tasks that you thought were unfamiliar or too difficult?
No.

6. Do you think programs are useful in aiding your teaching?
It would take more time and preparation on my part than I was able to do at this time to do the programs full justice. I definitely see benefits of this type of book, but more work and adjustments will be necessary in order to make it fit my particular class. I am still experimenting in ways to increase student outcomes and understanding at this point. I have not yet taught any class the same way twice.

7. How would you have changed the programs?
The programs came from many sources. There are areas that were general and did not cover a particular area as we do. For example, mixing and storing clay. I
would have made the text so that it would cover the way it was done in our class, and then mention other general methods.

8. Do you feel your students made art objects, or just objects?
Some are still just making objects. There are some who are beginning to think and create. There is a thin line when the confidence of being able to make an object turns into being able to create an object. There is no real way to teach that difference until the student matures to that step of development.

9. What criteria do you use in determining what is, or isn't art work?
When the student no longer struggles with the process and begins to struggle with what the finished product will look like before they actually start.

10. Do you teach process or product?
Both. However, with high school or any beginner, in any media, process must be mastered before product can become important. Failure is as much the road to the creative process as is success.

11. How do you think your student's work compares with other students' works you have seen?
I feel that all students start out the same in any
new media. However, some relate better to the media than others. Some try harder, some mature faster than others. I have the whole array of levels, where I have students who after 18 weeks are no further than when they began, and I have others that have excelled beyond normal expectations.

12. What attributes do you feel a "good" teacher should have?
Dedication to his area, an active participation in that area, a sincere interest in their students, a desire to share their knowledge, and the ability to continue to learn from their students.

13. Do you generally think the programs were worth it?
Any experiment to improve or explore better ways to present ideas to your students are worth whatever happens, even if it is a failure. To continue to try to do a better job of teaching is always important. The teacher who feels he has reached the ultimate, and sees no cause to change, is in my mind the poor teacher.

14. What did you learn from using programs with your class?
That more preparation will be needed and that no program can just happen, but must be carefully
worked and reworked over several years for each individual teacher. I also feel that if one were an individual teacher that they could become a slave to the program rather than using it as a tool.

15. **How do you know if your students are utilizing their imagination?**

When the student becomes dissatisfied and frustrated with their results, and seek ways to get the result that they have predetermined, or when they try new steps that they have devised on their own without being instructed in such steps.

16. **What do you think the developing of one's imagination is based upon?**

Self confidence and positive reinforcement are the key to imagination. Imagination is a delicate state of mind. When the student feels good about what they are doing, then their imagination will surface. Positive response by others and encouragement, even if the student has a failure by the teacher, will help keep that imagination alive and working. After self assurance develops, the imagination will be stable enough to work on its own as long as there are only minimum positive reinforcement. Peer group acceptance also
plays an important part in this positive reinforcement.

17. Do you feel it is important for an art teacher to perform as an artist/critic?

Definitely as an artist, and very cautiously as a critic. Art begets Art. Art has always been taught by artists to other artists. One must be capable as an artist so that the students can have confidence in, and look up to their ability. Otherwise it becomes the blind leading the blind. Theory is good in upper education, to a certain point. But you look like an ass if you tell your students to do a certain process that you yourself are not capable of doing.

18. How do you think programs can be utilized? How important do you think they are?

I think programs could be utilized more with individualized instruction when you have a lot of students working on various levels in the same class. However, the program is again one that would take several years to develop and get working in the way that I would feel satisfactory. If such programs were developed, and were affective, they would be valuable to the instructor and to the individual students.
19. Other comments:

I thought the program concept was worthwhile to experiment with, and there is much good to be said for them. However, it will take far more experimenting and work than one year can allow. More streamlining, eliminating the irrelevant, and adding some concepts were needed. I have a strong feeling that what may be relevant to one teacher could definitely be irrelevant to another, and such decisions would have to be settled.
RESULTS AND DISCUSSION

There have been numerous projects conducted that were intended to utilize the student's imagination in some fashion. In all cases the end results could only vaguely be hinted at. The utilization of various individuals' imagination always results in something of the unexpected. In the research that I conducted there were nine items that I felt had to be searched out and exposed. They are as follows:

1. Was the development of a curriculum model, designed with the primary goal of nurturing student imagination, more efficient in producing ceramic objects as a fine art, than a situation where imagination is left to develop at will? The model worked on paper but not very well in a practical situation. This was due largely to teacher variables, which focused primarily on a lack of interaction and knowledge of programming mechanics. For these reasons the effectiveness of the model could not be realized.

2. Was cognitive subject matter an integral part of the nurturing process in regards to the student's imagination? There was nothing in the study to disprove
this claim. However, the degree of knowledge gained by the students, as exhibited in the self tests and unit tests, did not generate to any significant degree the student's imagination. The lack of transfer was obvious by virtue of the tremendous similarity between works constructed early in the course and those constructed after the majority of the programs had been completed.

3. Is the teacher's influence as artist/critic an integral part of the nurturing process in regards to the student's imagination? The teacher, as exhibited in the Student's and Teacher's Questionnaire, did not conduct himself in the manner prescribed by the Teacher's Guide.

4. Did programmed instruction lend itself to acting as a primary stimulus in nurturing imagination when the "free-form" version was utilized? Even though I was pleased with the results of the programs, I feel that they did not serve their original function of aiding in the eliciting of the imagination. This I feel was due to teacher utilization of the materials and the student's low scores on the Ceramic Redesign Test. The "free-form"
format I used did serve its purpose to the extent of stimulating cognitively, but that I feel was all.

5. Was a high level of cognitive attainment instrumental in the development of imagination, and thereby acting as a measurement of imagination? This term was not exhibited through student works or the Ceramic Redesign Test.

6. Was the teacher and student interaction essential in establishing critical expertise of works? Through the use of the Ceramic Connoisseurship Test it was demonstrated that the experimental group could not reach a consensus as to the more imaginative works. This presumes a lack of experience in the area, and therefore, a lack of interaction. Particular reasons for the lack of interaction is hinted at in the Student Questionnaire, and the lack of readings conducted by the teacher.

7. Was there a high degree of retention of the information within the program? As a rule, the students exceeded between 26-28 days of retention. It became obvious that the most interested students performed better in the long run than those uninterested in ceramics.
8. Were the students able to transfer the information in the programs to their independent construction of ceramic works? Without exception, the students were unable to transfer the information. Here again, the lack of interaction and divergent thinking created a barrier for the students.

9. Was a "free-form" type of programming practical in its usage by both the teacher and students? The format was found to be practical. Even though the length and depth of the programs varied intentionally. The programs allowed the students an opportunity to receive basic information quickly, while the teacher is permitted to organize his instruction in such a fashion as to stimulate and elicit student imagination. The programs, which varied from between 5 and 25 frames, allowed the students many routes for experimentation without becoming too bored with the entire routine.
Student, Teacher and Program

In the study there was a great deal of attention paid to the effect of the programs when influenced by the teacher. The only interaction between student, teacher and program was during the administration of the programs or if students had a specific questions to ask in respect to program directions. This was in contradiction to the initial guidelines provided the teacher. In the guidelines, the teacher was to act as an integral component of the programs. He was to serve as a subject matter expert, critic, and artist. To fulfill all of the requirements, the teacher would have to be totally interactive with all components of the process. This was not the case. To the participating teacher, "The text was added into the experimental group as part of the required work; however, no actual due dates were set on individual self tests other than a certain amount due at the end of each six weeks. This was to allow for individual speed." The teacher went on to state that, "The program was foreign to my particular teaching technique, and in some ways it did hinder me." "I also feel that if one were an indifferent teacher that they could become a slave to the programs rather than using it as a tool." These statements leave doubts as to the teacher's complete understanding of the research purpose and program usage.
Relatively few studies have included augmentation of programmed materials as an experimental condition. Where relevant research has been conducted, there is conflicting evidence about the effect of such augmentation on student learning. Due to this fact the influence of the programs on the students was left totally to factors which might arise as a result of interaction with the programs themselves. This decision was based mainly on the following research.

Klaus and Lumsdaine (1960) compared teacher-plus-program with program alone, with the teacher's function restricted to lecture-recitation for an entire class. They found that the teacher did not add to the level of achievement produced by the programs.

However, some contradictory observations were made in recent System Development Corporation (SDC) studies that used a computer-based instructional system and allowed experimenter interaction with students. This research (Silberman, et al., 1964) suggested that the teacher may contribute significantly to student learning from the program, provided the teacher's function includes diagnosis of student as well as the program-clarification role. It appeared that, unless the teacher's interaction is directly related to the student's difficulty, little
There are at least three possible explanations for the lack of significant teacher effects in this study: (1) the teacher was not sufficiently familiar or sympathetic with his new role, or with the unconventional materials and procedures, to work effectively in the experimental environment; (2) the teacher did not have enough time with each student; (3) the teacher was used in a role that did not make full use of his capabilities.

Motivation, Reinforcement, Confirmation and Scoring

Certain assumptions about motivation need examination, for they underlie the thesis developed here. The principles and procedures previously mentioned assume a motivated student, one that possesses a genuine educational objective. If the student is not motivated, or to put it differently, if the teaching agent is not a clear instrument by

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158 Ibid., p. 3 and 15.
which he can achieve a reinforcer, the student will not perform and cannot learn. If the students are to learn, the consequences of the mastery of a knowledge or skill must be reinforcing. 159

It must be assumed that the students possess an educational objective, because by itself frequent and apparent success in the course of learning is not intrinsically reinforcing. 160 No matter how well designed materials are, if mastery of a subject is not an objective of the student, the materials will fail because the student will not complete them. The so-called programming principle that progress through the course of learning is inherently reinforcing is not only poor learning theory, but is, I think, an abandonment of common sense. We learn for the sake of attaining more fundamental objectives; sensible people do not hunger after useless assortments of information. Learning is a change in behavior, and the


160 Ibid., p. 27.
animal-man, not excepted, resists that change until some purpose is promised beyond the mere change itself. 161

One basic assumption about motivation is fundamental... that the student is sufficiently motivated by the benefits of mastery to give the minimum effort necessary to achieve that mastery. 162

A central process for the acquisition of behavior is reinforcement. Behavior is acquired as a result of a contingent relationship between the response of the student and the consequent event. In order for these contingencies of reinforcement to be effective, certain conditions must be met. Reinforcement must follow the occurrence of the behavior being taught. 163

In most instructional programs the reinforcing agent for the student is "knowledge of results," that is, knowledge about whether or not the response he performs is the result considered correct. Failure to provide

161 Ibid., p. 28.
162 Ibid., p. 28.
163 Glaser, Robert. Principles And Problems In The Preparation Of Programmed Learning Sequences, Department of Psychology, University of Pittsburgh, September 1960, p. 4.
adequate reinforcement and hence failure to strengthen the behavior of the student with respect to the subject matter often results in the student showing a lack of interest. 164

As indicated, an important aspect of programmed instruction is the fact that the program has in it some confirming mechanism by means of which the student receives information as to the correctness of his response. It is generally assumed that this confirmation can provide appropriate reinforcement. Without enough such confirmation the students tend to lose the point of a long development and also often fail to respond to frames at all; they may omit responses, misplace responses, etc. 165

Effects of Student Control

In the study conducted, the students were given a great

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164 Ibid., p. 5.
deal of freedom in their manner of completing the programs. The programs were added into the course of instruction as part of the required work. Due dates were determined by the participating teacher, and based on his progress and the students through the materials.

The general lack of concern on the students' behalf can be broken down into three areas: (1) the students were more concerned with completing the programs than they were with the amount they were learning along the way. This tendency has been observed in several studies, but no completely effective procedure has been developed for making the students self-critical about their own learning as they proceed through the program; (2) the format and procedures offered to the students were restrictive and unnatural; or (3) the basic methodology used prior to the programs did not allow for a logical transfer due to the lack of behavioral orientated programs present.

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In my research the students seemed initially receptive to the programs. After exposure to the programs it became evident that the students had been faced with an obstacle. The obstacle was not created by a student variable, but by one created by the teacher and his unfamiliarity with the teaching methodology issued in the instructional materials.

I feel that the research was generally a success in the fact that much valuable data was collected as to program utilization. Even though the data does not initially seem to support the use of programmed instruction in this realm, I must state that at no time was the program inferior to the instructional situation. Therefore, it is vital that further research be conducted into the ramifications of further indepth information in the cognitive realm. To vigorously criticize programmed instruction for external variables totally outside of it's domain would be foolish. The basic model may have been at fault, but not the basic information within. The vitalness of the information within the programs was demonstrated time and time again when the students could not produce beyond the more primitive stages of imaginative development.
IMPLICATIONS

For years art educators have talked about creativity, imagination, programmed instruction, etc. The main emphasis was placed on these facets as a phenomenon totally devoid of rational response by anyone. Granted, many educators have placed before their audiences a bevy of "facts" relating to the topic; however, few have taken the task to hand in an instructional environment where creativity was supposedly an inherent component. I contend that these facets are not out of necessity a component just because a course is labelled as "art." Other than demonstrating that these phenomena are realistic, noticeable, and workable, I contend that the purpose of art education is not only to talk of art, teach of art, and write of art, but to develop art — perhaps not in the traditional manner thought of, but in a manner where an instructional design or curriculum design becomes an artistic design. In other words, the purpose of art education is to develop schemes, plans, or methods by which individuals can utilize their imagination, whether in art, related aesthetic areas, education, or elsewhere.
As far as programming per se, the implication of the research indicates that programmed instruction is not something "cooked up" in the late 1950's just to train business employees and industrial workers. There is no doubt that programming has its place in educational circles. However, for programs to work effectively in an art curriculum implies that a large degree of interaction is essential in order to promote and utilize them appropriately. A program can teach relatively little without proper implementation. It takes the combined efforts of all involved for programs to work in their prescribed manner. In the case of this research, that was missing to a large degree.

Perhaps more important than the program utilization, is the teacher and student utilization. For the programs to become a major component of the instructional situation, it is necessary for the teacher and students (mainly the teacher) to conduct himself in a manner that gives relevance to the materials. The stigma surrounding programs has created a situation where fear of their very existence prevails. This I find to be the case. I also find it to be foolish and irresponsible in light of advancing education, and hopefully imagination.

In the areas dealing with imagination and creativity,
knowledge of their existence and importance was again renewed; however, any new developments as to their utilization in an educational situation did not materialize. This I feel implies further research into their inner workings, and therefore their facets that are most adaptable to the teaching/learning situation.

Much of what occurred in respect to imagination and creativity leads me to the conclusion that perhaps the search for ways of predicting positive individual creativity is a dead end. It also leads one to think that there is no such thing as a logical method of having new ideas, or a logical reconstruction of a process. However, it does not lead me to think as did Plato when he stated of the artist (student) that the first thing artists must do - and it is not easy - is to take human society and human habits and wipe them clean out, to give himself (the artist or student) a clean canvas. We learn from what has gone before. Without this guidance, there is little


or no direction. This does not mean that we should not organize and plan methods of conveying subject matter (programs for example); it means that placing restrictions on the development of the imagination is not wise or desirable.

If programmed instructional materials are to exist in a public school setting, or any other educational climate, it is essential that all individuals involved with the effort be totally aware of the implications and mechanics of programming. The quickest, and perhaps most effective manner of accomplishing an integrated state between the facts, theories, and principles of programming, is to approach the teaching of programming in an in-service educational program.

The modern conception of in-service education, with its heavy emphasis upon co-operative problem-solving, is in considerable degree a result of changes in our ideas about human motivation and the way learning occurs within an institutional setting. In-service education of school personnel has always has as its objective the improvement of professional behavior. Acquiring new attitudes and learning new knowledges were but means to this end. For many years, however, it was generally believed that learning about ways and means of improving instruction would stimulate changes in practice that would result in these improvements. It was generally believed that someone in authority
in the school — the supervisor or the administrator — could directly tell teachers how to better their instruction with the result of rapid improvement. These conceptions of bringing about change in professional behavior are no longer considered valid by individuals who have made a special study of this kind of learning.  

In brief, in-service education serves to define the most satisfactory kind of professional improvement program as a series of planned activities that provide a maximum opportunity for school personnel (a) to identify the instructional or other problems on which they want to work, (b) to decide upon ways and means for attacking these problems, (c) to work within an atmosphere of mutual support and permissiveness, and (d) to move from thought and study into action with a minimum of difficulty.

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The most valuable aspect of in-service education, in respect to programming, is the nature of change potential. Granted, college level courses on programming would bring about a certain degree of change, however, in an in-service program the "getting to the problem" would be more effective in light of the obvious gap that presently stands between those theorizing and those practicing programming in the schools. The greatest pitfall that presently stands in programming way is that personnel can be educated as to the skills of programming, but what about the attitudes? It can only be assumed that the learning and understanding of programming processes, principles, etc., can in some fashion enlighten those of a skeptical nature.

Educators sometimes criticize programming for raising issues and problems as though they were new when, in fact, many of these issues have a long history. There is some justice in this criticism, but it may ignore genuine contributions of programmed instruction. Programmed instruction has caused the educational world to consider different perceptions of the teaching process and purpose.173

The majority of problems encountered in the use of programs can be categorized in three distinct statements.¹⁷⁴

1. Not all programs are good.
2. Many needed programs have not been produced.
3. It has been difficult to fully incorporate the use of programs into on-going instructional sequences and organizational patterns.

It is these types of problems that Guy Hubbard has endeavored to solve. However, Hubbard has resorted to traditional reasons for programming.¹⁷⁵ If programming is to progress and develop in a healthy atmosphere, it is necessary that those involved in the programming effort to progress at the same rate. Merely concentrating on rote, or predetermined concepts, does not mean that the needs of the students or teacher have truly been met. If the function of art education is to develop art through curriculum


design, then his function in connection with programming would be to develop art through programming. Even though the findings, in this particular research, demonstrated that Ceramics, like any other subject, could be dealt with in a like manner, it is still debatable as to what is deemed necessary for the student and teacher when they are called upon to exceed the boundaries of the program. It is simple enough to say that programs have been utilized in the same fashion in other unrelated areas, therefore, a generalization can be made. But to proceed in such a direction in Ceramics, beyond the learning of cognitive subject matter or skills, is also debatable. The answer lies not in the terminal behaviors desired, but in the long range objectives. If art is to remain an area of study free from stereotypes, it will be necessary to explore beyond. As Ecker has stated, "...whether art instruction can be programmed; and, if the answer is "yes," whether art ought to be programmed," is a major point.¹⁷⁶ One thing is for sure, Ceramics, and areas with similar purposes, can be effectively programmed.

Generally speaking, I was well pleased with the organization of the programs, their original usage, and the research design. Below are those changes which I feel could result in further findings of vast importance.

1. Interaction of students with the teacher - As I have already stated, the interaction deemed necessary for the programs to function in their proper manner, was not carried through. Without this interaction, the programs take on a traditional aspect quite foreign to the original design.

2. Individually or Group paced - It is debatable whether programs used in a typical classroom context should be either individual or group paced. The whole question rests in whether or not group paced programs hindered the students in utilizing their imagination. If the students were on totally different levels of learning, then individually paced programs, or branching programs, would possibly be appropriate. Both pacing procedures should be tried out. This would obviously mean more students, and more classes.
3. Utilization of different teachers - Different styles in classroom teaching I feel would definitely demonstrate different results. I would like to compare, for example, a teacher very behaviorally orientated, to one aesthetically or humanistically orientated. These findings would bring to light a number of questions and answers that have haunted education for many years. These endeavors would place programming on the line as a method of instruction that could be generalized to other areas of study.
Creativity


Parnes, Sidney J. *Creative Retailing* (an instructor's manual for a course in creative retailing), Dept. of Public Instruction, Harrisburg, Pa., 1957.


Torrance, E. Paul (Ed.). Creativity (Proceedings of the Second Minnesota Conference on Gifted Children), University of Minnesota, Center for Continuation Study of the General Extension Division, Minneapolis, 1959.


Programmed Instruction


Holland, James. "A Teaching Machine Program in Psychology" (Galanter).


APPENDIX A
Ceramics As An Art is a unique, much needed, and highly useful book. It brings to art teachers the best that is known about the creative process in ceramics from refined theory and documented research results to practical suggestions for the use of such information in teaching. The central core of the book is in the excitement of seeing creativity used to improve learning and teaching in ceramics.

In the process you will be concerned with the role of student imagination in creating works. The problem is far more than establishing those procedures for instruction. The problem rests in generating sensitive discoverers, creative innovators, and developing concepts - all of which is rooted in the imagination of the students and yourself.

Imagination has long been a paradox for both teachers and students. Of great importance is the manipulation and use of imagination in the case of the creative worker. Yet, there is no definitive explanation of how the imagination works, there isn't even a consensus of opinion as to
what it is. However, it still remains a major element in human endeavor and accomplishment.

It is imagination which creates new insights. It is more than bringing images into consciousness. Creative imagination is an action of the mind that produces a new idea or insight.

The problems of implementing such materials in the art room are also caught up in problems of society at large. Ceramics in the public schools, colleges, and universities is seen repeatedly as an educational frill. Currently ceramics appears to be flourishing in society, but it is doubtful that educational practices are nurturing the ability among many ceramic students to participate more than superficially in the creative experiences available in contemporary art.

Ideally, Ceramics As An Art should help students to develop skills of discrimination and judgment and to refine attitudes, patterns of thought, and action through the development of student imagination as based on the learning of cognitive subject matter. The book also assumes that materials for such developments should include options that teachers and students can exercise toward effective teaching and learning in ceramics.
This is therefore the major purpose, to create an instructional environment and materials which will be of an advantage in an atmosphere where the use of, and development of imagination, works hand-in-hand, not only with cognitive subject matter of an already established field, but goes beyond to areas where mere recall of facts acts as basic foundations from which the imagination can emerge and flourish.

Why a new ceramics book? The answer is simple. For years there has been numerous textbooks on the scene which have done excellent jobs of telling teachers and students exactly what to do to construct ceramic works. Quite dictorial in nature, these references totally lacked direction toward the utilization of the all-important imagination. There seemed to be no avenue for the imagination, except in a false one. Here the imagination was defeated by duplication and stereo-typing of works. To the participants of such courses the ceramic works produced had sunk into a state of affairs where the "same-old-thing" was being done.

I am sympathetic with those in art who are bothered by the indiscriminate use of words such as "creative," "creativity," and "imagination." On the other hand, those
art teachers who scoff at the concepts that underlie these words are selling themselves short, and they may well be short-changing their students.

It may be too much to ask that conservative art teachers utilize *Ceramics As An Art*. For it is within this reference that desperately needed new ideas can exist without the fear of retaliation. There is no "right way" presented.
INTRODUCTION

Ceramics As An Art is the product of an indepth research project conducted at Grove City High School in the Southwestern School District just adjacent to Columbus, Ohio. Developed under the sponsorship of the Art Education Department at The Ohio State University, these materials are addressed primarily to ceramic art teachers at the 9th, 10th, 11th, and 12th grade levels. The materials are intended to guide the production of alternative programs, courses, and units of instruction.

The features of the book include:


2. A range of ceramic styles that are intended to act as stimuli for further student products, not duplication.

3. The range of approaches to accomplish the various tasks within the book are open-ended. The freedom to experience and experiment are encouraged.

4. Basic guidelines are provided; however, the final decisions are left to the teacher. Here it is the responsibility of the teacher to utilize every
resource possible to create an atmosphere where the student's imagination can flourish.

5. Basic guidelines for the reading and evaluation of ceramic works.

6. The teacher's role in respect to being an artist/critic.

The purpose of the book is to present a concept and method of instruction in ceramics that will enable the teacher and student to exercise their ingenuity to create challenging works. The goal for the teacher is to create materials, in addition to the materials in the book, which will aid in achievement of selected educational goals.

Ceramics is a fine art, if viewed with the development of unique works. Works that are characterized by imagination. Ceramics must be treated in an honorific format if it is to breach the confines of its present-day existence.
OBJECTIVES

Teacher

1. To develop those capacities which will evoke both a professional and personal view, of not only ceramics, but of their position in being an active agent in stimulating students through sound teaching principles, based on philosophical and psychological aspects of imagination.

2. To aid in developing student requisite ability or qualities in regards to sensitivity to ceramics and creating imaginative works.

3. To develop through critical readings of student works, and criticism procedures, an in-depth perspective into the facets of artistic evaluation.

4. To act as a guiding force in areas of artistic competency.

Student

1. To develop certain requisite abilities or qualities in regards to sensitivity to ceramics and creating
imaginative works.

2. To develop certain knowledges in regards to ceramics, particularly in those areas dealing with the foundations of ceramics, basic procedures, basic construction techniques, glazes, and firing of works.

3. To develop through critical readings of ceramic works, an indepth perspective of the various facets of the work.
Questions relating to the term "creativity," or "imagination," have been either shrouded in mystery, subjected to theoretical bans, or clouded by admiring awe excited by personal dignity or consecration. Researchers into such areas appear to be running into conceptual troubles, judging from the "bewildered confusion" which is said to beset theoretical pronouncements on the matter. It is not simply a question of wanting to engineer more creative products, but of regarding the "creative person," as an end product of educational technology — specifiable in terms of the teacher's role, the design of curricula, and the selective treatment of students.

Creativity is imaginativeness or ingenuity successfully manifested in any valued pursuit, and the paradigms of creativity are located, in not only the arts, but in

science and practical activity.¹⁷⁹

The Aim and Nature of Art

The aim of art, so far as one can speak of an aim at all, has always been the same; the blending of experience gained in life with the natural qualities of the art medium.

Artistic intuition is the basis for confidence of the spirit. Art is a reflection of the spirit, a result of introspection, which finds expression in the nature of the art medium.

When the artist is well equipped with conscious feeling, memory, and balanced sensibilities, he intensifies his concepts by penetrating his subject and by condensing his experience into a reality of the spirit complete in itself. Thus he creates a new reality in terms of the medium.

The medium becomes the work of art, but only when the artist is intuitive and at the same time masters its essential nature and the principles which govern it.

A work of art is a world in itself reflecting senses and emotions of the artist's world.

Just as a flower, by virtue of its existence as a complete organism, is both ornamental and self-sufficient as to color, form, and texture, so art, because of its singular existence, is more than mere ornament.180

Art and Education

Some students possess the school they work in. Others are possessed by the school.

Let a student enter the school with this advice:

No matter how good the school is, his education is in his own hands. All education must be self-education.

Let him realize the truth of this, and no school will be a danger to him. The school is a thing of the period. It has the faults and the virtues of the period. It either uses the student for its own success or the self-educating student uses it for his success. This is generally true of all schools and students of our time.

The self-educator judges his own course, judges advice,

judges the evidences about him.

No one can lead him. Many can give advices, but the greatest artist in the world cannot point his course for he is a new man. Just what he should know, just how he should proceed can only be guessed at.

A school should be an offering of opportunity, not a direction, and the student should know that the school will be good for him only to the degree that he makes it good. It is a field for activity where he will see much, hear much and where he must be a judge, selecting for his special need, and daily discovering his need.

When we have bred a line of self-educators there will then be no fear of school. Those who have done distinguished work in the past, who have opened new roadways of vision and invented techniques specific to such visions have done it in spite of environment. They have learned what the schools had to offer, how much, how little. Strengths and weaknesses have alike been material to their progress. 181

Without education it is not possible for a man even to appreciate any art. For education does not give only

knowledge, but taste; it qualifies the feelings as well as the judgment. It creates the sensibility which is a compound of feeling and judgment—the depths of a man's sensibility, the sureness of his judgment, will be in proportion with the thoroughness of his education.  

Many in the fields of art and education feel that art is in itself the sole purpose of one's schooling in both mental and physical development. This I feel is a misconception in the light of art's purpose which was stated earlier as the blending of life's experiences with the qualities of the art medium.

The all-importance of imagination

The fact that imagination is the uncorrupted power of the human mind has long been recognized by the greatest thinkers. As Aristotle put it, imagination is "bringing something into existence." They have concurred in Shakespeare's conclusion that this divine spark is what makes man "the paragon (a model of excellence or perfection) of animals."

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1. There are basically three types of ceramics. They are:

2. The original clay material is known as__________________.

3. The process of water and ice grinding away at natural materials is characteristic of_________________________.

4. The most plastic of all clays are the_________________.

5. Terracotta Clay is sometimes referred to as__________________.

6. Grey Clays are also called__________________________.

7. Earthenware heat is______________________________.

8. The essential preparatory processes for most clay work is known as_________________ and__________________.

9. What are the three basic methods used to make ceramics?
10. Any reorganization of basic forms to makeup a singular form with many joined shapes is called a __________ pot or work.

11. The first step in throwing is __________ the ball of clay on the wheel head.

12. The __________ is the basic shape from which all other thrown forms are developed.

13. To make designs, scratch, or carve into a ceramic work is called ________________.

14. Pure clay is a compound of __________ and __________.

15. For various ingredients in a glaze to fuse together various __________ must be in the formula.

16. A poisonous fluxing agent used in glazes is __________.

17. What type of glazing produces poisonous fumes of chlorine and hydrochloric acid?

18. To determine the exact glaze you want to use, Glaze Tests or __________ __________ will have to be conducted.
19. Most glazes need to be creamy enough to just coat a

20. The best method of applying glaze is by__________.

21. The main component in all glazes which are the coloring agents are known as__________  __________.

22. The most important colorant at stoneware temperatures is__________  __________.

23. The first firing of a ceramic work is known as a

24. The second firing of a ceramic work is known as a

25. There are basically two types of kilns used in studio work,_______________ and______________.

26. The condition of the raw ware when most of the moisture has left the body but when it is still soft enough to be carved or burnished easily is known as___________________.

27. Pottery that has not been bisque fired is known as _______________.

28. The quality that allows the clay to be shaped and formed is known as ____________.

29. A disc or slab of plaster of Paris or fired clay, used to dry out clay or to work on is known as a __________.

30. A natural compound of alumina, silica, minerals, organic organisms, and minerals held together by electrolisis and water is known as ____________.

31. A furnace made of refractory clay materials for firing ceramic products is known as a ____________.

32. Small clay rods which indicate kiln temperatures are known as ____________.

33. Clay that is not plastic is known as ____________.

34. Clay that is highly plastic is known as ____________.

35. To clean the bottom of a glazed piece before firing is known as ____________.

36. Producing a shiny surface on clay by rubbing it with a smooth tool when it is leather hard is known as ____________.
37. Clays that are low-firing between 1751°F and 2014°F. The clay is easily broken and porous. These clays are known as____________________.

38. A clay having a slightly higher percentage of fluxes than pure clay (Kaolin). Fires to a tan or grey color. It is often quite plastic and may be used by the potter as an ingredient of stoneware bodies. This clay is known as____________________.

39. Grinding and mixing clay in a pug mill is known as____________________.

40. An earthenware body, generally red in color and containing grog is known as____________________.

41. Forming pottery of plastic clay on a potter's wheel is known as____________________.

42. A block of wood or plaster of Paris with a post holding a wire so that a lump of clay may be cut in half and the two halves slammed together is known as____________________.

43. Japanese earthenware, used in the tea ceremony, rough, with dark glaze is known as____________________.
Clays that are fired between 1222°F and 1305°F. This clay is very hard and non-porous. It is preferred by most potters. These types of clays are known as __________________.
ANSWERS:

1. Hobby Ceramics
   Industrial Ceramics
   Creative Ceramics
2. Primary Clay
3. Secondary Clay
4. Ball clays
5. Red Clay
6. Buff Clays
7. 1100°C.
8. kneading, wedging
9. Pinch
   Coil
   Slab
10. Combination
11. centering
12. cylinder
13. texturing
14. alumina, silica
15. fluxes
16. Lead oxide
17. Salt-glazing
18. Line Blends
19. dry finger
20. dipping
21. metallic oxides
22. Iron oxide
23. Bisque or Biscuit
24. glaze
25. electric, gas
26. leather hard
27. greenware
28. plasticity
29. bat
30. clay
31. kiln
32. cones
33. short clay
34. fat
35. dryfoot
36. burnishing
37. earthenware clay
38. fireclay
39. pugging
40. terra cotta or Terracotta
41. throwing
42. wedging board
43. raku
44. stoneware clays
PROGRAM #1 - Glossary of Ceramic Materials, Processes and Colloquial Terms (Vocabulary)
(NO OVERT RESPONSE REQUIRED)

SELF TEST #1 - 25 possible (4 points each)

ANSWERS:

1. bisque or biscuit 18. fireclay
2. leather hard 19. pugging
3. glaze 20. wedging
4. greenware 21. terracotta or terra cotta
5. plasticity 22. throwing
6. bat 23. wedging board
7. clay 24. raku
8. kiln 25. stoneware clays
9. coiling
10. cones
11. kneading
12. short clay
13. fat
14. ball clay
15. dryfoot
16. burnishing
17. earthenware clay
PROGRAM #2 - Ceramic Examples

(NO OVERT RESPONSE REQUIRED)

SELF TEST #2 - 12 possible (8.33 points each)

ANSWERS:

1. non-functional
2. functional or non-functional
3. functional
4. functional
5. functional
6. functional
7. non-functional
8. functional or non-functional
9. functional
10. functional or non-functional
11. functional
12. non-functional
Types of Ceramics

Purpose

The purpose in briefly studying the types of ceramics is to instill in the students the magnitude that ceramics has taken in practically all walks of life. That ceramics is not just the ash tray on the coffee table, but an extremely complex undertaking which has fostered itself in primarily hobby ceramics, industrial ceramics, and creative ceramics.

Student Activities/Objectives

1. Do in class, the program on the types of ceramics.
2. Participate in a discussion of the types of ceramics, and how each type has influenced your personal life in some manner.

Teacher Activities/Objectives

1. Lead a discussion of the ways in which the various types of ceramics has influenced present-day life. If need be demonstrate through visuals some of the varying forms that ceramics now holds.
PROGRAM #3 - Types of Ceramics
(NO OVERT RESPONSE REQUIRED)

SELF TEST #3 - 3 possible (33.33 points each)

ANSWERS:

1. Hobby Ceramics - That type of ceramics which has come into identification with the hobby ceramic shop.
   Hobby Ceramics is characterized by pre-made forms which the customer purchases, cleans, pays to have fired, buys glaze to decorate, and again pays to have fired. Originally, Hobby Ceramics was a style which came out of the Victorian "art" of china painting. (OR WORDS TO THAT EFFECT)

2. Industrial Ceramics - That type of ceramics which has served man as a basic tool from practically the beginning of time. It has served in basic functional ways as plates, bowls, vessels, and storage containers. This earliest of mass production practices has come to be used in Aerospace Electronics, medicine, rockets, automobiles, radio, television, and electric appliance production. (OR WORDS TO THAT EFFECT)

3. Creative Ceramics - That type of ceramics which has been used since the earliest beginnings as a tool which
was functional. Creative Ceramics is characterized by a use of the imagination in creating aesthetic objects. It encompasses man's effort to create the unique and the artistic. (OR WORDS TO THAT EFFECT)
UNIT TEST #1

DIRECTIONS: On the following pages are test items covering the Glossary of Ceramic Materials, Processes and Colloquial Terms, Ceramic Examples, and Types of Ceramics. Read all of the questions carefully before answering. Place all of your answers in the spaces provided.

1. Unglazed fired clay is known as _______________.
   bisque  china clay  fireclay

2. A liquid suspension of finely ground minerals that is applied by brushing, pouring, or spraying on the surface of bisque-fired ceramic ware is known as ________.
   luting  frog  glaze

3. Pottery that has not been bisque fired is known as ________________.
   greenware  stoneware clays  grog

4. The quality that allows the clay to be shaped and formed is known as ________________.
   pugging  peeling  plasticity
5. A disc or slab of plaster of Paris or fired clay, used to dry out clay or to work on is known as a ____________.

slip  shard  bat

6. A natural compound of alumina, silica, minerals, organic organisms, and minerals held together by eletrolisis and water is known as ____________.

engobe  clay  fat

7. A furnace made of refractory clay materials for firing ceramic products is known as a ________.

kiln  frit  batch

8. Working clay with the fingers or the heel of the hand in order to obtain a uniform consistency is known as ____________.

luting  crawling  kneading

9. Clay that is not plastic is known as ____________.

short clay  porcelain clay  earthenware clay

10. Clay that is highly plastic is known as ____________.

dryfoot  fat  slurry
11. Producing a shiny surface on clay by rubbing it with a smooth tool when it is leather hard is known as

kneading  wedging  burnishing

12. Grinding and mixing clay in a pug mill is known as

peeling  pugging  trailing

13. The act of kneading clay by cutting it in half and slamming the halves together is known as

stacking  blowing  wedging

14. Forming pottery of plastic clay on a potter's wheel is known as

trailing  crazing  throwing

15. Japanese earthenware, used in the tea ceremony, rough, with dark glaze is known as

bone china  china  raku
Label the following examples as to whether they are functional or non-functional.

16. __________  17. __________

18. __________  19. __________
Identify the three types of ceramics, and explain their influences.

23.

24.

25.
UNIT TEST #1 - Glossary of Ceramic Materials, Processes and Colloquial Terms, Ceramic Examples, and Types of Ceramics
25 possible (4 points each)

ANSWER:

1. bisque
2. glaze
3. greenware
4. plasticity
5. bat
6. clay
7. kiln
8. kneading
9. short clay
10. fat
11. burnishing
12. pugging
13. wedging
14. throwing
15. raku
16. non-functional
17. non-functional
18. non-functional
19. functional
20. functional
21. non-functional
22. non-functional

(answers continued on next page)
23. **Hobby Ceramics** - That type of ceramics which has come into identification with the hobby ceramic shop. Hobby Ceramics is characterized by pre-made forms which the customer purchases, cleans, pays to have fired, buys glaze to decorate, and again pays to have fired. Originally, Hobby Ceramics was a style which came out of the Victorian "art" of china painting. (OR WORDS TO THAT EFFECT)

24. **Industrial Ceramics** - That type of ceramics which has served man as a tool from practically the beginning of time. It has served in basic functional ways as plates, bowls, vessels, and storage containers. This earliest of mass production practices has come to be used in Aerospace Electronics, medicine, rocket, automobile, radio, television, and electric appliance production. (OR WORDS TO THAT EFFECT)

25. **Creative Ceramics** - That type of ceramics which has been used since earliest beginnings as a tool which was functional. Creative Ceramics is characterized by a use of the imagination in creating aesthetic objects. It encompasses man's effort to create the unique and the artistic. (OR WORDS TO THAT EFFECT)
**Brief History of Ceramics**

This particular section has not been included in the student's book due to the nature of history in art and it being essential in many cases to use visuals or actual works to demonstrate their properties. It is felt that the history of ceramics is essential to gain a complete understanding of the scope of ceramics worldwide; however, it is also felt that to present works before the students which may have such an impact as to later elicit imitation is also an incorrect move. Therefore, the history of ceramics is to be viewed in its relationship to the history of the particular countries and the occurrences which had an effect on ceramic development.

**Student Activities/Objectives**

1. To participate in discussions on each separate aspect of ceramic history.

**Teacher Activities/Objectives**

1. To read a section at a time to the students from the *Brief History of Ceramics*. Emphasize a global aspect to the study. If need be, utilize world maps so as
to give the students an idea of the various locations.
It is further suggested that the time spent on each
area in the history be as brief, and as interesting
as possible.

2. Lead brief discussions after each area to ensure that
the students have some type of grasp on the section.

The following is a list of references which may be
utilized in sessions involving the history of ceramics.
The references are by no means meant to encompass all of
the materials you may find necessary for your particular
class. It must be emphasized here that the history of
ceramics is quite extensive; however, certain civilizations
have contributed vastly more than others. Major categories
are: prehistoric, Middle Eastern, Minoan and Mycenaean,
China and the Far East, Greek, Etruscan and Roman, Islamic,
Hispano-Moresque, Italian, Northern Europe, African, South
American, Colonial American, and Contemporary.

REFERENCES:

Attil, Esin. Ceramics from the world of Islam. Washington,

Boos, Frank H. The ceramic sculpture of ancient Oaxaca.

Brockington, Donald Leslie. The ceramic history of Santa
Rosa, Chinas, Mexico. Provo, Utah, New World Archae-
ological Foundation, Brigham Young University, 1967.


Periodicals - These references are among the best for viewing contemporary ceramic works.


The Ceramic Monthly. New York, N.Y.
Sensitivity to Ceramics

Purpose

This particular section is designed to acquaint the students with the qualities, personality, and basic procedures for working with clay. To accomplish this task it will be necessary to place yourself and your students in a situation where the boundaries of individuality, and that of the clay, are joined to form a force that can produce works of a highly imaginative nature.

Here again, the section has not been included in the student's book for reasons of teacher selection, or its non-programming qualities that would be better handled by the teacher.

Student Activities/Objectives

1. Engage in sensitivity activities concerned with the total familiarity of clay.

Teacher Activities/Objectives

1. To conduct the sensitivity session(s) as described on the following pages.
Sensitivity to Ceramics

It is vital that a high degree of sensitivity be established between the students and the clay. To begin with, make sure that there are ample amounts of plastic clay for each of the students to have. When this has been accomplished you are ready to begin.

**Step #1**

Have the students take the clay into their hands and form it into a ball.

**Step #2**

Once the ball has been formed, have the students tell you if they think the clay is too soft or too hard. At this time you can introduce the terms long and short clay. Examples can be given as to how clay is formed as the students are manipulating the clay.

**Step #3**

After the dryness of the clay has been determined, have the students take the clay by both hands and squeeze it until it becomes a mass of numerous holes, dips, concave and convex shapes.
Step #1

Next, have the students pound the clay into a patty. Make sure that the patty is large enough to cover an area approximately one foot in diameter, but not so small as to resemble a flattened oval shape.

Have the students take the clay in one hand and drape it over their hands, forearms, etc. This tactile experience should continue into areas where the clay is actually draped over the students back, legs, face, etc. In accomplishing the later tactile experiences it will be necessary to have students wear old clothes and work in couples. The extent to which you carry out these experiences is determined by individual students and your observation of their reactions to the clay.

Step #5

Have the students take the clay into their hands and form it into a ball.

Step #6

After this has been accomplished, have the students press their thumbs into the center of the clay ball. Once everyone has penetrated the clay for the complete diameter of the clay except for about \( \frac{1}{2} \) of an inch, have them begin
to form the walls by spreading out the cavity that was formed by their thumbs. Have them continue in this manner until they have achieved a base of about 4 to 6 inches. Then begin to press the remainder of the clay to the outside of the base until it reaches a height that the individual student feels is in direct proportion to the base in thickness and relative height.

Step #7

In this final step you can simply let the students decide whether they want to keep the works or throw them back into the clay bin. However, if the pieces are kept, the process of creating a work must be followed through with. It would therefore be necessary to delve into brief encounters as to how clay is dried, bisque fired, glazed, and glaze fired. These items are not necessarily considered to add to the sensitivity already established, but it would add to an introductory comprehension of the entire process involved in the making of ceramic works.
Procedural steps common to all ceramic ware

Kinds of Clay

Purpose

To familiarize the student with not only the various types of clay, but their components and origins. It is this basic understanding of the types of clay that will furnish a firm foundation upon which to build later knowledge in respect to how clay can be manipulated in the actual making of works and glazing them.

Student Activities/Objectives

1. To do in class the program on the kinds of clay.
2. To visually inspect the various types of clay and their properties. Special attention should be paid as to how each type can be used in the production of various works.

Teacher Activities/Objective

To conduct activities where the students are allowed to visually witness the types of clay and their properties. Here a laboratory setting is called for.
PROGRAM #4 - Kinds of Clay

ANSWERS:

1. Primary Clay
2. Bodies or Primary Clay
3. Secondary Clays
4. granite or felspar, potash or lime
5. Ball Clays
6. color (stained gray, blue, or nearly black)
7. Ball Clays
8. Buff Clays
9. sand, grog*
10. Ball Clays
11. Red Clay, red
12. Buff Clays, stoneware (1250°C. and 1350°C.)
13. sand, grog, Stoneware Bodies
14. Firoleays, earthenware heat (1100°C.)
15. Crank Mixture
16. Modelling Clays

SELF TEST #4 - 13 possible (7.69 points each)

ANSWERS:

1. Primary Clay
2. Secondary Clays
3. Ball Clays
4. Ball Clays
5. red, grey
6. terra cotta clay
7. Buff Clays
8. sand, grog
9. 1100°C.
10. Ball Clays
11. Modelling Clays
Keeping clay in condition

Purpose

To establish various knowledges as to basic storage procedures of clay, and the preparation of clay for working by kneading and wedging. It is these beginning steps that are common to all methods of creating works. Without knowledge of these facets nothing can be logically done with the clay to make any type of ceramic work.

Student Activities/Objectives

1. Do in class the program concerned with keeping clay in condition.
2. Visually inspect the clay bins to see if the clay has been properly stored. If not, re-store the clay in the proper manner.
3. Kneed and wedge clay to a consistency deemed necessary for making works.

Teacher Activities/Objectives

1. Prepare clay bins in a manner that will visually demonstrate to the students the proper and unproper
PROGRAM #5 - Keeping Clay In Condition

ANSWERS:

2. hard, soft
4. disciplined system, working, storage
8. kneading, wedging
9. kneading
12. air pockets, wedging

SELF TEST #5 - 10 possible (10 points each)

ANSWERS:

1. hard, soft
2. kneading, wedging
3. kneading
4. wedging
5. wedging table
6. coats
7. system, storage
manner of storing clay.

2. Demonstrate and explain to the students the method of kneading and wedging that is to be conducted in their particular ceramics class. It is vital that each and every student have a thorough knowledge of this procedure plus practice at the wedging table.
Fundamental Considerations

Purpose

To establish the stages of dryness in clay, how to make clay wetter, drying clay for use, shrinkage, warping, and cracking. These facets of ceramics are common to all areas in the field. They will also explain in some detail the more simpler defects in building works.

Student Activities/Objectives

1. Do in class, the program concerned with fundamental considerations.
2. Engage in activities concerned with making clay wetter and stages of dryness.
3. Visually inspect ceramic works for defects as a result of shrinkage, warping, or cracking.

Teacher Activities/Objectives

1. Have the students endeavor to make some clay wetter. This can be done on an individual basis or in small groups.
2. Conduct experiments with various amounts of clay to determine the stages of dryness it goes through.
3. Explain to the students, through visual representation, how shrinkage, warping, and cracking can be possibly avoided. Discussions should be held as to how students' individual projects could be deterred from the defects.
PROGRAM #6 - Fundamental Considerations

ANSWERS:

1. too wet, too dry
2. soft plastic condition
3. medium plastic condition
4. stiff plastic condition, trimming
5. leather hard, rigid
6. shrinkage, extreme brittleness
7. kneading, plaster
8. crack, explode
9. uniformly
10. dryness, warping
11. thickness of the walls and base
12. shrinkage, cracking

SELF TEST #6 - 10 possible (10 points each)

ANSWERS:

1. plastic
2. crack, explode
3. uniformly
4. cracking, warping
5. at the same time as the work, clay
6. grog
7. drying cabinet
UNIT TEST #2

DIRECTIONS: On the following pages are test items covering the Kinds of Clay, Keeping Clay In Condition, and Fundamental Considerations. Read all of the questions carefully before answering. Place all of your answers in the spaces provided.

1. China Clay or Kaolin are known as _______________.
2. The most plastic of all clays are the _______________.
3. Red Clay is sometimes referred to as _______________.
4. Grey Clays are sometimes referred to as _______________.
5. Earthenware heat is _______________.
6. _______________ and _______________ are essential preparatory processes for most clay work.
7. The best method known for mixing various types of clay into a single body is by _______________.
8. The elimination of air pockets from the clay is the major function of _______________.
9. Most wedging is performed on a _______________ with an absorbent surface of plaster, concrete, slate or pairing stone.
10. If clay is good and _______________ it will not be too wet or too dry.
11. If the clay has not been allowed to dry in the proper manner it may ______ because of being dried too fast, or _______ in the kiln if excess moisture is still present.

12. The important thing to remember about drying your work is that the entire piece dry rather ______________.

13. During the shrinkage process ___________ and ___________ are the two main defects to be careful of.

14. As far as lids, handles, etc. are concerned, they should all be made ________________________, plus with the same ________.

15. Even though _________ (ground bisque ware) should not be used in throwing pots, its use is encouraged in works created by other methods to reduce the possibility of shrinkage and cracking.

16. Perhaps the safest method of drying works is by the use of the __________________.
UNIT TEST #2 - Kinds of Clay, Keeping Clay In Condition, and Fundamental Considerations

20 possible (5 points each)

ANSWERS:
1. Primary Clay
2. Ball Clays
3. Terracotta Clay
4. Buff Clays
5. 1100°C.
6. kneading, wedging
7. kneading
8. wedging
9. wedging table
10. plastic
11. crack, explode
12. uniformly
13. cracking, warping
14. at the same time as the work, clay
15. grog
16. drying cabinet
Design Characteristics

Pinch Pottery

Purpose

The specific purpose in doing pinch pottery is to familiarize the student with one of the oldest methods of making pottery. It is this method which has characterized many ceramic forms worldwide. The pinch method is considered by many to be a basic method to other methods. For this reason the pinch method has established itself as a method encompassing the finer points of pottery making.

Student Activities/Objectives

1. Do in class the program on pinch pottery.
2. Construct a pinch pot under the direction of your teacher.
3. Participate in critical discussions (readings) of your individual works and those of others in the class.
PROGRAM #7 - Pinch Pottery
(NO OVERT RESPONSE REQUIRED)

SELF TEST #7 - 1 possible (100 points each)

UNIT TEST #3 - Pinch Pottery

1 possible (100 points each)

NOTE: The UNIT TEST is a repeat of the SELF TEST.
Teacher Activities/Objectives

1. Conduct a demonstration on how to do the pinch method.

2. Lead a discussion (reading) of the individual students' work and how it relates to other works done by the class.
Coil Pottery

Purpose

The major purpose in doing coil pottery is to familiarize the student with one of the basic methods by which all ceramic works are constructed. The other two methods being slab pottery and wheel-made pottery (thrown).

The constructing of a coil pot will give the students a first-hand knowledge of the methods and fundamentals associated with the method, plus act as an appropriate base from which to discuss other related methods.

Student Activities/Objectives

1. Do in class the program on coil pottery.
2. Construct a coil pot under the direction of your teacher.
3. Participate in critical discussions (readings) of your individual works and those of others in the class.

Teacher Activities/Objectives

1. Conduct a demonstration on how to do the coil method.
2. Lead a discussion (reading) of the individual students work and how it relates to other works done by the class.
PROGRAM #8 - **Coil Pottery**

(NO OVERT RESPONSE REQUIRED)

SELF TEST #8 - 1 possible (100 points each)

UNIT TEST #4 - **Coil Pottery**

1 possible (100 points each)

**NOTE:** The UNIT TEST is a repeat of the SELF TEST.
Slab Pottery

Purpose

As with coil pottery, the major purpose in doing slab pottery is to familiarize the student with one of the basic methods by which all ceramic works are constructed.

The constructing of a slab pot will give the students a first-hand knowledge of the method, plus added insights into a construction process which utilizes a variety of forms to accomplish a quite different looking ceramic piece.

Student Activities/Objectives

1. Do in class the program on slab pottery.
2. Construct a slab pot under the direction of your teacher.
3. Participate in critical discussions (readings) of your individual works and those of others in the class.

Teacher Activities/Objectives

1. Conduct a demonstration on how to do the slab method.
2. Lead a discussion (reading) of the individual students work and how it relates to other works done by the class.
PROGRAM #9 - Slab Pottery

(NO OVERT RESPONSE REQUIRED)

SELF TEST #9 - 1 possible (100 points each)

UNIT TEST #5 - Slab Pottery

1 possible (100 points each)

NOTE: The UNIT TEST is a repeat of the SELF TEST.
Combinations

Purpose

Even though combinations of the various methods is not considered one of the basic methods, it is considered to encompass numerous construction techniques characteristic of other methods.

The constructing of combination pots will give the students an opportunity to experience a form of ceramic construction with added dimensions in regards to creative possibilities.

Student Activities/Objectives

1. Do in class the program on combination pottery.
2. Construct a combination pot under the direction of your teacher.
3. Participate in critical discussions (readings) of your individual works and those of others in the class.

Teacher Activities/Objectives

1. Conduct a demonstration on how to do the combination method.
2. Lead a discussion (reading) of the individual students work and how it relates to other works done by the class.
PROGRAM #10 - Combinations

ANSWERS:

1. combination
2. preconceived
3. kiln

SELF TEST #10 - 1 possible (100 points each)

UNIT TEST #6 - Combinations

1 possible (100 points each)

NOTE: The UNIT TEST is a repeat of the SELF TEST.
Wheel-made Pottery

Purpose

The major purpose, as with coil and slab pottery, is to familiarize the students to one of the basic methods by which all ceramic works are constructed. Due to the nature of wheel-made pottery, it is viewed as a method that may take considerable time to master, depending upon the individual.

This method will allow the student to experience a ceramic process quite different in its approach and techniques; yet, just as magnificent in its end products.

Student Activities/Objectives

1. Do in class the program on wheel-made pottery.
2. Construct a wheel-made pot under the direction of your teacher.
3. Participate in critical discussions (readings) of your individual works and those of others in the class.
Teacher Activities/Objectives

1. Conduct a demonstration on how to do the wheel-made method.
2. Lead a discussion (reading) of the individual students work and how it relates to other works done by the class.
PROGRAM #11 - Wheel-made Pottery
(NO OVERT RESPONSE REQUIRED)

SELF TEST #11 - 1 possible (100 points each)

UNIT TEST #7 - Wheel-made Pottery
1 possible (100 points each)

NOTE: The UNIT TEST is a repeat of the SELF TEST.
Texturing

Purpose

The major purpose of exposing the students to various aspects of texturing is to familiarize them with tools that can be used in texturing, plus concepts to keep in mind when texturing is selected. The purpose is not so much to have students texture every work, but to provide them with knowledge as to its various components if it is ever called for.

Student Activities/Objectives

1. Do in class the program on texturing.
2. Construct a pot (any method may be used) utilizing texture as a major component.
3. Participate in critical discussions (readings) of your individual works and those of others in the class.

Teacher Activities/Objectives

1. Conduct a demonstration on various techniques of texturing clay and how it should relate to the
entire work.

2. Lead a discussion (reading) of the individual students work and how it relates to other works done by the class.
PROGRAM #12 - Texturing

ANSWERS:

4. imperfections, joints
5. natural, enhance, imitate

SELF TEST #12 - 5 possible (20 points each)

ANSWERS:

1. imperfections, joints
2. natural, enhance, imitate
Wrapping and storing unfinished works

Purpose

The major purpose is to instill in the students those procedures deemed necessary to keep unfinished works in a state of workability. It is this process which is vital to the completion of any ceramic work. Even though places for storing of works may vary, the process remains the same in principle and practice.

Student Activities/Objectives

1. Do in class the program on wrapping and storing unfinished works.

2. Participate in a demonstration on the correct procedures for wrapping and storing works.

Teacher Activities/Objectives

1. Conduct a demonstration on the proper method of wrapping and storing unfinished works. Include in the demonstration those reasons why clay should be kept wrapped if still being worked, and the importance of proper storage in completing works.
PROGRAM #13 - Wrapping and storing unfinished works
(NO OVERT RESPONSE REQUIRED)

SELF TEST #13 - 1 possible (100 points each)

ANSWER:

1. First, wrap the work in wet rags, then cover with polythene. Second, store the work on a shelf provided for such works. The shelves should be well out of the way of individuals who might bump or knock into them. (OR WORDS TO THAT EFFECT)
UNIT TEST #8

DIRECTIONS: On this page are test items covering Texturing, and Wrapping and storing unfinished works. Read all of the questions carefully before answering. Place all of your answers in the spaces provided.

1. Texturing is generally used by potters to act as an intricate part of the total work, to cover ___________, or to strengthen ___________ as well as cover them.

2. Any type of texturing should be ___________ to the clay and enhance the form; however, any attempt to ___________ surfaces of a non-clay substance should be totally avoided.

3. Explain, in your own words, how to wrap and store an unfinished work.
UNIT TEST #8 - Texturing, and Wrapping and storing unfinished works

5 possible (20 points each)

ANSWERS:

1. imperfections, joints

2. natural, imitate

3. First, wrap the work in wet rags, then cover with polythene. Second, store the work on a shelf provided for such works. The shelves should be well out of the way of individuals who might bump or knock into them. (OR WORDS TO THAT EFFECT)
Glazes

Purpose

The overall purpose in studying glazes is to familiarize the student with the various aspects of creating their own formulas for their particular works. However, it is recognized that certain ceramic classes utilize premixed glaze. Even in light of this situation, the process of a student experiencing this most vital aspect of ceramic creation should not be totally overlooked or replaced entirely.

Student Activities/Objectives

1. Do in class the program on glazes.
2. Run some test glazes on a work they have created, or on slabs of clay.
3. Participate in critical discussions (readings) of your individual glazes and those of others in the class to determine their qualities in respect to themselves (the glazes) and their impact on a work.

Teacher Activities/Objectives

1. Conduct a demonstration on how various formulas are
derived and how glazes should be utilized in respect to the ceramic work.

2. Lead a discussion (reading) of the individual students' glaze formulas and how they work on a creative work of art in ceramics.
PROGRAM #14 - Glazes

ANSWERS:

2. aluminium oxide (alumina), silicon dioxide (silica), water
6. glassy, stability
7. alumina
8. sticky
9. fluxes
10. predominant
11. lead oxide, highly poisonous
13. vegetable matter, hydrogen, carbon

SELF TEST #14 - 14 possible (7.14 points each)

ANSWERS:

1. aluminium oxide (alumina), silicon dioxide (silica), water
2. glassy, stability
3. alumina
4. sticky
5. fluxes
6. predominant
7. lead oxide, highly poisonous
8. vegetable matter, hydrogen, carbon
Purpose

As with the section on glazes, coloring oxides seem initially to be of little value in light of using premixed glazes. However, this section is vital to a complete understanding of the entire process of glazing ceramic works. The different colors that can be obtained through glazing is practically limitless. It is this great variety of colorants which create for the student an open door to glaze selection.

Student Activities/Objectives

1. Do in class the program on coloring oxides.
2. Do experiments using various coloring oxides.

Teacher Activities/Objectives

1. Conduct experiments using various coloring oxides.
PROGRAM #15 - Coloring Oxides

ANSWERS:
1. metallic oxides 
3. 1100°C, temperature
4. iron oxide, most important

SELF TEST #15 - 5 possible (20 points each)

ANSWERS:
1. metallic oxides
2. 1100°C, temperature
3. iron oxide, most important
Glazing Methods

Purpose

The purpose of this section is to present the students with various methods by which ceramic works can be glazed. It is these glazing methods which are vital in applying glaze in such a manner as to not detract from the overall design (both shape and glaze) of the ceramic work. A proper glazing method (depending upon the shape of the work) can make or break it as a piece of fine art. Sloppy glazing procedures can only result in sloppy works.

Student Activities/Objectives

1. Do in class the program on glazing methods.
2. Participate in a demonstration of the various glazing methods.

Teacher Activities/Objectives

1. Conduct a demonstration of the various glazing methods and how they relate to the shape of the work.
PROGRAM #16 - Glazing Methods

ANSWERS:

2. 1050°C, dry finger, experience
3. length of time, saturated
5. stirred, solid mass

SELF TEST #16 - 10 possible (10 points each)

ANSWERS:

1. 1050°C.
2. dry finger
3. experience
4. saturated
5. dipping
6. stirred
7. pouring
8. brush
9. sprayed
10. hold
UNIT TEST #2

DIRECTIONS: On the following pages are test items covering Glazes, Coloring Oxides, and Glazing Methods. Read all of the questions carefully before answering. Place all of your answers in the spaces provided.

1. Pure clay (china clay or kaolin) is a compound of ______________________, ______________________, and ______________________.

2. Bauxite ore, known as ______________________ is a welcome substance in clay.

3. For the glaze to not flake or dust off it must be ______________________ in nature.

4. For various ingredients in a glaze to fuse together various __________________ must be in the formula.

5. The most exceptional and effective fluxing agent is ______________________; however, precautions should be taken in its use since it is ______________________.

6. The main components in all glazes which are the coloring agents are known as ______________________.

7. Above __________________ the coloring oxides are highly influenced by kiln temperature.

8. At stoneware temperatures (1250°C. to 1350°C.) ______________________ is considered by far to be the most important colorant.
9. Most glaze thickness can only be found through __________________.

10. Caution must be taken when glazing a work because of the length of time the pot is held within the glaze can result in the clay becoming ________________ and little glaze will remain in place.

11. The best method of applying glazes is by ________________.

12. If glazes are not continuously __________ there is a large chance that a solid mass of glaze will form in the container and the glaze will be of no use.

13. When there is not enough glaze to cover an object by dipping, the next best method is ________________.

14. Touching up sticks or finger marks is done with a ________________.

15. Glazes can be __________ on to bisque ware, but compressors and spray guns are expensive and must be used in conjunction with a proper booth and extractor fan.

16. The chief difficulty with both pouring and dipping is how to __________ the pot.

17. Bisque temperature is ________________.
UNIT TEST #9 - Glazes, Coloring Oxides, and Glazing Methods
20 possible (5 points each)

ANSWERS:
1. aluminium oxide (alumina), silicon dioxide (silica), water
2. alumina
3. sticky
4. fluxes
5. lead oxide, poisonous
6. metallic oxides
7. 1100°C.
8. iron oxide
9. experience
10. saturated
11. dipping
12. stirred
13. pouring
14. brush
15. sprayed
16. hold
17. 1050°C.
Kilns and Firing

Types of Kilns

Purpose

To familiarize the student with the various types of kilns, their capabilities, and their limitations. Learning the types of kilns is a basic knowledge that all individuals interested in ceramics should know. Kilns are perhaps the most vital of equipment in the ceramic process.

Student Activities/Objectivos

1. Do in class the program on the types of kilns.
2. Make a visual survey of the types of kilns used, in not only your class, but in other areas doing ceramics.

Teacher Activities/Objectives

1. Aid the students in making a visual survey of the types of kilns used in ceramics by showing the students the kiln your using. If need be, use illustrations to exhibit the various types.
PROGRAM #17 - Types of Kilns

(NO OVERT RESPONSE REQUIRED)

SELF TEST #17 - 5 possible (20 points each)

ANSWERS:

1. electric
2. electric
3. bisque
4. raku
5. flame
Types of Firings

Purpose

To add to the basic understanding of the ceramic process, a knowledge of the types of firings is essential. Knowledge of the types of firings will instill in the students those aspects of clay and glaze preparation which at this stage of the process are paramount considerations. This type of insight into the process is a necessity.

Student Activities/Objectives

1. Do in class the program on the types of firings.
2. Visually inspect a kiln at various stages in the firing to check the process the clay or glaze goes through.

Teacher Activities/Objectives

1. Aid the students in a visual inspection of the various types of firings, what occurs during the firings, and the purposes.
PROGRAM #18 - Types of Firings

ANSWERS:

1. 1050°C., bisque or biscuit

SELF TEST #18 - 5 possible (20 points each)

ANSWERS:

1. two
2. bisque or biscuit
3. glaze
4. bisque or biscuit
5. single
UNIT TEST #10

DIRECTIONS: On the following pages are test items covering the Types of Kilns and the Types of Firings. Read all of the questions carefully before answering. Place all of your answers in the spaces provided.

1. The _______ kiln is the most suitable for school use.

2. _______ kilns may be left on all night, unattended, and require only to be switched up once or twice during the following day before the final temperature is reached.

3. The _______ kiln represents the simplest type of up-draught kiln (the circulating flow of air moves upward).

4. The gas and coal-fired kilns are examples of kilns which are _______ -producing.

5. Ceramic ware is usually fired _______ times.

6. The first firing is the _______ firing.

7. The second firing is the _______ firing.

8. All firings at 1050°C are considered to be _______ fired.
9. The ______ kiln has some refinements which make possible a higher temperature and the most dramatic initiation into the mysteries of pottery.

10. In some rare cases the bisque and glaze firings are combined. This particular type of firing is known as ________________ firing.
UNIT TEST #10 - Types of Kilns, and Types of Firings

10 possible (10 points each)

ANSWERS:

1. electric
2. electric
3. Bisque
4. flame
5. two
6. Bisque or Biscuit
7. glaze
8. Bisque or Biscuit
9. Raku
10. single
Equipment, Materials and Supplies

The below quantities of raw materials are minimal, they would go a long way with one person, but in a school they would only last a short time, though long enough for the teacher to decide which suit him best. Quantities of small tools are suggested for classes of about a dozen students.

Kiln Building Materials

Local builders' merchants supply firebricks of various thicknesses, 9 inches by $\frac{3}{4}$ inches by $3$, $\frac{7}{4}$, 2 or 1 inch, common bricks and fireclay. Local ironfounders will make firebars to fill the measurements of your grate. New materials are expensive; a gas works may be able to supply used firebricks of good quality, and commons may be found anywhere though there may be a lot of cleaning to do with mash hammer and cold chisel or bricklayer's hammer.

Kiln Shelves and Supports

Kiln shelves seem naturally to be accident-prone, so it is useful to have a few in stock. Order sizes as near as possible to the full area of the kiln floor (about half a
dozen) unless it is over 18 inches square; half area (6 or 8) and quarter area (one dozen). Stipulate high temperature always (H.T.).

One inch must always be left clear between the shelves and the kiln wall to allow heat to circulate. This gap should be greater with flame-producing kilns.

Plain tile cranks, 9 inches by 6 inches (1 or 2 dozen). Plain rectangular dots. No. 3 (1 or 2 gross).

Interlocking prop system G. 175. One gross 1 inch (H.T.), one gross 1½ inch (H.T.). Two dozen height-adjusting fittings, G. 175 S.T. (H.T.). Stilts for glazed ware (one gross each of Nos. oz, 1 and 2).

Pyrometric Cones

If a pyrometer is fitted to the kiln these are not necessary, but to test accuracy of the instrument order 1 dozen each of Nos. 3, 03A (1040°C., bisque), 1A (1100°C., earthenware glaze), 9 (1280°C., usual stoneware finish).

Without pyrometer buy the following numbers so that the progress of temperature rise can be observed:

05A (1000°C.), 03A (1040°C.), 01A (1080°C.),
1A (1100°C.), 5A (1180°C.), 6 (1200°C.),
7 (1230°C.), 8 (1250°C.), 9 (1280°C.),
10 (1300°C.).
Concrete Clay Preparation Slab

Ideally this should be built on brick piers, and the space underneath could be fitted with metal-lined doors, shelves and a water trough on the floor, to act as a clay store. Height needs to be between 30 and 36 inches, and the surface area as long as possible but at least 2 feet deep. The builders will skim the top of the concrete with a cement mix giving a smooth surface, but if this mix contains too high a proportion of cement it will not be sufficiently porous and clay will tend to stick.

If the floor of the classroom is wooden 2 or 3 inches of concrete can be laid on one or more substantial tables.

Plaster Drying Slab

A thick plaster slab in wooden frame, about 18 inches to 24 inches square, is useful for drying clay. Use dental plaster (local builders' merchant).

Workbenches

Clay working benches should have wood or linoleum tops giving a little absorbency. Tops of glazing benches should be of zinc or plastic laminate.
Clay

If adequate storage is available try one or two hundred-weight of: Red clay, Crank Mixture and St. Thomas' Body and Stoneware Modelling clay. Firoclay in powder form may be obtained from local builders' merchants.

Small Tools

Two wooden Rolling Pins or iron bars.
Two Potters' Fettling Knives.
Hacksaw Blades
Six Natural Sponges
Six Synthetic Bench Sponges for cleaning.
Three 4-inch flat Paint Scrapers
One Sheet 8 ft. x 4 ft. x ½ in. Asbestos for making slab or coil pots on.
Modelling Tools.
Wire Ended Modelling Tools
Flat Wire Turning Tools
One Carborundum Rubbing Block for grinding shelves and the bottoms of pots.

Equipment for Preparing Slips and Glazes

One moderate-sized (9 inch) Pestle and Mortar.
Three Lawns or Sieves.
Slip Brushes (Two)
Lawn Brushes (Two)
Two Enamel Jugs, 4-pint and 2-pint.
Polythene Bowls (half dozen).
Six Plastic or Rubber Buckets with Lids.
One all-purpose set of Scales. Counter-balance type without springs or weights is the most useful.
Slip Trailers, for decoration.
Three Goat Hair Kops.
Two Oriental Calligraphic Brushes
Also Scissors, Rulers, T-Squares, Garden Spray, Spatulas, Palette Knives.
Gum Labels coated with Sellotape make serviceable, washable labels on polythene or glass containers.

**Glaze and Slip Ingredients**

- Potash Felspar 1/2 lb.
- Soda Felspar 7 lb.
- Cornish Stone 1/2 lb.
- Nepheline Syenite 7 lb.
- Flint 1/2 lb.
- Whiting 1/2 lb.
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<tr>
<td>Magnesium Carbonate</td>
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<td>Manganese Oxide</td>
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<td>Iron Oxide (red)</td>
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<td>Tin Oxide</td>
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**Suppliers**

The research and Education Department of the American Craftsmen's Council (29 West 53rd Street, New York, N.Y.)
publishes a general list of craft suppliers which contains a comprehensive section on ceramics. The Council also publishes an excellent magazine, *Craft Horizons*, which is available from the Council.
Pyrometric Cones and Temperature Correlations

<table>
<thead>
<tr>
<th>British Cones</th>
<th>American Cones</th>
<th>Temperature °C</th>
<th>Temperature °F</th>
<th>Color Visible in Kiln Interior</th>
<th>Processes and Reactions</th>
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<td>01c</td>
<td></td>
<td>720</td>
<td>1320</td>
<td>Red heat begins to show at 600°C. after which point the color steadily increases in brilliance.</td>
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Brilliant light orange

Industrial earthware bisque (virtually non-porous).

Orange color begins to give way to white.

Some stoneware and salt glaze.
APPENDIX B
<p>| | | | |</p>
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*British Cones marked with an asterisk sometimes have a letter A after the number, thus 013A or 5A.

From some suppliers all the numbers are preceded by a letter K.

Usual stone-ware temperature. Bone China bisque. Some porcelains, others up to 1450°C.
INTRODUCTION

In only a few instances in visual arts has Ceramics been taught, or even considered, as a fine art in itself. Generally, all areas dealing with ceramics encompass a "craft-like" philosophy which overshadows and shields from sight those elements which aid in establishing and eliciting a truly creative media.

In the majority of cases, the study of Ceramics has been treated as one to be used to strictly develop a students skills, get his hands messy, make dozens of duplicate pots, or as an excuse for not doing fine arts. More quantity, and a lack of imagination, has caused ceramics to take on the features of an unartistic activity, restricted to traditional forms and ideas. In only select cases has student imagination been focused on Ceramics.

In the ceramic process you are about to engage in, the utilization of your ideas is of the highest importance. Throughout the course, you will be called upon to demonstrate your sensitivity to the clay, ceramic objects, and your artistic ideas.
DIRECTIONS

Enclosed in your workbook are mini-programs designed to acquaint you with the necessary subject matter that will act as a basis for further activities conducted by yourself and your teacher. The mini-programs in no way are intended to encompass the total amount of information in regards to each section. It will be up to the teacher to supply the main ingredient for each program. At all times the teacher is to be considered as a professional in the area of teaching and ceramics. Use him wisely, for his knowledge of the field is to act in the same manner as would a textbook. If there are questions ask, there the answers will be found.

The extent to which you will follow the programs is totally left to your teacher; however, doing programs that are not considered to be highly essential for your particular situation are also fine. Your teacher realizes that various questions may arise as to areas not covered by himself. If you feel that extra research is necessary, notify your teacher. He will be more than willing to assist you.
OBJECTIVES

1. To develop certain essential abilities or qualities in regards to sensitivity to ceramics and creating imaginative works.

2. To develop certain knowledges in regards to ceramics, particularly in those areas dealing with the foundations of ceramics, basic procedures, basic construction techniques, glazes, and firing of works.

3. To develop through critical readings of ceramic works, an indepth perspective of the various facets of the work.
Glossary of Ceramic Materials, Processes and Colloquial Terms

absorbency - The ability of a material (clay, plaster of Paris, and so forth) to soak up water.

alkali - Generally, the base compounds of sodium and potassium but also the alkaline earth compounds lime and magnesia. They function as fluxes, combining easily with silica at relatively low temperatures.

alumina (Al₂O₃) - A major ingredient found in all clays and glazes. It is the chief oxide in the neutral group (R₂O₃) and imparts greater strength and higher firing temperatures to the body and glaze. When added to a glaze, it will assist in the formation of matt textures, inhibit devitrification, and increase the viscosity of the glaze during firing.

ball clay - An extremely fine-grained, plastic, sedimentary clay. Although ball clay contains much organic matter, it fires white or near white in color. It is usually added to porcelain and white-ware bodies to increase plasticity.

bat - A disc or slab of plaster of Paris or fired clay, used to dry out clay or to work on.

batch - Raw chemicals comprising a ceramic glaze that
have been weighed out in a specific proportion designed to melt at a predetermined temperature.

**bisque or biscuit** - Unglazed fired clay.

**blowing** - The bursting of pots in a kiln caused by a too-rapid temperature rise. The water content of the clay turns into steam and forces the body to expand and explode.

**bone china** - A hard, translucent china ware produced chiefly in England. The body contains large amounts of bone ash (calcium phosphate), which allows it to mature at cone 6 (2232°F). It is not very plastic and is therefore difficult to form; it also tends to warp.

**burnishing** - Producing a shiny surface on clay by rubbing it with a smooth tool when it is leather hard.

**china** - A loosely applied term referring to white-ware bodies fired at low porcelain temperatures. They are generally vitreous, with an absorbency of less than 2 percent, and may be translucent.

**china clay** - See kaolin.

**clay** - A natural compound of alumina, silica, minerals, organic organisms, and minerals held together by electrolysis and water.

**coiling** - A hand method of forming pottery by building up the walls with ropelike rolls of clay and then
smoothing over the joints.

**combing** - A method of decoration developed by dragging a coarse comb or tip of a feather over two contrasting layers of wet clay slip or glaze.

**cones, pyrometric** - Small clay rods which indicate kiln temperatures.

**crawling** - A glaze defect in which the glaze rolls away from areas of the piece it is on, leaving bare spots.

**crazing** - A glaze defect resulting from lack of fit between a glaze and the body it is on so that fine cracks appear in the glaze.

**damp box** - A box, usually zinc-lined, for keeping work moist.

**dipping** - A method of applying glaze to a piece of pottery by immersing it in a container of glaze.

**dryfoot** - To clean the bottom of a glazed piece before firing.

**earthenware clay** - Clays that are low-firing between 1751°F and 2014°F. The clay is easily broken and porous.

**engobe** - Clay slip, usually colored.

**fat or long clay** - Clay that is highly plastic.

**firebox** - The portion of a kiln in which the flame burns.

**fireclay** - A clay having a slightly higher percentage of
fluxes than pure clay (kaolin). Fires to a tan or grey color. It is often quite plastic and may be used by the potter as an ingredient of stoneware bodies.

**flux** - A substance which melts and causes other substances to melt also.

**foot** - The ringlike base of a ceramic piece, usually heavier than surrounding body.

**frit** - A glaze or partial glaze that has been fired and pulverized.

**frog** - A device for cutting clay made by a wire stretched across two prongs.

**glaze** - A liquid suspension of finely ground minerals that is applied by brushing, pouring, dipping, or spraying on the surface of bisque-fired ceramic ware.

**glaze fire** - A firing cycle to the temperature at which the glaze materials will melt to form a glasslike surface coating.

**greenware** - Pottery that has not been bisque fired.

**grog** - Hard fired clay that has been crushed or ground to various particle sizes. It is used to reduce shrinkage.

**kaolin** - Pure clay, also known as china clay.

**kiln** - A furnace made of refractory clay materials for firing ceramic products.

**kiln furniture** - Refractory shelves and posts used to
stack a kiln.

**kiln wash** - A protective coating of refractory materials applied to the surface of the shelves and the kiln floor to prevent excess glaze from fusing the ware to the shelves.

**kneading** - Working clay with the fingers or the heel of the hand in order to obtain a uniform consistency.

**leather hard** - The condition of the raw ware when most of the moisture has left the body but when it is still soft enough to be carved or burnished easily.

**luting** - The process of joining two pieces of leather-hard clay with slip or slurry.

**matt** - Dull surface, not shiny.

**peeling** - A defect in which portions of a glaze or an engobe separate from the ware.

**peep hole** - A hole placed in the firebox, kiln chamber, or muffle flues of a kiln, through which one can observe the cones or the process of combustion.

**piercing** - Cutting through the wall of a piece to create an open design.

**pinholes** - A glaze defect caused by too rapid firing or by tiny air holes in the clay.

**plaster of Paris** - Partially dehydrated calcium sulfate, made by calcining gypsum rock. Useful for bats.
plasticity - The quality that allows the clay to be shaped and formed.

porcelain clay - Clay that is fired in extremely high temperatures of 2275°F or higher. This clay is used only for fine china and is very expensive.

pugging - Grinding and mixing clay in a pug mill.

pug mill - A machine for grinding and mixing plastic clay.

pyrometer - A device for measuring kiln temperature, usually operated by an electric thermocouple.

raku - Japanese earthenware, used in the tea ceremony, rough, with dark glaze.

raw glaze - A glaze that contains no fritted materials.

sgraffito - Decoration achieved by scratching through a colored slip to show the contrasting body color beneath.

shard - A broken fragment of pottery.

short clay - Clay that is not plastic.

shrinkage - Shrinkage of the clay body occurs first as the clay form dries in the air. The clay form will again shrink when fired the first time. Clay shrinks from 5 to 12 percent in drying and another 8 to 12 percent during firing. This will result in a shrinkage rate of from 13 to 24 percent in total.
silica - Flint (SiO₂) produced in the United States by grinding almost pure flint sand.
single fire - A firing cycle in which the normal bisque and glaze firings are combined.
slip - A clay in liquid suspension.
slurry - Clay of paste-like consistency.
spraying - A method of applying glazes with a spray gun.
spray booth - A boxlike booth equipped with a ventilating fan to remove spray dust, which, whether toxic or not, is harmful.
stacking - Loading a kiln.
stilts - Porcelain tripods on which glazed ware is fired.
stoneware clays - Clays that are fired between 1222°F and 1305°F. This clay is very hard and non-porous. It is preferred by most potters.
terra cotta - An earthenware body, generally red in color and containing grog.
throwing - Forming pottery of plastic clay on a potter's wheel.
trailing - Using a tube to apply a line of slip to clay.
viscosity - The nonrunning quality of a glaze, caused by glaze chemicals that resist the flowing action of the glaze flux.
vitrification - The act of becoming vitreous, that is,
hard, glasslike, non-absorbent.

**wax resist** - A method of decoration in which liquid wax is applied to portions of greenware after which engobe is brushed or sprayed over the piece. The wax repels the engobe.

**wedging** - The act of kneading clay by cutting it in half and slamming the halves together.

**wedging board** - A block of wood or plaster of Paris with a post holding a wire so that a lump of clay may be cut in half and the two halves slammed together.

**Additional Terms**
SELF TEST

DIRECTIONS: Answer the following questions by referring to the Glossary of Ceramic Materials, Processes and Colloquial Terms. Place your answer in the blank provided.

1. Unglazed fired clay is known as
   - bisque
   - china clay
   - fireclay

2. The condition of the raw ware when most of the moisture has left the body but when it is still soft enough to be carved or burnished easily is known as
   - vitrification
   - leather hard
   - viscosity

3. A liquid suspension of finely ground minerals that is applied by brushing, pouring, or spraying on the surface of bisque-fired ceramic ware is known as
   - luting
   - frog
   - glaze

4. Pottery that has not been bisque fired is known as
   - greenware
   - stoneware clays
   - grog
5. The quality that allows the clay to be shaped and formed is known as ______________

pugging  peeling  plasticity

6. A disc or slab of plaster of Paris or fired clay, used to dry out clay or to work on is known as a ___________

slip  shard  bat

7. A natural compound of alumina, silica, minerals, organic organisms, and minerals held together by electrolysis and water is known as ___________

engobe  clay  fat

8. A furnace made of refractory clay materials for firing ceramic products is known as a ___________

kiln  frit  batch

9. A hand method of forming pottery by building up the walls with ropelike rolls of clay and then smoothing over the joints is known as ______________

crawling  coiling  kneading
10. Small clay rods which indicate kiln temperatures are known as__________.

   cones   pinholes   flux

11. Working clay with the fingers or the heel of the hand in order to obtain a uniform consistency is known as

   luting   crawling   kneading

12. Clay that is not plastic is known as__________.

   short clay   porcelain clay   earthenware clay

13. Clay that is highly plastic is known as__________.

   dryfoot   fat   slurry

14. An extremely fine-grained, plastic, sedimentary clay. Although ball clay contains much organic matter, it fires white or near white in color. It is usually added to porcelain and white-ware bodies to increase plasticity is known as__________________.

   bone china   ball clay   short clay
15. To clean the bottom of a glazed piece before firing is known as a__________________.

dryfoot  crazing  grog

16. Producing a shiny surface on clay by rubbing it with a smooth tool when it is leather hard is known as ____________________.

kneading  wedging  burnishing

17. Clays that are low-firing between 175°F and 201°F. The clay is easily broken and porous. These clays are known as__________________.

earthenware clay  stoneware clays  ball clay

18. A clay having a slightly higher percentage of fluxes than pure clay (kaolin). Fires to a tan or grey color. It is often quite plastic and may be used by the potter as an ingredient of stoneware bodies. This clay is known as__________________.

china clay  porcelain clay  fireclay
19. Grinding and mixing clay in a pug mill is known as ___________________.

peeling   pugging   trailing

20. The act of kneading clay by cutting it in half and slamming the halves together is known as __________.

stacking   blowing   wedging

21. An earthenware body, generally red in color and containing grog is known as ________________.

fireclay   ball clay   terra cotta

22. Forming pottery of plastic clay on a potter's wheel is known as ________________.

trailing   crazing   throwing

23. A block of wood or plaster of Paris with a post holding a wire so that a lump of clay may be cut in half and the two halves slammed together is known as a ________________.

wedging board   firebox   piercing
24. Japanese earthenware, used in the tea ceremony, rough, with dark glaze is known as ____________.

bone china  china  raku

25. Clays that are fired between 1222°F and 1305°F. This clay is very hard and non-porous. It is preferred by most potters. These types of clays are known as ________________.

stoneware clays  bone china  china clay
Ceramic Examples

Purpose

The following examples of ceramics is intended to pro­vide you with insight into the various shapes that can possibly emerge from your future efforts. The shapes are by no means the total of ceramic shapes that have been made, or could be made. The amount of imagination that you put into your ceramic efforts will more than be sufficient to provide ideas.

The ceramic shapes presented are not to be considered as something to copy. It is hoped that in presenting you with a variety of shapes that they will aid in eliciting your own special creations. Use the presented shapes wisely.

In the examples that follow, you will notice that each ceramic work has been labelled as to whether it is functional or non-functional. Many of the examples are visually heavy, some are not. It will be your task as a ceramist to make these types of decisions in regards to your works. Many works function as objects that are only aesthetically pleasing, while others may not be pleasing at all.
If you are viewing a particular work it should be viewed as having a specific purpose. Ceramic works that "work" always have some specific underlying purpose that creates for the ceramist and the audience visual properties that make it function in a manner prescribed by the artist, and accepted by the audience. For example, a work that is intended to hold a liquid should not be constructed in such a manner that the liquid cannot function as an important component of the work. Also, the work should not be such that the liquid cannot be poured. I realize that it sounds a little ridiculous to make a work that does not function in a prescribed and established manner, but it does happen frequently.

The manner in which you create your works is up to you. The main thing to remember is that the visual weight should be off of the table as much as possible, and the weight is in proportion to the size of the work. Clay is only clay. It is not metal or wood. It can only take so much weight and unorganization by the ceramist before it becomes nothing more than a lump of broken plans.
SELF TEST

On the following pages are examples of ceramic works. Their sizes, shapes, and functions vary greatly. However, it is possible to view each work with its formal properties of weight distribution, and whether or not it is functional in regards to its visual appearance.

Look over the various ceramic examples and examine each carefully keeping in mind the properties already discussed. After careful inspection of the examples, indicate on the space provided by each example whether or not it is functional, non-functional, and where the weight/visual weight is dispersed. Remember, your answer will depend largely on your personal views in respect to what is functional or non-functional. The fact that we all have individual differences in this respect can only be eased by the fact that they are all aesthetic works that are pleasing in many different ways to many different viewers.
Types of Ceramics

Purpose

The purpose in briefly studying the types of ceramics is to instill the magnitude that ceramics has taken in practically all walks of life. Ceramics is not just the ash tray on the coffee table, but an extremely complex undertaking which has fostered itself in primarily hobby ceramics, industrial ceramics, and creative ceramics.
There are basically three types of ceramics. They are:

1. Hobby Ceramics
2. Industrial Ceramics
3. Creative Ceramics

Hobby Ceramics is primarily that type of ceramics which has come into identification with the hobby ceramic shop. It is these shops which have in only recent years taken on great popularity throughout the United States.

These shops sale pre-made forms which the customer purchases, cleans, pays to have fired, buys glaze to decorate, and again pays to have fired. The end result is a very commercially looking object which for many in this area is the goal.

Originally, Hobby Ceramics was a style which came out of the Victorian "art" of china painting. In these early endeavors, only the cultured ladies of the day were allowed to participate. The indulging in this form of ceramics was considered as a demonstration of their upbringing and refinement.
The second type of ceramics is **Industrial Ceramics**. This type has served man as a basic tool from practically the beginning of time. It has served in basic functional ways as plates, bowls, vessels, and storage containers.

As industry began to emerge other uses for clay in society changed. Today there are universities which have schools of **Ceramic Engineering** staffed by scientists which study the chemical qualities and properties of clay. They deal in such fields as plate and china making to come up with such material as "correll" for tough, virtually unbreakable china at a low cost.

To say that the Ceramic Engineer is concerned with only plates and bowls would be an understatement. In Aerospace Electronics and medicine, ceramics has made noticeable contributions. There is no rocket, automobile, radio, television, or electric appliance which has not seen the uses. As far as medicine is concerned, ceramics is being used for bones and in mechanical parts for artificial organs.

One of the earliest countries to practice mass production of ceramic works was China. Here entire towns were economically based on the throwers, decorators, firing people, transportation, and sales people. This later caught hold in such countries as Japan.
4.

The third type of ceramics is known as Creative Ceramics. Man has used ceramics in this realm since the earliest beginnings of his existence as a tool which was functional. Man used the clay to make pots, plates, pipes, and even bricks.

Shortly, Creative Ceramics emerged in its own right. Mankind has always seen fit to turn functional items into aesthetic objects (relating to beauty and artistry) or creating them out of his imagination. Artistic objects made of clay emerged very quickly in the form of statues and decorative objects.

Industry in the late 1800's and early 1900's overpowered the creative craftsman as commercially made ceramics ware became popular and less costly. Because of this, many of the old ceramists disappeared or turned to industry.

It was not until the late 1950's that creative pottery began to reappear as people began to gain more leisure time. More important than this fact was that people in general were rediscovering that there was something far superior in man's effort to create the unique and the artistic, than the unimaginative output characterized by the machine made objects.
Identify the three types of ceramics, and explain their influences.

1.

2.

3.
The purpose of this program is to familiarize you with not only the various types of clay, but their components and origins. It is this basic understanding of the types of clay that will furnish a firm foundation upon which to build later knowledge in respect to how clay can be manipulated in the actual making of works and glazing them.
1. The original clay material is known as **Primary Clay** though the names **China Clay or Kaolin** have come to be used from association with bone china manufacture or Oriental porcelain.

China Clay or Kaolin are known as ________________.

2. **Primary Clay** does not possess the attractive plastic quality associated with clay and it forms only part of a mixture, or **Body** as mixtures are called in ceramics.

Mixtures of clay would be classified as ________________

3. The plasticity of clay is induced by the grinding action of water and ice and is a quality that is to be found in the vast majority of clay deposits which have long since been moved away from their original sites of formation. These clays are broadly labelled **Secondary Clays**, but the name is rarely used because of the variety of them.

The process of water and ice grinding away at natural materials is characteristic of ________________.
4.

On the journey from the sites of formation they became mixed with varying proportions of other minerals in the Earth's crust, and names have been devised which give some indication of the kind or quantity of additional matter contained in them. The most frequent impurities are the remains of decayed granite or felspar - lime, sand or potash - now no longer chemically combined with the clay, but the all-pervading oxide of iron has crept into most secondary clays in some quantity.

Among the vast numbers of impurities in clay are decayed____________________, sand or ____________.

5.

Ball Clays are secondary ones which have been moved from their sources and finely ground on their journey, but which have not acquired much iron oxide and therefore provide useful white or cream burning clays.

Secondary white or cream burning clays are known as ____________________.
6. The name "ball clay" comes from an old system of transporting the material from the pits as round lumps in horses' saddlebags.

7. In their raw state Ball Clay is often stained grey, blue, or nearly black by decayed vegetable matter and, though this color burns away entirely during the firing, it may be used to describe the clay in a merchant's price list.

What is used to describe Ball Clay in most suppliers lists of clays? ________________________________

8. Among all clays perhaps the ball clays are the most plastic, so much so in fact that plasticity itself becomes a drawback in that it can cause too much shrinkage and warping.

The most plastic of all clays are the______________.
9.

It is those ball clays, and many other white, creamy or ivory Earthenware Bodies which are not especially suited to hand working except for occasional use as decorative coatings.

10.

The pleasantest clays to use by hand, and those which are recommended, are the red or grey ones which are not so fine.

11.

Red Clay, sometimes referred to as Terracotta Clay, may contain as much as 8% of iron oxide with other additions as well. The additions have the effect of lowering the melting point; primary or china clay may begin to melt at about 1800°C., but some impure clays will be liquid at just over half this temperature. Red clays sold by reputable suppliers do not melt much below 1300°C.

Terracotta Clay, sometimes called simply___________________________, contains as much as 8% of iron oxide which is why the clay is__________ in color.
12.

Grey Clays are called Buff Clays many times due to the fact that they fire to this color. They contain between 2% and 4% of iron oxide which, together with other additions, gives a melting point above 1400°C, enabling them to be used for stoneware fired between 1250°C and 1350°C. Grey Clays or ____________________ have a melting point above 1400°C, which enables them to be fired at __________ temperatures.

13.

Additions of sand or other materials are often made to the buff clays in order to reduce shrinkage or cracking, and the mixtures, sold as Stoneware Bodies, are strongly recommended. Sometimes an addition is made in the form of Grog which is clay that has already been fired and then finely ground.

To reduce shrinkage or cracking in buff clays, ________ or __________ can be added to the mixture therefore known as ________________________.
The heat resistant Fireclays are usually grey in color in their raw state and are sold by suppliers in powder form. In common with most other clays they develop their most interesting qualities when fired to a very high temperature, and their good working properties may be a little offset by their dull appearance when fired only to earthenware heat (1100°C). Other grey clays known as ____________ are not fired as high as Stoneware Bodies and therefore are fired at only _____________. 
15.

The shelves on which pots are supported in kilns are known as Cranks. Many suppliers sell a course fireclay and grog mixture, from which they could be made, under the name of Crank Mixture. This prepared plastic refractory is most useful because its course, open texture allows it to be used freely for large, thick or irregular forms which would only crack if made from finer grained material. Crank Mixture is also a splendid additive to red or grey clays which seem too smooth for modelling purposes, or which seem too ready to crack on drying.

Course fireclay and grog mixture are two ingredients used to make__________________________ which is also a splendid additive to red or grey clays.
16.

Many pottery studios include Modelling Clays in their list of supplies; however, it must be remembered that these are usually bodies of the white or cream earthenware type suited to the production of fine, lathe-turned models of teapots, tureens, etc., in preparation for the making of plastic moulds for mass production methods, and would be out of key with the bold, imaginative modelling of art students, or the hand-thrown ware from the studio.

Out of all of the various types of clay,____________
____________ are the only ones not specifically useful for creative ceramics.

17.

On the next page is a chart which lays out the pertinent information concerning the Kinds of Clay. Study the chart carefully and any other pages in this program. When finished with your review, notify your instructor for further instructions.
SELF TEST

1. China Clay or Kaolin are known as_________________.
2. The process of water and ice grinding away at natural materials is characteristic of_________________.
3. Secondary white or cream burning clays are known as_________________.
4. The most plastic of all clays are the____________.
5. The most pleasant clays to use by hand are the_______ and_______ ones.
6. Red Clay is sometimes referred to as_________________.
7. Grey Clays are sometimes referred to as_________________.
8. To reduce shrinkage or cracking in buff clays,_______ or____________ can be added.
9. Earthenware heat is_________________.
10. In their raw state____________ are sold as powder.
11. Out of all of the various types of clay,____________
_________________ are the only ones not specifically useful for creative ceramics.
Keeping Clay In Condition

Purpose

The purpose of this program is to establish various knowledges as to basic storage procedures of clay, and the preparation of clay for working by kneading and wedging. It is these beginning steps that are common to all methods of creating works. Without knowledge of these facets nothing can be logically done with the clay to make any type of ceramic work.
1.

The condition of the clay is a factor of primary importance in any ceramic work and, though different conditions are required for different processes, nothing much can be achieved without ample quantities of good plastic material being available.

2.

If the clay is a little too hard or too soft you will quickly become disheartened, and in the average class there is little time to spare for correcting the condition. If it is only a little too soft work will not stand up; if it is a little too hard the clay cannot be shaped without cracking.

If clay is either too________ or too________ very little can be done with it in creating a particular work.
3.

Somewhere between these two is a condition in which clay is attractive to use, it is soft but firm enough to remain in whatever position it is placed, and it coats the fingers with only the lightest film.

Clay dries quickly in a warm atmosphere and, when hard, it cannot be worked soft again like plastieine (modelling clay - green). The reconditioning of a quantity which has been allowed to become dry is an arduous and messy job which has to be avoided at all costs by a disciplined system of working and storage.

If the ceramist has a_________________________ of_________________________ and_________________________ the task of reconditioning clay can in most cases be avoided.
In an airtight container clay will keep moist forever and actually improve a little in working qualities as its moisture content is distributed throughout even the minutest pores by capillary action.

EXAMPLE: Airtight Container

Duckboard (top view)
6.

Few containers are really airtight and provision must be made to keep the circulating current damp by standing the clay on a duckboard over an inch or two of water. Wet sacking and then polythene should be put on top of the clay beneath the lid.

7.

Dustbins are frequently used as clay stores but their round shape is inconvenient; an old water cistern, with a zinc or plastic lined wooden lid, is capable of holding two or three times as much for only little extra floor space and is easier to load or unload.
8. **Kneading** and **wedging** are essential preparatory processes for most clay work and the knack associated with each has to be grasped so that they can be carried out with the minimum expenditure of energy.

To get to work as soon as possible, the ceramist must grasp the knack associated with_________ and ________ as soon as possible.

9. **Kneading** is precisely the same as the process used in bread-making and is the fastest possible method of evenly mixing clays of different color.

The best method known for mixing various types of clay into a single body is by___________.
10.

It is done (in small quantities at any rate) on a table of convenient height with an absorbent surface to which clay does not stick unless it is too wet (plaster, concrete, slate or pairing stone).

EXAMPLE: Wedging table

- canvas covering absorbent surface
- plaster, concrete, slate or pairing stone top
To begin kneading, the soft clay lump is grasped on top by both hands which are then pushed into it by a thrust of the body. The hands are immediately moved back to the top and the movement is repeated until the clay has been folded over upon itself time and time again. With correct body movements a rhythm develops which makes comparatively light work of the job—those who rely on arm movements alone will soon tire—and if the hands are placed a little towards the top corners the clay preserves a tidy, manageable shape such as is illustrated.

EXAMPLE: Kneaded clay
Wedging fulfills a different function though it does mix the clay to some extent. It compresses the clay and eliminates air pockets which are a nuisance in all processes associated with cut or rolled sheets, and which make throwing impossible.

The elimination of ________________ from the clay is the major function of ________________.
13.

To wedge, the top of a block of clay is rounded by boating with the hands. The block is then sliced horizontally in two with a wire. The top half is then lifted high, inverted, and the round "wedge" banged smartly on top of the half remaining on the bench. The illustration clearly demonstrates the compressive force of this action which is repeated - each cut at right angles to the last - a number of times until the cuts themselves reveal that the clay is air-free and homogeneous (of uniform quality).

EXAMPLE: Wedged clay

Kneading of clay is mostly performed by all potters in about the same general fashion; however, wedging is a totally different matter. For this reason you are encouraged to experiment for yourself, or follow the prescribed method that your instructor will demonstrate a little later.
SELF TEST

1. If clay is either too________ or too________
   very little can be done with it in creating a particular work.

2. ___________ and__________ are essential preparatory processes for most clay work.

3. The best method known for mixing various types of clay into a single body is by__________.

4. The elimination of air pockets from the clay is the major function of__________.

5. Most wedging is performed on a__________ __________
   with an absorbent surface of plaster, concrete, slate or pairing stone.

6. Somewhere between clay being too wet or too dry is a condition in which clay is attractive to use, it is soft but firm enough to remain in whatever position it is placed, and it__________ the fingers with only the lightest film.

7. If the creative ceramist has a disciplined__________
   of working and__________ the task of reconditioning clay can in most cases be avoided.
Fundamental Considerations

Purpose

The purpose of this program is to establish the stages of dryness in clay, how to make clay wetter, drying clay for use, shrinkage, warping, and cracking. These facets of ceramics are common to all areas in the field. They will also explain in some detail the more simpler defects in building works.
1. The consistency (wetness) of the clay is of prime importance. If the clay is of the proper firmness for the particular process at hand, it is easily worked, but if it is too wet or too dry it can become completely unruly.

If clay is good and plastic it will not be__________ or____________.

2. In order for you to be totally aware of exactly how dry it may be, it is necessary to cover briefly those stages of dryness that clay goes through, and the properties of the clay which enables the potter to recognize the various stages.
3. First, in a **soft plastic condition**, the clay may be readily formed, even in large masses, with relatively little pressure; however, it is sticky and cannot support itself for any great height. The drying shrinkage is large.

If the clay sticks badly to your hands it is in a __________________________ and should be left to dry for a little longer.

4. Second, in a **medium plastic condition**, clay may be readily formed with reasonable pressure, will weld together, and will support itself for considerable heights. This consistency is mostly used for forming ceramic works.

To form ceramic works of a favorable clay quality it is necessary to have clay in a________________________.
5.

Third, in a **stiff plastic condition**, the clay is deformed. Only with considerable pressure can the potter weld two pieces together. If the deformation is carried too far, cracking occurs. When clay is of this consistency it may be carved or trimmed and small clay additions may be made. The drying shrinkage is much less than for the softer mixes.

Generally clay in the_________________________ cannot be used except for carving or______________.

_____________________________________________________

6.

Fourth, the clay becomes **rigid** and cannot be appreciably reformed without breaking. If struck lightly, it sounds solid, and the surface has lightened in color. In this state the clay can be readily trimmed or carved, but only very small additions of clay can be made without the danger of introducing drying cracks. However, it is possible to join two pieces of clay of this consistency, using soft clay as "glue." This is what is known as the "leather-hard" condition. There is little further shrinkage in drying.

If clay is______________ it is extremely_________ and any shaping is virtually impossible; however, some trimming can be done.
7.

Fifth, and final stage of consistency is characterized by extreme brittleness. There is no further shrinkage on drying. The surface now is white and may be polished by burnishing (rubbing) with a shiny tool (a spoon works very well in smoothing a clay surface), or if finishing touches are required the surface may be smoothed with sandpaper or worked with a wet sponge.

There is no further___________________ on drying in the____________________________ stage of dryness; however, burnishing can still be done.
8.

Working closely with various stages of consistency of the clay is the process of making the clay wetter.

Very soft clay that has been stored becomes too dry may need to be moistened. Because water is absorbed very slowly into the clay it is necessary for the mass of clay to be cut into thin slices with a wire stretched between two handles in order to hasten the absorption process.

EXAMPLE:
9.

The slices are laid out on a damp plaster bat or table top and sprinkled with water. As the water soaks into the clay the sprinkling process is repeated. This procedure is continued until the clay is of the proper consistency. The slices are then worked together into a uniform mass.

10.

Another consideration is whether you need the clay to be drier.

If the mass of clay to be worked is too wet and sticky it may be dried out by kneading it on a dry plaster bat, or a wedging table. The plaster draws water from the clay and hastens the drying process.

To dry the clay where it is of a good plastic quality, __________ is necessary. The best item to be used for drawing out the excess water from the clay is either a bat or wedging table made of __________.
11.

After you have gone through the complete process of actually constructing your ceramic work you will have to take into consideration the drying of the work.

Drying seems like a very simple process, but it often presents problems to the potter because pieces that are dried too fast tend to crack, and pieces that have not been dried thoroughly explode in the kiln upon firing. These explosions are due to the excess moisture still in the clay turning into steam, which in turn builds-up pressure within the clay wall.

If the clay has not been allowed to dry in the proper manner it may____________ because of being dried too fast, or____________ in the kiln if excess moisture is still present.
12.

As far as shrinkage is concerned, everyone knows that ceramic objects are smaller when dry than when they are first made. This is due to the loss of the very thin films of water between the clay particles which allows the whole mass to shrink rather uniformly.

The important thing to remember about drying your work is that the entire piece dry rather

13.

Some clays shrink a great deal, and some only moderately. For example, red stoneware body has an average lengthwise drying shrinkage of 5%; that is, a piece constructed 10 inches would shrink to 9 1/2 inches. On the other hand, a terracotta body shrinks only 3% on drying. Shrinking occurs largely in the plastic range; however, once the leather-hard state is reached, little further shrinkage takes place.
One of the most annoying problems encountered by the potter is the **warping** of his work in drying. Warping is caused by lack of uniformity in the body because of poor wedging, strains, or nonuniform drying. It is comparatively easy to make the body uniform, but it is difficult to eliminate strains.

**EXAMPLE:**
If the piece has been uniformly made, warping is avoided by even drying; that is, every portion of the piece should be at the same stage of dryness at any given time. In the case of simple pieces with walls of even thickness, uniformity is easily accomplished, but when the piece has walls of varying thickness, uniform drying is more difficult.

If a work is going through the same stage of_________ at any given time, the chances of the work__________ are minimal.
16.

There are two ways of effecting evenness of drying. First, cover only the thin or exposed portions of the surface to slow up the drying rate. Second, you can retard the drying of the entire piece by means of a covering over the whole surface.

EXAMPLES:
17.

It is discouraging to find that a piece has cracked in drying. The causes are much the same as those for warping, but because of greater strains the piece cracks as well as warps.

EXAMPLES:

- Rim of a bowl
- Bottom of a jar
18.

**Cracking** is caused by differences in the shrinkage between various parts of the piece. In thrown work, as well as unthrown, the thickness of the walls and base is the determining factor. The thinner areas will dry before the thicker ones. If the piece has even walls and an even base, no matter what thickness, cracking will not occur. For this reason all pieces are generally made with the same thickness, depending upon the final use of the piece.

To eliminate many of the problems associated with a work cracking make sure the______________________________
___________________ are just about the same.

As far as lids, handles, etc. are concerned, they should all be made at the same time as the work, plus with the same clay. This will result in even shrinkage and a lack of cracking.
19.

To prevent cracking, precautions should be taken to assure that the piece is of the same consistency throughout. A vase with a moist bottom, a slab pot with one section drier than the other, or a joint in which soft clay has been squeezed between harder clay - all of these conditions will lead to drying cracks. Slip should be used for joining leather-hard pieces only when the joint is so well fitted that the slip can be applied in a very thin layer.

20.

When the piece is uniformly moist to start with, the drying must be carried out in such a way that the rate of drying is uniform throughout the piece. Generally larger pieces dry more slowly.

It will be found that some clays and bodies can safely be dried more rapidly than others. Clay bodies containing grog (ground bisque ware) have less drying shrinkage than others, and therefore may be quite rapidly dried without danger of cracking.

Even though grog should not be used in throwing pots, its use is encouraged in works created by other methods to reduce the possibility of ___________ and __________.
Small pieces may be dried rapidly by exposure to the air, provided the drying takes place uniformly. For example, air cannot reach the bottom of a piece if it is resting on a board or bat. However, if the piece is raised, the drying is much more uniform and the time required to dry the piece is lessened.

EXAMPLE:
Successful drying by the potter is more often a problem of _delaying the drying process_ than of accelerating it. The drying of a piece of any large size may be slowed by placing a cover over it. This cover may be a tin can, or a piece of thin transparent plastic draped over the work. The rate of drying is governed by the distance the cover is raised from the base.

**EXAMPLES:**

![Diagram of drying methods]

OR

OR
23. For large bowls, or other large works, the drying of the upper edge may be delayed by covering it with a plastic sheet or aluminum foil. This method is recommended for slowing the drying of any thin extensions of a piece, such as handles.

EXAMPLE:

If the thin handle dries faster than the rest of the pot the result will be stress between the handle and the body of the work. The stress, which is brought on by gravity, will result in a cracked or broken handle. To avoid this occurrence, slow drying and careful handling is necessary.
Perhaps the safest method of drying works is by the use of the drying cabinet. The cabinet resembles a typical locker that one might see in a school locker room. The shelves are perforated. This allows air to circulate freely. In the bottom of the cabinet is a reservoir for water. When water is placed in the reservoir an even circulation of the evaporating water is held in the cabinet. This retards drying. Elimination of the reservoir results in a slow drying of the work. The moisture escaping from each of the works creates more or less a steam cabinet. In this fashion, the drying is very gradual and thorough.

EXAMPLE:
SELF TEST

1. If clay is good and ________ it will not be too wet or too dry.

2. If the clay has not been allowed to dry in the proper manner it may ________ because of being dried too fast, or ________ in the kiln if excess moisture is still present.

3. The important thing to remember about drying your work is that the entire piece dry rather ________.

4. During the shrinkage process ________ and ________ are the two main defects to be careful of.

5. As far as lids, handles, etc. are concerned, they should all be made ________, plus with the same ________.

6. Even though ________ (ground bisque ware) should not be used in throwing pots, its use is encouraged in works created by other methods to reduce the possibility of shrinkage and cracking.

7. Perhaps the safest method of drying works is by the use of the ________. 
Pinch Pottery

Purpose

The specific purpose in doing pinch pottery is to familiarize you with one of the oldest methods of making pottery. It is this method which has characterized many ceramic forms worldwide. The pinch method is considered by many to be a basic method to other methods. For this reason the pinch method has established itself as a method encompassing the finer points of pottery making. This method also allows for a closer contact with the clay. You can truly "get the feel" of the clay in respect to its qualities while it is being worked and dried.
Pinchware is a name given to one of the earliest and most obvious forms of making pots. The method is used primarily in the making of small, rather crude pots. However, this method need not be crude if appropriate refinements are made. In this way the pinch pot can take on the qualities of a fine piece of art work.
2.

To begin this method, take a lump of clay, roll it into a ball, rest the ball in one hand, then press your thumb into the center of the ball while working it round and round in the palm of your hand.

**EXAMPLE:**

A.  

B.

C.
3.

Carry on in this manner until you have hollowed out a small container. Naturally the scope of pinchware is rather limited. However, using this method will enable you to make bowls, small dishes, as well as vases.

Other forms can be constructed that are combinations. However, these forms would involve numerous pinch forms joined, spouts, lids, legs, etc. The additions that can be made to pinch pottery is only restricted by your imagination.
While the result is bound to be crude, you can reduce this effect by occasionally moistening your thumb and fingers and smoothing over any rough edges. In addition a foot or base can be added to the pinch pot by turning over the pot, rolling out a coil of clay for the foot, and attaching it by gently smoothing down part of the coil with small tools.

EXAMPLE:
SELF TEST

Utilizing your knowledge of function and design of ceramic works, construct a pinch pot using a combination of forms. You are encouraged to use primarily pinch forms; however, if adaptations are needed from other construction methods it is permissible.

Strive for individuality in your work. This particular work should demonstrate your competencies in the pinch method. Carefully think through your plans before you start. In this manner much useless effort can be eliminated. A well designed work always results in better ceramics, than a work constructed in a haphazard fashion.
The major purpose in doing coil pottery is to familiarize you with one of the basic methods by which all ceramic works are constructed. The other two methods being slab pottery and wheel-made pottery (thrown).

The constructing of a coil pot will give you a first-hand knowledge of the methods and fundamentals associated with the method, plus act as an appropriate base from which to discuss other related methods.
Coiling is the name we give to one of the earliest of all forms of pottery making. The reason for this method going back so far is very simple. It was, originally, the apparent way to make pots. It is popularly supposed that our ancestors came to pottery from basket making. To them it seemed quite logical to apply the same technique of building up a shape in coils of clay.
2.

To make a coil pot you first roll out lengths of clay in strips of about half an inch in diameter and, say, a foot or eighteen inches in length. When you have several of these coils prepared you are ready to begin.

EXAMPLE: Coil being rolled
3.

The next step is to cut out the base of the pot. The base should be in direct proportion to the rest of the work.

After rolling out a flat piece of clay, take a coffee can, or some other device which will enable you to draw a circle, and outline the base of your pot in the clay. Next, cut out the circle.

EXAMPLES:
You are now ready to start building the pot.

Take one of the coils and place it around the top edge of the base. When you have completed using one length, join them by pinching the ends together and filling-in the joint with a little clay. Lastly smooth-down the inside and outside of the coil where there is no sign of a gap between the base and first coil.

EXAMPLES: Coil plus base

Coil and base smoothed-down
5.

The coil method continues in this manner, placing coil on top of coil, until the desired size and shape is achieved.

This method, as does a few others, restricts itself only to kiln size and one's imagination. Where size is of little restriction, there have been coil pots made of such a magnitude that the coils had to be rolled-out on the floor. The coil method can truly result in works of a tremendous size and still be highly skillful in respect to texturing, shape, function, etc.
SELF TEST

Utilizing your knowledge of function and design of ceramic works, construct a coil pot using a combination of forms. You are encouraged to use primarily coil forms; however, if adaptations are needed from other construction methods it is permissible.

Strive for individuality in your work. This particular work should demonstrate your competencies in the coil method. Carefully think through your plans before you start. In this manner much useless effort can be eliminated. A well designed work always results in better ceramics, than a work constructed in a haphazard fashion.
**Slab Pottery**

**Purpose**

As with coil pottery, the major purpose in doing slab pottery is to familiarize you with one of the basic methods by which all ceramic works are constructed.

The constructing of a slab pot will give you a first-hand knowledge of the method, plus added insights into a construction process which utilizes a variety of forms to accomplish a quite different looking ceramic piece.
Slab pottery is a simple method of rolling out sheets of clay and then pressing or cutting them into specific shapes which are combined to form the pot. You can use several slabs of flat clay, alone or in combination with coiling, to make a vast variety of vertical and horizontal forms.
To make a slab of clay, you will need two flat boards of the same thickness as you want the walls of your pot, and a rolling pin or steel pipe.

Roll out a ball of clay between the boards. Work the clay until it is as even and regular as possible.

EXAMPLES:

A.

B.
After trimming-off the ragged ends of the slab, commence to cut the slab into the various shapes that will fit the design of the piece to be created. Totally cut all of the slabs before you start putting the work together.

EXAMPLE:
4.

To attach the shapes, score the ends of the shapes that will be eventually joined. Then place some slip (liquid clay) along the scored edges. The scoring, along with the slip, act as an adhesive.

EXAMPLES: **Scoring** (drawing in lines on the edges)

![Diagram showing scoring of clay edges](image-url)

Applying the slip

![Diagram showing applying slip to scored edges](image-url)
Unlike many of the other methods used in ceramics, the slab method can yield forms of vast size and complexity. The size of the slab is only restricted by the size of the kiln and one's imagination. Where size is of little restriction, the slab method can yield unique forms which can be circular, square, rectangular, triangular, etc. The extent to which these various shapes can be utilized is totally dependent on one's individual imagination. Like the coil method, the slab method can be used to create forms of a high quality in respect to form, texture, function, etc.
SELF TEST

Utilizing your knowledge of function and design of ceramic works, construct a slab pot using a combination of forms. You are encouraged to use primarily slab forms; however, if adaptations are needed from other construction methods it is permissible.

Strive for individuality in your work. This particular work should demonstrate your competencies in the slab method. Carefully think through your plans before you start. In this manner much useless effort can be eliminated. A well designed work always results in better ceramics, than a work constructed in a haphazard fashion.
Combinations

Purpose

Even though combinations of the various methods is not considered one of the basic methods, it is considered to encompass numerous construction techniques characteristic of other methods.

The constructing of combination pots will give you an opportunity to experience a form of ceramic construction with added dimensions in regards to creative possibilities.
An added dimension to the making of coil or slab pots is the construction of combination works. As the name implies, the method is a putting together, or rearranging of basic ceramic methods to form a new combination. In many cases the combination may all be of the same type of construction; therefore, there can be combination pots which are totally slab in nature or totally coil in nature.

Any reorganization of basic forms to makeup a singular form with many joined shapes is called a___________ pot or work.
2. For the most part, the combination method is utilized wherever it is found to be appropriate to the construction. Just making combination works with no preconceived plan for the operation is a waste of time and materials. The method generally takes large amounts of clay and time to construct. It would be easier to make a single work without the variety of forms, than to begin a combination work and not be prepared.

Due to the large amounts of clay and time needed for the construction of most combination works a plan is a necessity.

3. The shapes to be used in the construction are for all intense purposes limitless. Only ones imagination is the final determining factor in the work. The major obstacle to be confronted will probably be the kiln size.

For all intense purposes a combination work is limited only by size.
Since combination works are generally coil, slab, or coil-slab pots, the method for joining the works will depend to a large degree on the basic shapes to be used, and how they should appear after combination.

EXAMPLE: Combination pot
5.

Usually the shapes are joined by placing the shapes up against each other and filling in the gaps with clay, or building supports between the shapes.

EXAMPLE: Joining
6.

The second most common method of combining the shapes is by the use of clay bridges. Here again, the supports are joined to the shapes by using clay to fill-in the gaps. This method is not as widely used as the previous one for reasons of difficulty, not for its lack of attractiveness.

EXAMPLE: Joining with bridges
7.

Obviously, the combination has its good and bad points, but nevertheless, it is a method of ceramic construction widely practiced by many throughout the field. To restrict yourself to the more basic forms of construction may be allowing yourself to shortchange exciting ceramic forms that can only be achieved through the use of combinations.

After a complete review of any of the information in this section, contact your instructor for further directions.
SELF TEST

Utilizing all that you have learned through the construction of coil and slab pots, construct a combination work. The adaptations that you may select from are totally left to you. Select your shapes carefully. Remember, being prepared in making a combination work is essential to its completion.

Strive for individuality in your work. This particular work should demonstrate your competencies in numerous methods. Carefully think through your plans before you start. In this manner much useless effort can be eliminated. A well designed work always results in better ceramics, than a work constructed in a haphazard fashion.
Wheel-made Pottery

Purpose

The major purpose, as with coil and slab pottery, is to familiarize you to one of the basic methods by which all ceramic works are constructed. Due to the nature of wheel-made pottery, it is viewed as a method that may take considerable time to master, depending upon the individual.

This method will allow you to experience a ceramic process quite different in its approach and techniques; yet, just as meaningful and magnificent in its end products.
For the most part, "throwing a pot" on the wheel is a difficult and sometimes impossible task for many. However, this method can be mastered with much practice, skill, and mostly stubbornness.

A thrown piece of pottery is formed by the potter's hands as the clay revolves as an integral part of the wheel head. Some potter's prefer throwing directly on the wheel head, others prefer throwing on a plaster bat which has been placed on top of the wheel head. The bats are attached with slip. For the most part, bats have an advantage in that they can be removed without cutting the thrown piece from the bottom. Many pots have been totally ruined due to cutting them loose from the wheel head.
2.

Start by wedging a mass of clay about the size of a baseball, or a little larger, and pat and smack it into a round, smooth ball. Slap the ball of clay lightly on the center of the wheel, using sufficient force to flatten it slightly on the bottom. Remember, if using only the wheel head, it must be dry. If using a plaster bat, it must be slightly damp.

EXAMPLES: Round ball of clay

Ball of clay placed on wheel head
3. The first step in throwing is centering the ball of clay on the wheel head. Start the wheel turning counterclockwise. When it is turning quite rapidly, dip your hands in water and clasp the clay mound in both hands. Exert uniform pressure from all sides until the clay spins smoothly and shows no irregular motion as the wheel revolves. Lubricate the clay and hands as often as needed, for if the clay drags under the hands, centering it will be impossible.

4. As far as body position is concerned, brace your left elbow firmly against the body and the left forearm held rigid as the lower part of the palm of the left hand is pressed against the clay, combined weight of body, arm and hand will force the revolving clay to the wheel center. Use the right hand to sprinkle water on the clay and to pull it toward you as the left hand is pressing it away from you.
5. Under this pressure, clay will rise in a cone. Some potters spin clay into a cone, then press it down by flattening it with the thumbs several times before forming the low flattened mound which is the starting shape forming the cylinder.

6. The cylinder is the basic shape from which most thrown forms are developed. It will be worthwhile to practice making cylinders before attempting other forms.

7. For the remainder of this exercise on throwing, consult your instructor. The main emphasis in wheel throwing is in applying what one mainly experiences with the spinning clay. The varied ways of pulling up the cylinder, centering, and spreading the ball of clay make it almost impossible to structure the throwing on the wheel to any type of book format. The method varies greatly from even potter to potter.
SELF TEST

Utilizing your knowledge of function and design of ceramic works, throw a pot on the wheel. You are encouraged to use primarily thrown forms; however, if adaptations are needed from other construction methods it is permissible.

Strive for individuality in your work. This particular work should demonstrate your competencies in the wheel method. Carefully think through your plans before you start. In this manner much useless effort can be eliminated. A well designed work always results in better ceramics, than a work constructed in a haphazard fashion.
Texturing

Purpose

The major purpose of exposing you to various aspects of texturing is to familiarize you with tools that can be used in texturing, plus concepts to keep in mind when texturing is selected. The purpose is not so much to have you texture every work, but to provide you with knowledge as to its various components if it is ever called for.
1. Creating something useful with your own hands is a basic urge, and the desire to mark into wet, unblemished surfaces is instinctive. Almost everyone can recall times when he has been tempted to touch wet paint - to make certain it was wet - or to inscribe names and initials into wet cement. Small wonder that potters working with wet, impressionable clay frequently carve into or scratch its surface, build it up or polish it to change the texture or give it a different character.

2. Clay is so sensitive that it always bears the stamp of the potter's own personality. Designs are so easily impressed into its yielding surface that the ways and means of texturing are limited only by the artist's imagination. To stimulate the imagination you must learn to see as well as look and thus reach beyond the mere recognition of objects. When you have gained a little creative insight, the chance observation of foot prints in wet sand or even automobile tire tracks will take on new meaning and suggest patterns. Your ideas can start from observing a motif (a dominant idea or central theme) as majestic as the escarpments in a canyon or by handling an object as humble as the bobbin of a sewing machine.
3.

Texturing clay can be dealt with in great detail. You will find it enjoyable to work in this manner, and it will stimulate your imagination. Textures can be extremely handsome if used with restraint and good taste. The degree to which you utilize texturing is totally dependent upon your personal feeling for the work, the work's function, and the overall qualities that you wish the work to present.

4.

In a more practical sense, texturing pottery covers the imperfections of hand work. The process strengthens the joints as well as covers them. The tool marks are an honest result of the construction. They are valid and add character; however, it must also be remembered that pieces without textures can also serve your purpose as well. Here again, the amount and type of texture, is left to the potter. In many instances a smooth surface is more appealing than a textured one.

Texturing is generally used by potters to act as an intricate part of the total work, to cover__________, or to strengthen____________ as well as cover them.
Some ceramic pieces seem to ask for texture to enrich and unify them. The texture can be delicate and fine or bold and deep. It may be scattered and abstract, rhythmical or asymmetrical. It can be a repeat pattern or a single motif. Whichever technique you utilize, the resulting pattern should be natural to the clay itself and enhance the form.

When developing ideas for new textures, let the clay speak for itself. Any attempt to imitate driftwood, marble or other surfaces foreign to the true nature of clay will look false.

Any type of texturing should be_________________ to the clay and_________________ the form; however, any attempt to_________________ surfaces of a non-clay substance should be totally avoided.
Other than using your hands as a texturing tool, you can also utilize objects. Below is a brief list of tools you might make use of in texturing.

- Fancy pairing knives
- Apple corer
- Pie-edge crimper
- Serving fork
- Swedish rolling pin used for flatbread
- Ravioli cutter
- Toy automobile wheels
- Shells of nuts
- Sea shells
- Broken piece of cement
- Rolled-up piece of leather
- Handle of a spoon
- Plastic screw-on tops
- Children's construction blocks
- Dog grooming combs
- Scissors handles
- Twigs from trees
- Dicers and choppers
- Seed pods
- Dry breakfast cereals rolled in a cloth
7.

There are many pottery techniques that lend themselves to using pre-textured clay, while others require that the structure be built first, with the texturing added as a final embellishment. Both methods have a place in creating pottery forms.

After a quick review of this particular section, contact your instructor for further directions.
SELF TEST

1. Texturing is generally used by potters to act as an intricate part of the total work, to cover ________, or to strengthen ________ as well as cover them.

2. Any type of texturing should be ________ to the clay and ________ the form; however, any attempt to ________ surfaces of a non-clay substance should be totally avoided.
Wrapping and storing unfinished works

Purpose

The major purpose of this section is to instill within you those procedures deemed necessary to keep unfinished works in a state of workability. It is this process which is vital to the completion of any ceramic work. Even though places for storing of works may vary, the process remains the same in principle and practice.
For the most part, the process of wrapping and storing unfinished works has the same principles employed as those for keeping clay in condition and storing clay. The major difference being that the work has already been partially constructed. The only remaining items to be added to the work may be handles, lids, or even carving designs. Nevertheless, proper procedures must be carried out to ensure that the work is still wet enough to be completed.
2.

The procedure for wrapping the clay is simple. First wrap the work in wet rags, then cover with polythene. This should ensure that there is ample moisture surrounding the work, plus an insulator to keep the moisture from escaping, or heat from getting in.

EXAMPLE: Wrapping
3.

It is assumed in the storing stage that the works are located on either wood or masonite for easy transport. Generally there will be a group of shelves provided for works not yet completed. The main thing to keep in mind is that a work down close to people working seems to get bumped and knocked over very easily.

EXAMPLE: Storing
As simple as the procedure seems, it is vital to the completion of a work(s) that you have planned. Many a ceramist has thought he wrapped and stored his work correctly, just to find it dried out the next day, or disfigured in some way.

After a quick review of this section consult your instructor for further directions.
SELF TEST

1. Explain, in your own words, how to wrap and store an unfinished work.
Glazes

Purpose

The overall purpose in studying glazes is to familiarize you with the various aspects of creating your own formulas for your particular work. However, it is recognized that certain ceramic classes utilize premixed glaze. Even in light of this situation, the process of experiencing this most vital aspect of ceramic creation should not be totally overlooked or replaced entirely.
1. In the past potters have been secretive about glazes and their silence has created a mystical atmosphere which, to the mind of the student, is often encouraged by a glance at some recipes or formula. Are glaze ingredients really so mysterious, and is their chemistry so incomprehensible? Is it not possible for anyone to produce their own recipes, and to prospect for some of their own raw materials?

2. It was stated that most clay is descended from felspar and that the pure material - china clay or kaolin - melts at about 1800°C. Pure clay is a compound of aluminium oxide (known as alumina, Al₂O₃), silicon dioxide (silica SiO₂) and water which is driven off when the material is heated above 500°C.

Pure clay (china clay or kaolin) is a compound of ________________________, ________________________, and ____________________.
3. Since the melting point of alumina is 2050°C and silica 1713°C, one can only assume that, when compounded together, some reaction takes place causing the lowering of the melting point of alumina by some 250° and raising that of silica by nearly 100°.

4. Though the proportions of alumina to silica varies from one clay to another it would seem doubtful, however, that this reaction can ever be strong enough to lower the melting point of a clay sufficiently to cause it to glassify (turn into glass) at pottery glaze temperatures.
Impure varieties of clay sometimes melt at only a little over half the temperature required by china clay, so that it may be pertinent at this point to discover precisely what impurities are usually found in clays. The following table shows that all natural clays contain varying amounts of:

- potassium oxide (potash, $K_2O$)
- sodium oxide (soda, $Na_2O$)
- iron oxide ($Fe_2O_3$)
- magnesium oxide (magnesia, $MgO$)
- calcium oxide (lime, $CaO$)
- small amounts of other substances
6. White sand - almost pure silica - is the basic ingredient of glass, and may surprise you that it occupies such a position in pottery glazes. There are three reasons for this; firstly the potter does not melt his silica and other ingredients in a pot and use them while they are cooling, he applies them as powders to his pot and requires them to be viscous enough (gluey) when molten to adhere to vertical surfaces. The proportions of alumina in clay provides this stability and enables a glaze to mature slowly over a considerable range of temperature without becoming too runny.

Silica makes a glaze look ______________, while alumina provides ______________ which keeps the glaze from running during firing.

7. Secondly, alumina on its own is a rare substance confined to only a few districts of the world in the form of bauxite ore so that the high proportion contained in clay is welcome.

Bauxite ore, known as ______________ is a welcome substance in clay.
8.
Thirdly, the sticky nature of clay serves to bind the dry powdery ingredients to the surface of the pot so that they do not flake or dust off before firing.

For the glaze to not flake or dust off it must be ________________ in nature.

9.
The four oxides apart from iron-potash, soda, magnesia and lime are all known as fluxes (substances used to promote fusion especially of minerals). They vary in their activity and have different effects on surface qualities and colors.

For various ingredients in a glaze to fuse together various________________ must be in the formula.
Glazes are often classified by their predominant flux hence "lime matt," "soda," "alkaline" (potash and soda). Several other metallic oxides (boron, zinc, barium, lithium, strontium) have similar fluxing action on silica and, though they are not common oxides, they may occasionally be used to obtain some special effect.

The major flux in any glaze is called the __________ flux due to its significant fluxing action.

Lead oxide is exceptional and is certainly the most effective fluxing agent at low temperatures, though its use declines rapidly above 1200°C. Lead oxide is highly poisonous in all forms, but some pre-fused mixtures of lead and silica are considered safe enough for use.

The most exceptional and effective fluxing agent is ____________; however, precautions should be taken in its use since it is ____________.
12. Lead bisilicate contains 35% silica, 65% lead; Lead sosquisilicate contains 28% silica, 72% lead. Proportions of these lead silicates with various pottery clays - especially red clays - will quickly yield attractive earthenware glazes like those used in Europe for many centuries.

13. All vegetable matter is composed largely of hydrogen and carbon compounds, but when these have been burned away a small deposit is left of non-combustible material which consists mainly of the six chief "ceramic" oxides (alumina, silica, lime, soda, magnesia and potash) with the fluxes strongly predominating.

The six chief "ceramic" oxides before being converted into non-combustible material were all________________________ composed largely of________________________ and ______________ compounds.
14.

Ash compositions vary from one tree to another, or one plant to another, from season to season, and from district to district, so that rich variety can be expected from glazes of which they form a part. Ashes are prepared for use by soaking in water and sieving (anything from 40 mesh to 120 depending on smoothness of required result) to remove coarse or unburned particles.

15.

Salt-glazing is also carried out on unbisques ware, but the substance is not applied direct to the pots, it is thrown into the fire when the temperature has reached about 1200°C., and after a period of reduction firing.

16.

About half a pound of common salt is required per cubic foot of kiln space. Plain salt-glaze on grey or "buff" stoneware clays produces only shades of brown, but a wide range of color and texture can be produced by applying other glazes or slips to the pots first.
17. Salt-glazing produces poisonous fumes of chlorine and hydrochloric acid, and should therefore only be tried in kilns built out of doors in fairly open surroundings. Under no circumstances should it be tried in electric kilns.

18. Felspathic glazes are based on rocks (orthoclase or potassium felspar, albite or soda felspar, anorthite or lime felspar, nepheline syenite and Cornish stone) which have similar compositions to the clay which is derived from them.

19. Additions are usually made in the forms of limestone or whiting (both calcium carbonate), and flint or quartz (both silica). Felspathic recipes are often further complicated by the addition of more clay to improve the handling qualities of the glaze before firing. Ashes may also be incorporated into the glaze.
20.

Folspars are associated with granite and other igneous rocks, and it will be found that the compositions of these are also sometimes suitable for making high temperature glazes without any direction. Igneous rocks are not used in the industry because of their variability and their iron content, but many interesting surfaces or colors may be discovered by using them. You may be daunted by the thought of powdering granite or basalt, but these rocks - and others - are often used by stonemasons, whose polishing and sawing machines yield quantities of sludge of almost ceramic fineness which they are generally only too willing to give away. The sludge requires only sieving and drying before use.
21. It will be evident that the provision of roughly glassified coatings on pottery is a simple matter and some enjoyable texture or color may well be discovered from your experiments. However, finding a glaze that never crazes (a network of fine cracks in glazes appearing after firing), never has little holes in it, or crawls (common glaze defect caused by poor adhesion of the glaze film before melting) up in lumps - or even flakes off altogether - is an entirely different matter.

22. Glazes have to be suited to the clay of the pot in terms of equivalent shrinkage and, when found, will need standardized firing schedules and temperatures.

Most potters rely upon rule of thumb methods or experience. So far as trials, it should suffice to watch fusibility; glazes containing too much flux flow down the sides of pots and collect as pools in the bottoms of bowls and glazes with too little flux appear dry to the touch, or they may be blistered or pinholed.
The flux content can easily be altered, but an alteration of the firing temperature may be equally effective; a mixture that is too runny at 1300°C. may be excellent at 1100°C. or 1200°C. Similarly a dry feel, or pinholing, may be the result of under-firing; a glaze that appears like a dead coat of plaster at 1100°C. may be gloriously translucent at stoneware heat. Excessive gloss - especially in lead glazes - may be dulled by the addition of up to 10 or 15% of extra clay which increases the proportion of alumina.

On the next page are some examples of Lino Blonds (Glaze Tests). Look over them carefully, for it is these tests which you will be conducting to determine the appropriate glaze for your works.
### Glaze Tests

<table>
<thead>
<tr>
<th>Lead silicate</th>
<th>Any clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 80 60 70 50 60 40 30 20 10</td>
<td>10 20 30 40 50 60 70 80 90 100</td>
</tr>
</tbody>
</table>

(Additions of 5%–10% of extra silica (flint) may also be tried).

*Leadless boracic glazes may also be evolved by substituting a borax frit (borax, being soluble, cannot be used on its own) in place of the lead silicate.*

<table>
<thead>
<tr>
<th>Any ash</th>
<th>Any clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 60 50 40 30</td>
<td>30 40 50 60 70</td>
</tr>
</tbody>
</table>

Apply to damp, unbisqued, pots like a coating of slip (raw glazing).

<table>
<thead>
<tr>
<th>Any ash</th>
<th>Any igneous rock</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 40 30 20</td>
<td>30 35 40 45</td>
</tr>
</tbody>
</table>

Any predominantly felspathic rock

<table>
<thead>
<tr>
<th>Any ash</th>
<th>Any clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 45 40 35</td>
<td>20 20 20 20</td>
</tr>
</tbody>
</table>

(The clay content may also be varied).

<table>
<thead>
<tr>
<th>Felspathic rock</th>
<th>Flint or quartz (silica)</th>
<th>Limestone, whiting</th>
<th>Any clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 60 70 50 (3) 40</td>
<td>10 33 (2) 30</td>
<td>20 20</td>
<td>17 (1) 20</td>
</tr>
</tbody>
</table>
1. Pure clay (china clay or kaolin) is a compound of ______________, ______________, and ______________.

2. Silica makes a glaze look ______________, while alumina provides ______________ which keeps the glaze from running during firing.

3. Bauxite ore, known as ______________ is a welcome substance in clay.

4. For the glaze to not flake or dust off it must be ______________ in nature.

5. For various ingredients in a glaze to fuse together various ______________ must be in the formula.

6. The major flux in any glaze is called the ______________ flux due to its significant fluxing action.

7. The most exceptional and effective fluxing agent is ______________; however, precautions should be taken in its use since it is ______________.

8. The six chief "ceramic" oxides before being converted into non-combustible material were all ______________ composed largely of ______________ and ______________ compounds.
Coloring Oxides

Purpose

As with the section on glazes, coloring oxides seem initially to be of little value in light of using pre-mixed glazes. However, this section is vital to a complete understanding of the entire process of glazing ceramic works. The different colors that can be obtained through glazing is practically limitless. It is this great variety of colorants which create for you an open door to glaze selection.
1. Transparent glazes depend for their effect on the color of the clay of the pot or the colors of slips which have been applied to it, but other colors of glaze can easily be achieved by mixing a small proportion of certain metallic oxides with the glazes.

The main components in all glazes which are the coloring agents are known as____________________________.
Following is a list of the effective coloring oxides together with the average proportions in which they are added to glazes.

### Coloring Oxides

<table>
<thead>
<tr>
<th>Oxide</th>
<th>Range of addition</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vanadium oxide</td>
<td>2 - 10%</td>
<td>gives yellows</td>
</tr>
<tr>
<td>Chromium oxide</td>
<td>1 - 5%</td>
<td>greens, pink in tin glazes</td>
</tr>
<tr>
<td>Manganese oxide</td>
<td>2 - 9%</td>
<td>purple - brown</td>
</tr>
<tr>
<td>Iron oxide</td>
<td>3 - 10%</td>
<td>browns - black, celeryon when reduced.</td>
</tr>
<tr>
<td>Cobalt oxide</td>
<td>6 - 1%</td>
<td>blues</td>
</tr>
<tr>
<td>Nickel oxide</td>
<td>1 - 3%</td>
<td>greys</td>
</tr>
<tr>
<td>Copper oxide</td>
<td>1 - 6%</td>
<td>greens, purples or reds when reduced.</td>
</tr>
</tbody>
</table>

Coloring oxides can of course be combined and an infinite number of colors obtained from them which will also be affected to some extent by the fluxing oxides (lowest-melting compound in a glaze, such as lead, borax, soda ash, lime, and including the potash or soda contained in felspar).
3. **Temperature** also has an effect on color. Above 1100 C. the clay and glaze layers become increasingly united, and the one influences the other.

Above___________ the coloring oxides are highly influenced by kiln_______________.

4. **Iron oxide** is by far the most important colorant at **stoneware temperatures**, but its most pleasing attributes can only be obtained in what is known as "reduction" firings (a firing using insufficient oxygen producing color changes in coloring oxides).

At stoneware temperatures (1250 C. to 1350 C.) ________________ is considered by far to be the ________________ colorant.

5. On the next two pages are charts which give you the basic glazes which can be mixed and then colorant added. Look over the charts carefully taking note of the various temperatures required for the particular glazes, their ingredients, and percentages. After reviewing report to your instructor.
<table>
<thead>
<tr>
<th>Temperature</th>
<th>Raw Material</th>
<th>Recipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000°C - 1100°C</td>
<td>Lead bisilicate</td>
<td>56.7</td>
</tr>
<tr>
<td></td>
<td>Whiting</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>Felspar</td>
<td>30.6</td>
</tr>
<tr>
<td></td>
<td>China clay</td>
<td>7.1</td>
</tr>
<tr>
<td>1000°C - 1100°C</td>
<td>Lead bisilicate</td>
<td>72.7</td>
</tr>
<tr>
<td></td>
<td>Cornish stone</td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td>China clay</td>
<td>12.1</td>
</tr>
<tr>
<td></td>
<td>Flint</td>
<td>4.6</td>
</tr>
<tr>
<td>1200°C</td>
<td>Felspar</td>
<td>35.5</td>
</tr>
<tr>
<td></td>
<td>Whiting</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td>Lead bisilicate</td>
<td>56.6</td>
</tr>
<tr>
<td></td>
<td>China clay</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Flint</td>
<td>5.4</td>
</tr>
<tr>
<td>1200°C</td>
<td>Felspar</td>
<td>37.8</td>
</tr>
<tr>
<td></td>
<td>Whiting</td>
<td>13.5</td>
</tr>
<tr>
<td></td>
<td>Barium carbonate</td>
<td>26.6</td>
</tr>
<tr>
<td></td>
<td>China clay</td>
<td>13.1</td>
</tr>
<tr>
<td></td>
<td>Flint</td>
<td>4.0</td>
</tr>
<tr>
<td>1300°C - 1300°C</td>
<td>Felspar</td>
<td>37.0</td>
</tr>
<tr>
<td></td>
<td>China clay</td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>Whiting</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>Flint</td>
<td>37.0</td>
</tr>
<tr>
<td>1300°C - 1300°C</td>
<td>Felspar</td>
<td>35.2</td>
</tr>
<tr>
<td></td>
<td>Dolomite</td>
<td>11.7</td>
</tr>
<tr>
<td></td>
<td>China clay</td>
<td>27.2</td>
</tr>
<tr>
<td></td>
<td>Whiting</td>
<td>20.3</td>
</tr>
<tr>
<td></td>
<td>Flint</td>
<td>12.0</td>
</tr>
</tbody>
</table>
Basic Glasses without Colorants for

Iron Glazes (750° - 900°C.)

<table>
<thead>
<tr>
<th></th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red or white lead</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Flint</td>
<td>10</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ferric (increasing as lead decreases)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chino clay for stability</td>
<td>2 - 5%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SELF TEST

1. The main components in all glazes which are the coloring agents are known as__________________.

2. Above________________ the coloring oxides are highly influenced by kiln__________________.

3. At stoneware temperatures (1250°C. to 1350°C.) __________________ is considered by far to be the __________________ colorant.
Glazing Methods

Purpose

The purpose is to present you with various methods by which ceramic works can be glazed. It is these glazing methods which are vital in applying glaze in such a manner as to not detract from the overall design (both shape and glaze) of the ceramic work. A proper glazing method (depending upon the shape of the work) can make or break it as a piece of fine art. Sloppy glazing procedures can only result in sloppy works.
1. Mixing a glaze from a recipe using prepared raw materials supplied by a potter's merchant is an easy job. The powders are weighed and then stirred into sufficient water to provide a creamy mixture which is brushed through a "120" sieve. After the glaze has been sieved the water content will probably need adjusting.

2. If the bisque ware, red, grey or white clay, is fired at 1050°C., then most glazes need to be creamy enough to just coat a dry finger. However, some glazes give their best results when applied thickly, others when thin, and the most suitable coating can only be found by experience.

Bisque ware fired at__________ need glazes which are generally creamy enough to just coat a__________.

However, most glaze thickness can only be found through__________.
3.

Thickness of coating also depends on the **length of time** the pot is held within the glaze which adheres because the porous bisque absorbs water from the mixture leaving a layer of the powdered ingredients on the surface. If the pot is immersed **too long** the clay becomes **saturated** and little powder is retained on the surface.

Caution must be taken when glazing a work because of the __________________________ the pot is held within the glaze can result in the clay becoming____________________ and little glaze will remain in place.
4.

The best method of applying glazes is by dipping the pots into the mixture and small quantities are irritating because they do not cover even small articles.

EXAMPLE: Dipping method
5.

Glazes in use need stirring continuously, especially those containing heavy lead compounds, and it is advisable to stir occasionally between times otherwise the powdery ingredients settle to a solid mass which is hard to remix.

If glazes are not continuously______ there is a large chance that a________________ of glaze will form in the container and the glaze will be of no use.
When there is not enough glaze to cover an object by dipping, the next best method is to **pour the glaze over it**. Provided the glaze is poured in a good stream - not slowly dribbled - this works very well. Cup shapes are filled to the brim with glaze which is poured out right away, they are then held upside down and glaze is poured over the outside. If there is more than a moment or two of time lag between glazing the inside and the outside, the moisture from the inner glaze will have time to seep through to the exterior surface of the pot which will then be too wet to absorb a proper coat.

**EXAMPLE: Pouring Method**
7. Narrow-necked or tall vases should not be filled; a little glaze is poured inside which is then slowly tipped out while the pot is being rotated. If tall pots are filled they cannot be emptied quickly enough and too thick a coating adheres to the walls.
Very flat shapes can be rested on edge on sticks placed over a bowl, and be held upright by one finger. The stream of glaze from a jug is then spilled over the rim so that back and front are glazed at once.

EXAMPLE:
9.

The **chief difficulty** with both pouring and dipping is how to hold the pot so that as few finger marks as possible are left on the glazed surface. Most works have bases which can be held quite easily, but many pot forms are difficult unless the problem has been carefully thought out in the shaping.
Bowl shapes, or cylindrical forms that have no emphasis or change of form at the bottom, are difficult to glaze, but they can be stood upside down on sticks across a bucket as was suggested for flat works. The stick marks on the rim can be touched up, but this has to be done carefully when using opaque (glaze that cannot be seen through) or matt glazes (dull surface, not shiny).

EXAMPLE:
11. Touching up sticks or finger marks is done with a brush and, when dry, the marks are carefully scraped to the level of the glaze film with a razor blade or other sharp-edged piece of metal. If the fingers are liberally coated with glaze beforehand touching up is made easier, but the business should be avoided wherever possible by designing graspable foot (base) or other areas which can be left unglazed.

EXAMPLE: Touching up
12. Glazes can be sprayed on to bisque ware, but compressors and spray guns are expensive and must be used in conjunction with a proper booth and extractor fan. Spraying is generally used only in industry on difficult decorated wares or large cumbersome objects such as sinks or toilets. The occasional pot which cannot be dealt with by any other method can fairly successfully be painted.

13. Make sure that you understand thoroughly the basic methods by which a ceramic piece can be glazed. After looking over any information that you need to review, consult your instructor for further directions.
SELF TEST

1. Bisque temperature is______________.
2. Most glazes need to be creamy enough to just coat a ________________.
3. Most glaze thickness can only be found through ________________________.
4. Caution must be taken when glazing a work because of the length of time the pot is held within the glaze can result in the clay becoming______________ and little glaze will remain in place.
5. The best method of applying glazes is by__________.
6. If glazes are not continuously____________ there is a large chance that a solid mass of glaze will form in the container and the glaze will be of no use.
7. When there is not enough glaze to cover an object by dipping the next best method is______________.
8. Touching up sticks or finger marks is done with a ________________.
9. Glazes can be____________ on to bisque ware, but compressors and spray guns are expensive and must be used in conjunction with a proper booth and extractor fan.
10. The chief difficulty with both pouring and dipping is how to____________ the pot.
Types of Kilns

Purpose

The purpose of this program is to familiarize you with the various types of kilns, their capabilities, and their limitations. Learning the types of kilns is a basic knowledge that all individuals interested in ceramics should know. Kilns are perhaps the most vital of equipment in the ceramic process.
1. To add the finishing touch to the ceramic process it is necessary to establish the types of kilns presently in use in ceramics and their major characteristics. Granted, you will probably be using only one kiln, however, the various types of kilns are in many respects so different that a general statement concerning all kilns would create a false impression about them.

2. Any fuel can be used to heat a kiln, but electricity has one or two advantages which make it the most suitable for school use. Kilns fired by flame-producing fuels require constant attention, especially in the case of gas, skilled attention over a period of ten to twelve hours. Electric kilns may be left on all night, unattended, and require only to be switched up once or twice during the following day before the final temperature is reached.
3. The Bisque kiln represents the simplest type of updraught kiln (the circulating flow of air moves upward) fired essentially with wood or coal. This particular type of kiln is suited for firings not much above 800°C.

4. The Raku kiln has some refinements which make possible a higher temperature. Raku firings form probably the most dramatic initiation into the mysteries of pottery. Raku ware is different from all other kinds in that the pots, after they have been bisqued, glazed and decorated, are plunged directly into a red hot kiln and withdrawn as soon as the glaze has formed. They may then be immersed in cold water so that they are ready for instant use. Remember, this process could be very dangerous in electric kilns because heated air is conductive. Forgetting to switch off the current first could be fatal.

5. The coal-fired kiln is the third type capable of firing earthenware glaze at 1100°C., and it would provide a potter wishing to make small decorative works with a workable proposition.
SELF TEST

1. The________________ kiln is the most suitable for school use.

2. ________________ kilns may be left on all night, unattended, and require only to be switched up once or twice during the following day before the final temperature is reached.

3. The______________ kiln represents the simplest type of up-draught kiln (the circulating flow of air moves upward).

4. The______________ kiln has some refinements which make possible a higher temperature and the most dramatic initiation into the mysteries of pottery.

5. The gas and coal-fired kilns are examples of kilns which are______________-producing.
Types of Firings

Purpose

The purpose of this program is to add to the basic understanding of the ceramic process, a knowledge of the types of firings. This essential knowledge of the types of firings will instill in you those aspects of clay and glaze preparation which at this stage of the process are paramount considerations. This type of insight into the process is a necessity.
1. Ceramic ware is usually fired twice. The first time, known as the Bisque or Biscuit fire, rids the clay of water and other gaseous matter, leaving it in a strong and porous state which can easily be glazed. A satisfactory temperature for this particular firing would be 1050°C.

All firings at___________ are considered to be___________ fired.

2. After the bisque ware has been dipped in glaze it is fired again at a suitable temperature for the glaze. Temperatures will obviously vary as to type of clay used and glaze.

3. During the bisque fire the pots may touch one another and be piled up. It should be remembered that clay expands before it shrinks in firing, and care has to be taken to ensure that pots do not settle into one another so that they become locked together as they contract.
During the glaze fire the pots should not touch one another, nor should the glazed surfaces touch the kiln walls or kiln furniture.

In some rare cases the bisque and glaze firings are combined. This particular type of firing, known as single firing, is one continuous operation which may create unforeseen problems due to the duration of time lapse from beginning to end.
SELF TEST

1. Ceramic ware is usually fired_________ times.
2. The first firing is the_________ firing.
3. The second firing is the_________ firing.
4. All firings at 1050°C. are considered to be_________ fired.
5. In some rare cases the bisque and glaze firings are combined. This particular type of firing is known as
   ____________ firing.