A Study Of Methods For Developing Thinking In Industrial Arts

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CHAPTER I

INTRODUCTION

Thinking may be considered as the recalling of past experiences to enable a person to respond, and is usually a sequential affair leading from one thing to another. When the sequence of recall and association are random affairs, thinking may be synonymous with day-dreaming; but when controlled, thinking becomes synonymous with reasoning.

Reasoning is considered to be the predominant method of solving problems, and therefore is the type of thinking with which this study is concerned. As that part of General Education which deals with industry and industrial concepts, Industrial Arts courses must develop within the student a controlled sequence directed toward the solution of problems faced by our industrial society. According to some psychologists, reasoning occurs only when a difficult problem arises, and the nature of the problem, as it is conceived, determines the direction of recall and association.

A concept is considered to be a product of reasoning, and may be developed through figuring out relations of common observations and through questions being answered. After a concept is developed, it has a strong influence upon the direction of thinking and solving problems. Therefore, the development of concepts are of vital importance in Industrial Arts courses, as well as preparation for any line of creative thinking.

When the type of thinking that is called reasoning is so vital to our industrial society, it is not surprising that many of the recent criticisms against Industrial Arts, in secondary education, concern the failure of the instructor to develop student thinking ability. In general, these critics agree that students are too often allowed, and sometimes encouraged, to follow a set pattern of procedure to build some exercise projects, and to make an exact copy of a project created by someone else.

This procedure may be well planned by the instructor, to develop within the student such manipulative skills as sawing and squaring a board, driving a nail, boring a hole, and reading instructions. All of these skills are important, and so is the knowledge of tools and materials that he will gain from this procedure. But most of the critics believe that students should receive more training in thinking through and planning their jobs: thinking in terms of separate and whole parts, visualizing end results, forming concepts, and creating something through their own thinking.

Recent professional literature has shown that some of the teachers are conscious of this condition. Stuck reports that progress is being made towards enrichment through closer correlation with the fine arts.[1] This idea is clearly expanded by Wilber who says "it is probably more important, from the educational stand-point, that child be able to plan his project cor-

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[1]Stuck, Ferdinand T., Creative Teaching. New York: John Wiley & Sons, Inc., 1938. p. 573.

rectly, than that he be able to carry it out skillfully."[2] This indicates that teachers may have to spend as much time and attention with the students in thinking out and planning their projects as on the work of their projects.

Some instructors have undertaken, on their own time, the development of new methods and procedures to develop student thinking, as well as to aid general shop progress. As Brown explains his development and use of "Picture boards,"[3] considerable time was involved in development, but the time was well spent, as the results were very gratifying. By studying the picture boards for their project, students could discriminately think out their own construction problems.

The same problem was suggested by Brawden who said: "Industrial Arts courses are part of General Education and do not have a distinctly bread-and-butter justification, but are assumed to generate a sympathetic interest in the whole industry."[4] Stockton claimed that the Industrial Arts course was justified in a training school on the basis of a rich body of "thought subject matter" which gave the subject social meaning and real life value.[5] These views give definite support to the writer's

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[2]Wilber, Gordon O., Industrial Arts in General Education. Scranton: The Haddon Craftsmen, Inc., 1948. p. 24.

[3]Brown, Everett M., "Picture Boards Help Students Learn To Think and Plan," Industrial Arts and Vocational Education, September, 1951. p. 270.

[4]Brawden, William T., "Early Concepts of Industrial Arts," Industrial Arts and Vocational Education. June, 1952. p. 183.

[5]Stockton, James LeRoy, Project Work in Education. Boston: Houghton Mifflin Co., 1920. p. 118.

contention that Industrial Arts must strive to provide the student, not only with some technical skill and knowledge, but also with the thinking ability to become adapted to our fast growing industrial society, and to meet its variety of problems. This is well summarized in the words of Wilber:

> The first step in any thinking process is the recognition of a problem. So, it is essential that Education must continuously face students with problem situations requiring solution, and allow and encourage individual critical thinking. Only in this way can Education make the maximum progress in teaching youth to think and solve problems. The pupils must be given every opportunity to solve their own problems of planning and making projects.[6]

In teaching the pupils to solve their own problems, it appears that instructors must guide them in such a way that they will learn to form a mental image through association and contrast. This may be better understood by considering the problem of this study, and some definitions.

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[6]Wilber, op. cit., p. 22.

CHAPTER II

THE PROBLEM AND DEFINITION

During the past few years some comments have been made regarding the failure of Industrial Arts instructors to develop thinking in the industrial arts courses, at the secondary level. The increasing number of articles appearing in recent professional literature shows that some of the instructors are conscious of this condition, and that progress is being made towards total enrichment through closer correlation with the fine arts, and through changes in methods of instruction.

The Problem

Statement of the Problem. Most of the critics of Industrial Arts instruction believe that the development of manipulative skills, knowledge of tools, materials and procedures may be well planned and executed; but the important aspect of developing thinking is too much neglected. In order that the student may better adapt himself to our fast changing industrial society, industrial arts instructors must emphasize the development of student thinking ability.

This presents the problem of how industrial arts instructors can emphasize the development of student thinking ability without neglecting the development of manipulative skills. The investigation of this problem includes the following purposes : (1) to study the common methods of instruction used by indus-

trial arts instructors at the ninth grade level; (2) to study the extent of emphasis placed by these instructors on the development of manipulative skills, in contrast with the development of concepts and thinking ability; (3) to point out the importance of developing thinking ability; and (4) to arrive at, and present, a flexible program of instruction to develop thinking in a ninth grade industrial arts course.

Importance Of The Study. The development of the whole individual has often been stressed as one of the major functions of education. As a part of General Education, all industrial arts courses must follow the same general functions.

A primary and controlling objective of General Education must be its adaptability to a fast changing environment. The rapid developments being made in industry and technology require an open minded desire to learn, and a sincere readiness to modify, and to change, when that modification and change will contribute towards improvement. A half-hearted change, just to try something different, will accomplish nothing. We must realize that our modern industrial society places upon our school system, as a part of General Education, the grave responsibility for the study of industry and industrial concepts for developing the whole individual, and helping him become adapted to the requirements of adult life through personal growth. So that the reader may follow better, some of the terms used in the study have been defined.

Definitions of Terms Used

Industrial Arts. Industrial Arts are interpreted as those phases of General Secondary Education which deal with the organization, occupations, products, processes, and materials of industry, and with the problems resulting from the industrial and technological influence upon our society. It is the study of the changes for increased value that man has made upon materials, and of the life related to those changes.

Visual Aids. Visual aids are interpreted as being any type of visual stimulus used as a spoken or printed supplement to instruction. Visual aids have been used quite extensively in industrial arts courses, especially since World War II.

Perspective. Perspective is interpreted as the visualizing of a true picture from actual dimensions, with the expression of space, color, size, and distinctness, in relation to distance and position.

Manipulative Skills. Manipulative skills are considered to be the mechanical control and operations of the hands to efficiently and expertly perform such operations as driving a nail, or sawing a board.

Creative. Creative is defined as the power or ability to bring into being, by thought or imagination, a new form or a change in the old form. Creative work can be adding a new touch or tone to some standard form, or a new solution to an old problem. For example, the common hammer and saw were improved

by creative thought and work centuries after being invented. True creativeness comes as a product of child-initiated activity and self-nourished thinking.

Behavior Change. Behavior change is interpreted as an indication that learning has taken place, and is evidenced by student interest in, and recognition of, appreciation for color, workmanship, and design.

Integration. Integration is represented as the development of the whole individual, and indicates the development of every talent within the student, and every phase of his life's preparation for the future.

Analytical Thinking. Analytical thinking is interpreted as thinking in terms of component parts, separately ~~of~~ OR in relation to the whole.

This problem is an important one. There is a need for clarification of thought about the opportunities for developing thinking. The approach or procedures for doing this will by presented in the following Chapter.

CHAPTER III

PROCEDURE FOLLOWED

To conduct this study on how to develop industrial arts thinking, the writer first formed a general over-all view of how he intended to approach the problem, and how it should be solved. It was decided that a comparison should be made of common teaching methods, that do not develop student thinking with some methods that do develop student thinking, and to compile those points and ideas that made the greatest contribution to the development of thinking into a flexible and cooperative plan of instruction.

The writer realized that certain words and terms would have to be defined, in order that the reader would better follow the writer's lines of thought. These words and terms are defined in Chapter II. Also for the reason of maintaining parallel lines of thought, it was decided that the general objectives of Industrial Arts should be explained, as is done in Chapter IV.

Having decided upon the method of procedure, the writer set up an outline of the study and then began to fill in with appropriate information. It soon became evident that such words and phrases as perspective, concept, creative, manipulative skill, reflective thinking, analytical thinking, and discriminating thinking were keys for constructing and developing the outline.

As the time, travel, and local facilities were too limited for personal observation and application, this study was conducted through library reference material. Numerous books and periodi-

cals of industrial, vocational, and general education were consulted. When the key words or phrases were found, the articles were studied for their contribution to the developing of thinking.

The methods of instruction which were covered in this study were divided into two groups: those common methods which emphasize the development of manipulative skills and do not develop student thinking ability; and those methods which do emphasize the development of student thinking ability along with the development of manipulating skills. A few methods were then selected from each group, on the basis of their contribution to this study, and were presented to show their contrast. These selected methods are presented in Chapters V and VI, respectively.

Those points and ideas which were indicated by this study to make the greatest contribution to the development of thinking, are combined in Chapter VII to produce a flexible and cooperative method of instruction to develop the individuals thinking ability as well as his manipulative skills. The importance of thinking, as a part of every industrial arts course, may be exemplified by viewing the objectives of industrial arts, which are presented in the next Chapter.

CHAPTER IV

OBJECTIVES OF INDUSTRIAL ARTS

In general, the objectives of Industrial Arts are similar to those of General Education, and help to make efficient and socially worthy instruction possible. They are consistently in close relation to the Seven Cardinal Principles of Education, which are:

1. Health
2. Command of fundamental processes
3. Worthy home membership
4. Vocation
5. Citizenship
6. Worthy use of leisure
7. Ethical character [1]

"Thinking" could very well be listed as the eighth Cardinal Principle.

Through the democratically organized and operated Industrial Arts courses, and various combination of emphasis and influence by the instructors, attempts are being made to maintain a cooperative balance and relationship between the Industrial Arts objectives and the Seven Cardinal Principles of Education.

Health instruction should be included in the Industrial Arts course by the effective use of physical activities and healthful habits. A disregard for health during the secondary school years, can be very serious for the individual, and for society.

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[1] U. S. Bureau of Education, Bulletin No. 35. Washington; U. S. Government Printing office. 1937, p. 9. Requoted by N. L. Bossing, "Principles of Secondary Education" p. 117. The Seven Cardinal Principles of Education were proposed in 1918 by the Commission on the Reorganization of Secondary Education, which was a committee for the National Education Association.

A major objective of General Education must be its adaptability to a fast changing environment. As that part of General Education which deals with industry and industrial concepts, Industrial Arts must accept a major portion of the responsibility for this adaptability to a fast changing environment. To give our youth the necessary background, and to prepare them for the adult requirements of our modern world, we must instill in the students, an attitude which will enable them to honestly contribute something to the improvement of their plane of living, and to their community. Only through planned and purposeful instruction can this be effectively done.

The value of art and aesthetic appreciation becomes evident in various forms of behavior change. The Industrial Arts courses must instill a growing sense of appreciation for beauty of color, design, and style, and a sincere appreciation for skill in workmanship.

Social education is nearly as important as any other objective of general education. In our modern society, we are continually coming in contact with other people; no matter where we work, or where we play, there are always other people involved. It is well to remember that more people loose their jobs for not being able to get along with their fellow-men, than from lack of job skill. The system of students working together, and planning together in an industrial arts course, is one of the most effective means of aiding the student to become adapted to the requirements of adult life.

The recreation of body, mind, and spirit are essential to the individual's development. Guiding and helping the individual use his leisure time, are means of enriching and enlarging his personality for adult life.

In modern terminology, "instruction is a means of bringing about a better social order through developing, in each individual, the right habits of conduct, appropriate patterns of thought, and worthy ideals that shall serve as goals and standards of achievement."[2] This is of great importance in the development of the whole individual. These habits of conduct, patterns of thought, and ideals can be definitely influenced and developed through the cooperative methods of planning and conducting the Industrial Arts program, where the students learn to accept and respect the judgment of others, as they think and work out their plans together.

Any process of thinking or acting becomes a habit, if it is performed often enough. A habit is a process that can be performed without thinking, but usually requires a considerable amount of thinking to perform the task many times before it becomes a habit. For the reason that habit formation does aid the development of thinking through this process, the formation of good and worthy habits should be encouraged by the instructor.

The student must also be encouraged to think creatively and critically. To be creative does not necessarily mean to be

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[2]Stuck, Ferdinand T., Creative Teaching. New York: John Wiley & Sons, Inc., 1938. p. 71.

an inventor of great scientific fame, although it is an example of high creative ability through the process of experimental thinking, which is well illustrated by Wilber:

> Advancement in industry still continues in a small way by experimental thinking by an unknown and obscure workman. Basically, his process is the same as in the great laboratories and testing departments of great corporations: a problem is recognized, a guess is made concerning a solution, and then this hypothesis is put to test. If the results are in keeping with the guess, or hypothesis, a discovery is made, and civilization advances.[3]

This process of analysis indicates the application of thinking critically, experimentally, and creatively. It indicates that a society's ability to advance and progress depends, at least to some extent, upon the ability and willingness of its members to do critical and creative thinking.

Creative ability may also be on a much smaller scale, in which more individuals are directly involved, and may be just as important to society. Most of the common tools and machines, as we know them today, have been improved by creative thought and work, sometimes centuries after being invented.

The creative attitude and ability must be developed in industrial arts courses through the encouragement of individual thinking, and the developing of concepts. True creativeness is a product of self-initiated thinking and acting, with self-motivation and self-discipline, to which the instructor must add interest, inspiration, and guidance.

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[3]Wilber, Gordon O., Industrial Arts in General Education. Scranton: The Haddon Craftsmen, Inc., 1948. p. 21.

The development of concepts and perspective thinking are very important in any form of creative work. The showing or seeing relationship of angles, is a simple and effective use of concept and analysis. The contrast in the angles of the teeth of the hand rip-saw and the hand cross-cut saw in relation to the angle at which they are held for sawing is a practical example. The judgment of quality may face the student as he tries to decide whether to use hardwood or softwood for his project, and whether to use an oil stain or a water stain. The judgment of quantity may determine how much paint to buy for a given job, or how many pounds of nails to buy. The judgment of time and speed are very essential to everyone nowadays, with so many high speed automobiles in common use; or how many hours will be required for building a project. These concepts must be among the aims in planning Industrial Arts courses.

To a very large extent, the development of these, and similar concepts, are part of the requirements for adaptability to our fast changing industrial society. They are best developed by continuous study, analytical thinking, and consistent practice.

As a vocational exploratory course, industrial arts must make available to the pupils sufficient occupational information that they may wisely select their life's vocation. This information should include such items as preparation, qualifications, duration, compensation, hazards, and problems of the various vocations in which any of the pupils have interest

or ability. In each instance, emphasis must be placed upon the importance of thinking, as well as on manipulative skills.

The common methods of teaching that are covered in Chapter V illustrate some of the various ways in which emphasis is placed upon the development of manipulative skills, and the lack of emphasis upon the development of thinking.

CHAPTER V

COMMON TEACHING METHODS

Through the delegation of routine jobs or procedures, the common methods of teaching industrial arts courses place emphasis upon various manual operations, and the knowledge of tools, materials, and procedures. This is very good, as far as it goes, but it does not go far enough. Industrial arts covers such a broad field of so many industries in such a short period of time that the development of skill is not a major objective. This is clearly brought out by Brawden in his statement: " Industrial Arts courses are a part of General Education, and do not have a distinctly bread-and-butter justification."[1]

As a part of General Education, industrial arts courses must provide the student with the ability to adapt himself to a fast changing industrial society. This can best be done through purposeful planning to set up a learning situation whereby the student finds the need and the desire for self-motivated and self-initiated thought and action. This is explained by Stuck in his statement:

> We must strive to bring out and strengthen in every way possible the kinds of imagination that make for improvement, refinement, and betterment, as distinguished from satisfaction with present ways and standards. This is done by showing interest and encouragement in creative thought and work, by recognizing the spirit that promoted

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[1]Brawden, William T., "Early Concepts of Industrial Arts." Industrial Arts and Vocational Education, June, 1952. p. 183.

> the activity and by guiding learners so that they will strive persistently to develop their latent capacities. Creative and productive imagination frees us from the common place, and enables us to weave old experiences into new patterns of thought and of behavior.[2]

The following common teaching methods are considered in this chapter; Written Instruction Sheets, The Modified "Four Step Method," and The Assigned Project Method. Each method is considered separately, having a brief description of the method and comments regarding its advantages and major disadvantages relating to the development of thinking.

Written Instruction Sheets

There has been a common tendency among Industrial Arts instructors to plan their courses through the medium of Instruction Sheets. This type of planning requires considerable thinking on the part of the instructor, but not very much on the part of the student.

These written instruction sheets have the advantages of being simply and effectively written, and are likely to be more accurate than impromptu oral instructions because they have usually been revised several times and proven to be complete and accurate instructions.

The purpose of the written instruction sheet is to give a direct step-by-step procedure for completion of a project. It is not the least bit uncommon to find included in the instruc-

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[2]Stuck, Ferdinand T., Creative Teaching. New York: John Wiley & Sons, Inc., 1938. p. 576.

tion sheet, a detailed description of how many nails to use, what size of nail, what kind of nail, and how far apart to place the nails, as well as an explanation of how to hold the hammer while pounding.

It should not be difficult to realize that this type of instruction emphasizes completion of the project. If any thinking is done by the student, it is purely coincidental. Some of the major limitations of written instructional material, as stated by Wilber are:

1. It is difficult to prepare "good" written material,
2. It tends to "set" the course in a definite pattern and discourages change,
3. Its effective use depends upon careful reading, and
4. Some of them tend to provide a substitute for thinking.[3]

When all of the answers are given on the instruction sheet, there seems to be little desire or need on the part of the student for thinking and planning.

The Modified "Four Step Method"

The "Four Step Method" of instruction has been used, in various modified forms, by many Industrial Arts instructors. When used in its entirety, it is a very effective method of developing thinking among the students, but that will be covered in a later section. Only the modified forms will be considered here.

Perhaps the greatest modification of the "Four Step

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[3]Wilber, Gordon O., Industrial Arts in General Education. The Haddon Craftsmen, Inc., 1948. p. 160.

Method" produces the simplest form, and is the least effective. It is used when the instructor feels that the material should be presented, but he must hurry through it so he can get something else done. Maybe a few students are ready for the material, or maybe he doesn't want to get behind on his schedule; but the results are the same either way. A rushed-through and half-hearted presentation is almost as bad as no presentation: in fact, in many cases, such as instruction for the operation and care of a complicated piece of machinery, it may be worse. Its simplest form is as follows:

1. Introduction - state the objective,
2. Demonstrate - perform the operation,
3. Application - assign students to the job,
4. Follow up - grade work.

This "simplest" form of the "Four Step Method" is the simplest to prepare and to perform, and it gives the simplest results. No doubt the instructor thinks that the students are bound to get something out of it, which they no doubt do; but very little has been learned, and very little thinking was done by the students.

One of the main reasons for this lack of student thinking is the lack of motivation, which is one of the basic essentials for learning. Motivation should have been stimulated, and student interest created, by tying the new information and process to information and processes already known, by illustrating large scale and other practical applications within the students interest, and by asking questions throughout the demonstration that

are directed towards developing thought. The development of thinking must be done through purposeful planning.

Assigned Projects

The system of assigning definite and specific projects for the students is sometimes used when the shop is very limited in space, facilities, and equipment. This system does provide construction of only those projects for which the shop is equipped, and can be planned by the instructor to provide every student with a limited amount of manipulative skill in such jobs as making dowel joints, plaining a board, and similar exercise jobs. It is under strong pressure of its limitations to practice, at least to some extent, the old theory of stressing conformity, regimentation, and standardization.

Under this assigned project system, limited thinking may be encouraged, but the limitations are too definite. A project without boy interest or desire has little chance of receiving whole-hearted enthusiasm or motivation. Without motivation, there is not likely to be very much purposeful thinking by the student.

Regardless of apparent shop facilities, a student should be able to select, plan, and build his own project. The apparent facilities of a shop are never equal to the potential facilities. To plan a project, the student must think it through to arrive at a definite pattern of procedure, and materials. Through the encouragement of critical, creative, and analytical thinking,

the apparent facilities might more nearly approach the potential facilities, by devising a few rather ingenious methods of utilizing some piece of available equipment. An example of this might be to use the circular saw as a sanding device, in the absence of a standard sanding machine, maintaining of course, a strict consciousness for emphasis upon safety precautions.

In every Industrial Arts course, one of the major objectives should be to set up a learning situation for the pupils to work out their own problems, and their own projects, with the help and guidance of the instructor. Brown particularly stresses the need for teacher guidance:

> If the shop is to be more than an unplanned adventure, if definite worth-while goals are to be worked toward, then "Teacher guidance" must be available all along the way and it is the instant availability to the student of this guidance which determines how a shop "stacks up" as a learning situation.[4]

Summary

This chapter has shown how the common methods of teaching Industrial Arts courses emphasize the development of the routine manual skills, and neglect the development of student thinking and planning. Since industrial employment, except for assembly-line production, seldom includes such clear-cut procedures for every task, and since every-day-living presents new problems requiring solution, it becomes apparent that the adjustment to

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[4]Brown, Everett M., "Picture Boards Help Students Learn To Think and Plan," Industrial Arts and Vocational Education. September, 1951. p. 270.

adult life necessitates that these courses provide the student with the opportunity to face problem situations and to solve them by thinking and planning. In the following Chapter four methods of instruction are covered which do provide problem situations, and aid the development of thinking through problem-solving.

CHAPTER VI

METHODS THAT DEVELOP THINKING

The four methods of instruction covered in this Chapter are: Visual Aids, The Job Report, The Four Step Method, and The True Confession. Each method in turn is explained, and the major disadvantage is included, along with the major advantages of the method in aiding the development of thinking.

One of the strongest objectives of the industrial arts course, should be to set up a "learn by thinking" situation in the shop. The boy should be able to plan his own project, select his own course of action, and complete his project with the satisfaction that it is his own creation. "While the old belief concerning instruction stressed conformity; breathed regimentation, and featured standardization; the modern belief stresses initiative, self-development, and recognition of individual differences."[1]

Since the recognition of a problem is the first step in any thinking process, Industrial Arts courses must continuously present to the student some problem situations which require solutions. The students must be given every opportunity to solve their own problems, and must be encouraged to do their own thinking.

Thinking and problem solving can be encouraged by the use of drawing room and library in conjunction with the shop. By

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[1]Stuck, Ferdinand T., Creative Teaching. New York: John Wiley and Sons, Inc., 1938. p. 71.

having the regular drawing room and equipment as a separate room of the shop, the students will be more inclined to plan their projects through neat and accurate drawings. The shop library should contain an adequate number of trade books and magazines, where the students can look for ideas, and broaden their knowledge.

The Visual Aid method of instruction, which follows, is a practical "learn by thinking" situation for solving problems by contrast and comparison.

Visual Aids

Visual aids of various types have been used quite extensively in Industrial Arts courses, but developments during World War II have drawn new attention to their increased effectiveness. Visual aids may be defined, in a broad term, as: Any type of visual stimulus used to supplement instruction by the spoken or printed word. A few of the most common visual aids, or teaching aids, being used are: motion pictures, slides, photographs, and bulletin boards.

According to Brown the requirements of a perfect teaching aid are:

1. It must be instantly and continuously available to one student, or to many students, and it must not block the use of other aids;
2. It must not depend upon words for instruction, yet it must so interest the beginner that every step is crystal clear to him;
3. It must be light in weight, and easy to carry;
4. It must be entirely complete in itself; and

5. It must be permanent, easily taken out and put away, and be reasonable in cost.[2]

He used a series of 4" by 4" photos taken at important intervals during the building of some major project, these photos were then mounted on a series of panel-boards for the students to consult. By studying the photos, thinking about the change from one photo to the next, the students could figure out the necessary procedure. If the students do get into trouble, the teacher can usually help them for one or two minutes, and straighten out the trouble. Some of these aids that Brown has developed, run as high as 130 photos in the series. The two big disadvantages, obviously, are the time required to develop a series, and the fact that each project requires its own series of pictures. This system certainly does set up a learning situation, and requires student thinking by association, contrast and comparison.

The Job Report

Another method of instruction which has been used to create a thinking situation is the " job report." The student starts this report before he begins construction of the project, and adds to the report as he progresses with the project. The essential features of this job report, which is practical and readily adapted to any project, are shown by Bushfield:

1. Name of the job,
2. Why the job is undertaken,
3. Operations listed in sequence,

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[2]Brown, Everett M., "Picture Boards Help Students Learn To Think and Plan," Industrial Arts and Vocational Education. September, 1951. p. 271.

4. Tools required,
5. New trade terms and definitions,
6. Provide a sketch, drawing, or diagram of the job,
7. List of technical topics or scientific and mechanical principles involved,
8. List the safety precautions,
9. List the references used in the report, and
10. Make a proper record of the job.3

The job report requires some time on the part of the student, but it does stress the development of concepts and the aspect of analytical thinking. The student must plan his job so that he knows clearly the steps of operation and their sequence; he becomes familiar with the trade terms and definitions, develops perspective thinking by making his sketch or drawing, becomes conscious of the safety precautions, and becomes familiar with the technical topics and the scientific or mechanical principles which are involved in the job. The Job Report also correlates his shop work with his other school subjects. His hand work becomes directly associated with English, writing, drawing, and physics. On a project of his own choice, by self-motivation, a learning situation is present, and he is eager to solve his problem.

The Entire Four Step Method

The "Four Step Method" of instruction has been used quite extensively in Industrial Arts courses. When used in its entirety, it is a very effective creator of a thinking situation. When

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[3]Bushfield, Gordon, "Individual Instruction," Industrial Arts and Vocational Education, March, 1930. p. 339. Requoted by F. T. Stuck. p. 189.

only part of it is used, as explained in the preceding section, it may be worthless as a means of encouraging and developing thinking.

Following, is an example of the effective "Four Step Method," in its entirety as shown by one author:

1. Introduction - state the objective, the why, tie new to old, stimulate the student, show some enthusiasm, use examples and exhibits, put the class at ease, don't waste time.
2. Demonstration - perform the operation, give an example, based on job breakdown, a step-by-step procedure, go slowly, emphasize important points, don't forget safety, repeat by points.
3. Application - assign student to job, have steps of procedure available for reference, assist where necessary, walk the beat, circulate among the class, repeat parts of demonstration, see that the step-by-step procedure is followed.
4. Follow up - check and double check, test, grade work.[4]

When used in this entire form, the Four Step Method of instruction develops thinking in several ways. By tying the new information in with knowledge and procedures already known, the student is reassured by familiar ground, and can see some practical application for it: he becomes interested and motivated. When application immediately follows the demonstration, retention is best. With the instructor ready to assist when necessary, the chance of a wrong application is decreased, and the student is on his way to correct learning. As he applies the learning a few times, and is encouraged by favorable checks, he will venture into new applications of thought and action.

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[4]Bond, Troy C., "Lesson Planning," Industrial Arts and Vocational Education. November, 1953. p. 297.

The True Confession

A True Confession written on each project is a variation of the job report, which was already mentioned, but is worthy of separate notification. The True Confession, as used by Wright,[5] contains the following items:

1. Students name and the project name,
2. List procedures and processes of the project,
3. List mistakes made on the project.

By listing the procedures and processes of the project before actual construction begins, the student develops the habit of planning his work and analytically thinking about each component part, separately as well as in relation to each of the other parts. As each successive project is undertaken, the student should develop greater efficiency in thinking-through and planning his work.

After the project is completed, the student must study it and find his own mistakes, which he lists on his true confession. With the help of the instructor, the student then checks his procedures and mistakes, and corrects them. By comparing each confession of a student with his last one, it is easily seen whether he made the same mistake each time and shows his main source of trouble.

When the student fully realizes his own procedures and mistakes, and makes his corrections, with the aid of the instructor, he has been through a real learning situation. The

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[5]Wright, William R., "Correlating Industrial Arts with the Academic Studies." Industrial Arts and Vocational Education. April, 1953. p. 145.

use of this true confession is a strong motivation for the student to think more critically and more analytically as he plans and constructs each succeeding project. As his self-confidence increases, so will his perspective increase, and his concepts of size and shape, and his judgment of quantity and quality.

Summary

This Chapter has covered four methods of instruction that do aid the development of thinking in Industrial Arts courses. It has shown how each method provides a learning situation for the successful solution of practical shop problems. When these methods of thinking and planning are followed throughout the Industrial Arts courses, it seems reasonable to assume that their favorable characteristics will be transferred to the solution of similar problems in adjusting to adult life.

The following Chapter combines some of the authors ideas with some of the most favorable and practical ideas of those methods that develop thinking. The result is the "Diat" Method of Instruction which is presented as a suggested method of developing student thinking ability, as well as manipulative skill.

CHAPTER VII

The "Diat" Method of Instruction

During this study of Developing Thinking in Industrial Arts, the writer has gathered some very important and practical information, concerning Industrial Arts instruction and learning. From the material covered, the writer has selected those points and ideas which made the greatest practical contributions to the development of thinking in students in industrial arts courses, and has combined them to form a comprehensive program. Since every method and program must have a name, the writer has chosen to call this the "Diat" Method of Instruction; taken from the initials of Developing Industrial Arts Thinking.

The "Diat" Method of Instruction is composed of four major sections;

1. A combination shop-library and drawing room,
2. All demonstrations by the Four Step Plan,
3. Picture board learning aids,
4. Job confession reports.

The "Diat" Method of Instruction is a flexible and co-operative program for developing the "whole individual" so that he may more readily adapt himself to our fast changing technological and industrial environment, and to society. By the instructor showing interest and encouragement in the learners creative thought and work, by recognizing the spirit that prompts the activity, and by guiding the learner so that he will persistantly strive to develop all his capacities, he will develop

habits of critical, analytical, and creative thought to establish within himself a creative and productive imagination.

The first major section of this Chapter covers the shop-library and drawing room, which are of major importance in providing a learning situation. Through acquiring ideas and suggestions from the library material, through drawing-board try-out and application, the student visualizes and plans each phase of his project.

The Library and Drawing Room

The library and drawing room may be separate rooms, or combinations, depending upon the size of shop classes, and the space available. In either case, they shall be within the shop area, or in adjacent rooms, easily accessible to the students. Through this arrangement, the student will more readily accept them as a part of the shop program, and use them to greater advantage.

The library shall contain as large a selection and scope of books and magazines as possible. Current literature of importance to this type of library may include, the scientific, mechanical, and hobby magazines, as well as trade journals, and various manufacturers publications. By having this literature continually available, the students may brouse through it to keep informed of happenings and potentialities within the field. The literature will also be first hand source of reference material for new project ideas, or improvements. This atmosphere is a contributing factor to a self-motivated learning situation.

By having a moderately equipped drawing room in conjunction with the shop, and easily accessible, the students will feel free and willing to make increasingly neater and more accurate scale drawings and sketches of their projects. Through the correlation of drawing and constructing, with instructor encouragement on originality, the student shall progress towards a perspective vision with a creative ability to think for himself.

Demonstration By The Four Step Plan

All demonstrations, whether group or individual, shall be given by the entire Four Step Method, with special emphasis placed on student participation through consistent questioning directed to student thinking by analysis. The following Four Step form will be used:

1. Introduction - state the objective, the why, tie new to old, stimulate the student, show some enthusiasm, use examples and exhibits, put the class at ease, don't waste time, ask thought promting questions.
2. Demonstration - perform the operation, give an example, based on job breakdown, a step-by-step procedure, go slowly, emphazise important points, ask questions, don't forget safety, repeat by points.
3. Application - assign student to job, have steps of procedure available for reference, assist where necessary, walk the beat, ask questions, circulate among the class, repeat parts of demonstration, see that the step-by-step procedure is followed, allow several applications.
4. Follow up - question for retention and new application, check and double check, test, grade work according to stated objectives.

The continuous use of thinking questions, such as how, why, and what next, will help retain student interest, and will

keep him thinking in terms of the separate parts being related to the whole process. Correlation of new and old information with other courses of study, will also be a major aim.

Picture Board Learning Aids

The picture boards give a definite encouragement to student thinking by contrast and by comparison. Also, they allow the instructor to circulate more and help those students that need the most help, which is a main factor in meeting individual differences.

Picture boards will be developed for some of the difficult projects that are often built in the Industrial Arts course, such as desk construction, coffee-table construction, and separate joint construction.

The first step in developing a picture board, after selection of a project, is to plan carefully and exactly, how each photo will be taken. This may require several hours of out-of-school planning. According to the plan, numerous photos will be taken at appropriate intervals during the actual project construction, and may be done largely through the students. After the project is completed, and all photos have been developed, they will be mounted on pieces of plywood, hinged together in the form of a book. A very satisfactory arrangement, for a large project may be 24, 4 x 4 photos on 18 x 26 inch plyboard panels. The number and size of panels may be determined by the project, and each project requires its own picture board series.

As the student builds his project, he places the picture board nearby so that he may consult the photos to guide his procedure. Although the instructor may be consulted on occasion, the student learns in general to proceed by himself. The board may be used by one student, or by several students at a time.

Through the process of thinking by contrast and comparison of successive photos, the student can determine the suggested steps of procedure. This does not provide as rigid a form of procedure as some people might think. No picture will produce the same interpretation to everyone; creative and analytical thinking may produce an abundance of progressive thoughts.

The Job Confession Report

The Job Confession Report provides an outstanding learning situation through integration of curriculum, practice in phrasing thoughts, developing broader interest with the technical fields, safety consciousness, and critical analytical thinking to evaluate ones own project in honest competition with himself.

The Job Confession Report consists of the following items:

1. Student and project names,
2. List of operations, planned in sequence,
3. Make a sketch or drawing of projects,
4. List new trade names encountered, and explain,
5. List technical and mechanical principles involved, and give their references,
6. List safety precautions to be observed,
7. List mistakes made on the project.

This report is started before actual construction begins, and the student adds to the report as his project progresses. When the project and the report are completed, and corrected

with the instructors assistance, the job confession report is kept on file by the instructor for comparison with future projects by the student, and then analized for areas needing special attention.

Student and Project names. The student and project names, are, of course, needed only for identification purposes, and should be placed on the report as soon as the project is started.

List operations in sequence. To promote critical thinking and thorough planning, this part of the report must be made before the project begins, although it could proceed with the drawing. This thorough planning of the project requires the application and development of analytical thinking through the study of the individual parts in relation to the whole project.

Make a sketch or drawing. A sketch or drawing should be made to scale, and may be made along with the plan of procedure for the project. By developing these two parts together, a better perspective is reached, and clearer concepts of hidden lines, size and shape contrasts, and judgment of quality are developed.

List Trade Terms. By listing all new trade terms as they are encountered, and listing their identities, a keener interest and knowledge of the trade is established.

Technical and Mechanical Principles. By listing the technical and mechanical principles involved in the project, and noting their reference for future use, the student broadens his

technical and mechanical knowledge. A broad background is to be encouraged, as it is essential to good creative and analytical thinking, which soon includes new application of old ideas.

List Safety precautions. By listing all safety precautions which might be encountered in the project, an attitude of safety consciousness is developed which becomes a grave asset to society, and to the student. The safety conscious attitude develops a habit of critical thinking in terms of safe practices and procedures.

List mistakes made on the project. Through analytical and evaluative thinking, the student finds his own mistakes, then with the help of the instructor, he corrects them. This is almost an ideal learning situation, which the instructor must continually strive to maintain on a cooperative basis.

On first appearance, the "Diat" Method of Instruction may indicate too little emphasis left upon the development of manipulative skills, but this is not the case. Instead of taking something away from the development of manipulative skills and giving it to the development of thinking, the "Diat" Method of Instruction strives to bring in and develop self-motivation and interest so the student will exert more effort. In fact, the writer believes that the development of analytical and creative thinking will also improve the efficiency of learning the manipulative skills.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

As a part of General Education, Industrial Arts must accept a major part of the responsibility for developing the "whole individual" so that he may more readily adapt himself to our fast changing technological and industrial environment, and to society. Various articles in the recent professional literature indicates that some Industrial Arts instructors are conscious of the lack of originality in Industrial Arts projects, and progress is being made to enrich the courses through integration with the fine arts.

In the belief that most Industrial Arts courses placed too much emphasis on the development of manipulative skills, and very little emphasis upon the development of learning to think, the writer decided to study the problem of manual vs mental. In this study, several common methods of instruction emphasizing mechanical skills, were compared with several methods emphasizing thinking.

As a result of this study, the writer selected those points and ideas which made the greatest practical contributions to the development of thinking in Industrial Arts courses. These favorable and practical ideas were combined to form a program of instruction to develop student thinking, along with manipulative skills, as a major part of the industrial arts program. Student interest is maintained through choosing and developing one's own project. Self-interest and self-motivation are essential

features of a learning situation, and are consistent aims of the "Diat" Method.

The "Diat" Method of Instruction is composed of four major sections:

1. A combination shop library and drawing room,
2. All demonstrations by the Four Step Plan,
3. Picture board learning aids,
4. Job Confession Reports.

The "Diat" Method of Instruction is a flexible and co-operative program for developing the "whole-individual" so that he may successfully and more readily adapt himself to a full adult life in our modern industrial world. By the instructor showing interest and encouragement in the learners creative thought and work, by recognizing the spirit that prompts the activity, and by guiding the learner so that he will persistently strive to develop all his capacities, he will develop habits of critical, analytical, and creative thought to establish within himself a creative and productive imagination. These are major aims of the "Diat" Method of Instruction.

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