TO DETERMINE METHODS OF PLANNING MORE EFFECTIVELY WITH STUDENTS IN SHOP WORK

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TO DETERMINE METHODS OF PLANNING MORE EFFECTIVELY WITH STUDENTS IN SHOP WORK

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By

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CHAPTER I

INTRODUCTION

The Problem

The selection of this problem is the result of a careful consideration of the purposes for the study and the need for the information it should reveal. The author graduated from North Texas State Teachers College in June, 1938, with a major in industrial arts and a minor in social science. During the four years' work leading to a bachelor of science degree, the work in the major field consisted of classes in woodwork, mechanical drawing, and metal work. While attending school in the summer of 1938, employment was secured to teach industrial arts in Beaumont, Texas, at a junior high school. The work at Beaumont consisted of woodwork in the seventh and eighth grades and, in addition to this work, the coaching of seventh grade athletics in the afternoons.

The chief difficulty in working with junior high school boys in woodwork centered around the lack of an adequate drawing of the jobs from which the boys could work. The general nature of the work allowed the students to choose their projects, but they were limited to simple jobs until they were capable of doing more advanced work. The very limited kinds of material and the few machines
available required them to make small projects. It was
difficult to keep advanced students interested for a sem-
ester on small projects, while the beginning classes which
worked one half of the semester maintained their interest.
It appeared that the beginning classes, which used small
patterns and tracings, made faster progress than did the
second-year woodworking classes, which worked by remem-
bering the size, shape, and dimensions of their jobs from
blueprint books, pictures, and partial drawings, as pat-
terns of larger projects were not available.

At the end of the first semester the place of employ-
ment was changed to teaching woodwork in a junior high
school in Austin, Texas. There was not so much difficulty
encountered here as there had been at the junior high
school in Beaumont.

Several factors were involved in the lack of diffi-
culty in planning and in the lack of an adequate drawing
to refer to while working on the jobs. They are as fol-
lows:

(1) Students in the sixth and seventh grades began work
in exploratory courses in woodwork in which they remained six
weeks. This type of course enabled them to keep up their
interest and to work steadily and willingly on a few pro-
jects which could be completed and the finish applied in
this period of time.

(2) Students had access to several models of small
projects and to the use of patterns in laying out parts for their jobs.

(3) Very little planning and no drawing was necessary, as most of this work was set up for the students.

This lack of knowledge about planning and drawing seemed to carry over into the students' advanced classes of woodworking. It was difficult to get them to make adequate drawings from which to work and drawings which were adequate for the teacher's use in assisting the student to the best advantage.

In the fall of 1939 the teaching position was changed to Brownwood, Texas, where woodworking and mechanical drawing were taught in the junior and senior high schools. There were both junior and senior high school boys taking beginning work, and the same difficulty of getting boys to make drawings existed. The senior high boys did not want to make beginner's projects in order to attain the basic principles of woodworking. Instead, they wished to start on more advanced jobs before they had become acquainted with hand tools and had acquired enough skills and knowledge to use them. The older boys were reluctant to start on the same type of small project with which the younger junior high boys began. It was difficult to get the boys to make an adequate drawing from which to work except when they were taking both woodworking and mechanical drawing. Through a
combination of these two classes the problems were worked up in the mechanical drawing class and executed in the woodwork class.

These two years' experience led the author to believe that if he were to continue teaching and to make progress, an additional degree was needed. The next step was enrollment in the graduate school at North Texas State Teachers College in the spring semester of 1941. In discussing the possibilities for a suitable thesis subject with members of the staff of the Industrial Arts Department, it became apparent that it would be desirable to choose a problem which would fulfill the thesis requirement of the graduate school and which would also provide an opportunity for the author to do work which would be instrumental in assisting him to become a better teacher. In attempting to choose a problem that would provide these opportunities, the author listed problems that had been encountered during previous teaching experiences.

The following indications of problematic situations were found:

1. Boys were wasteful of materials in cutting out the parts for their projects. This practice was caused by their failure to have the exact dimensions at hand and, in some cases, their failure to have the design and the best proportions worked out in detail.
(2) The boys became discouraged and stopped work before the jobs were completed. This fact was due to their failure to consider the time element by adequate planning and to be thoroughly satisfied with the project started.

(3) The boys often chose problems that were too difficult, because they failed to recognize the skills and fundamental principles required in working out the details. For example, they wanted to work on chests and similar pieces of furniture before acquiring the basic principles on smaller projects that afforded all the details of larger jobs.

It appeared that the boys' most pertinent problem was to make a drawing of the job they selected. In searching for a practical way to solve this problem, it was decided that the best method would be for the author to work with a class of boys in the shop, where observations could be made and procedures tried out. This opportunity was afforded in the shop of Demonstration School, where the student teachers received their experience under the direction of a member of the Industrial Arts Department of the college.

Situation Prior to Study

Upon examination of a number of the reports of the student teachers' experiences in the fall semester of 1940, the lack of good planning and an adequate drawing
by the student was found. By talking with the supervisor of student teachers of Demonstration School classes, a further investigation of this situation confirmed this belief. One of the teachers' major problems was getting the students interested in some job and then maintaining that interest. Another was the proper organizing of students into groups for the work in which they were most interested. This problem caused a great deal of unnecessary changes on the part of the pupil. For example, when a student lost interest in his project he was allowed to change to another, even if it meant going to another student teacher's section. A third problem was the fact that students wanted practice teachers to do the work to be done on machines for them. Many also wanted to use machines before they were capable of handling them.

The greatest problem, as has been mentioned, was to get students to plan their work effectively and to make an adequate drawing. Some indications of this situation were:

1. Students asked for too much assistance and made costly mistakes.

2. They lacked variety in projects.

3. They started jobs requiring materials which were not in the store room.

In further study it was found that authors who have dealt with similar problems have also expressed this need
for further development in planning among students in their shop work.

William T. Bawden, director of the Manual Arts Committee on Publications, very aptly substantiates in his book, *Industrial Arts in Modern Education*, that this problem exists. He said:

It is only through well-planned and deliberate purpose that situations can be set up in connection with subject matter which will provide for the development of traits which are not directly related to the subject matter but grow out of the practices and points of view developed in handling the subject matter. Self-reliance is not an essential part of a job; its development will depend upon how the job is handled. Pride in workmanship is not a part of the instructions on a job; it comes as a result of a job well done. The habit of industry is not a part of any job; but every job affords an opportunity to give training in it, if that is made a part of the plan.1

The validity of this statement emphasizing the importance of effective planning is expressed by S. A. Hamrin and C. E. Erickson. They advocate that in assisting students with the planning we employ both group and individual techniques in collecting information through such devices as tests, questionnaires, sketches and drawings, individual observations, and an analysis of their individual purposes for the job.

All of these activities contribute to the students' ability to plan. As a member of a group, the student has learned much about possible educational and vocational

opportunities; this information is an essential element in all planning, along with giving students information about themselves and assisting them in thinking through the relationships of their abilities and interests to the opportunities available. Planning and adjustment are as interwoven and interdependent as are individual and group techniques.2

People react differently to situations as do students to types of procedure involved in planning. A student with a background involving satisfactory experiences similar to shop work, or who has had some industrial arts classes, will require less assistance in his procedure of planning than will the student who has had unsatisfactory or none of these experiences, and who is taking an industrial arts class for the first time. These facts will be substantiated in this study.

Purpose of the Study

Due to the difficulties and inadequacy of student planning present in the field of industrial arts in the public schools, it has been deemed worth-while to analyze these factors as nearly as possible. This study tries to evaluate more effective ways of assisting students in planning their jobs. One of the values to be received from such a method would be to enable the student to be

self-directive in his projects in such a way that he may adapt himself in life to situations that he meets. Another should enable students to set up a cooperative participation in shop management. A third value which may be realized is that each student may develop an appreciation of good workmanship and good design and also develop in each student a feeling of self-reliance, confidence, initiative, judgment, reliability, and the habit of self-discipline. The purpose is revealed in three stages and is described in this study as it was conceived by the author at each stage. The statement of purpose in the third stage was the one that finally became the purpose for the whole study. The other statements are given to show the developing process which took place in the mind of the author as he worked on the problem.

Statement of the Problem

In order to discover more effective ways of assisting students with their planning in industrial arts classes, this study deals with the related problems of junior and senior high school boys and their teachers. Very careful planning must be used in order that students may secure learning through their experiences and the guidance of their teachers. The teacher has to offer the best he has in terms of philosophy and reflective thinking toward the solution of the problem of planning and working democratically with students and, at the same time, he has to develop
self-directive interests on the part of the pupil. This does not mean that the teacher has no decisions to make, nor does it mean that if he makes decisions he is therefore dictating. Therefore, the problem in this study is to determine democratic ways of causing students to engage in more effective planning before undertaking a job in industrial arts and to continue to plan effectively as they pursue the job.
CHAPTER II

BEGINNING PROCESS OF CONDUCTING STUDY

In considering ways of working on this problem, several alternatives were observed, both as to sources of information and to ways of getting this information from these sources.

First, there was a possibility of the questionnaire method, that is, sending questionnaires to successful teachers with the intention of getting their reactions to the problem. The disadvantages of this method were the inaccuracy involved in such reports, and the incomplete responses. It would also involve the setting up of hypothetical cases from the teachers' experiences.

The second possible source was reading from authors and recognized authorities dealing with the problem. This method fails to produce the actual experiences and involves the problem of variable opinions due to prevailing circumstances, the time the work was done and the validity of such work.

The third available method was the gaining of first-hand information by working with the Demonstration High School boys in the shop. The advantages of this method, combined with the apparent advantages of reading from recognized authorities, made this appear to be the most
desirable source of information.

Since one of the purposes of this study was to improve the author's ability as a teacher, it was decided that the third method of working on the problem was best suited to achieve this purpose in that the decision was based on the assumption that a person learns best by doing the job. This method was to be carried on in such a manner as to give the author the desired experiences and information without interfering with the work of the student teachers or pupils.

The Demonstration High School shop consisted of two divisions, one of metal work and one of woodwork. The metal work division was made up of two classes in which the beginning students learned to work with the lathe, forge, and tools used in sheet metal work. The use of the oxy-acetylene torch in welding was added to this work for the advanced students. The woodwork division also was made up of two classes in which the beginning students worked on the lathes and used hand tools, while the advanced students added work with machines. There were five student teachers, two for each division mentioned above and one for the girls, who worked with plastics and wood. The fifty students, twelve of which were girls, were from grades eight through eleven. This study deals with the twenty boys in the woodwork division, including both beginning and advanced students.
The boys were allowed to choose the division in which they wanted to work and to continue in that division until the close of the semester, unless their projects consisted of jobs in both divisions. Then, too, a student could change, provided he had finished his projects started in one division and had some jobs to do in the other division. This change was to be agreeable with the student teacher and the supervisor of teacher training.

Students were permitted to choose projects they wanted to make as long as their choice was within their ability to construct. The projects should be arranged in an instructional order that goes from the known to the unknown and from the simple to the complex.¹ As pupils achieved skills and abilities in handling small problems they might encounter, they were guided and assisted in accomplishing greater problems in more difficult projects.

The author first met with the student teachers and the supervisor of teacher training on the staff of the industrial arts department two weeks before the spring semester began. Plans for beginning their classes were discussed and suggestions were offered by previous student teachers for improvement in shop classes. One of the greatest problems which student teachers of the previous semester encountered was the fact that students changed from one division of industrial arts to another. It was decided that students did not do good work if they

¹F. T. Struck, Methods in Teaching Problems in Industrial Education, p. 54.
were divided into too many sections, such as crafts, woodwork, metal work, welding, lathe work, and art metal. These divisions were discussed and a better plan was evolved, as described in the preceding paragraphs.

Another pertinent problem concerned the type of drawings needed by the students. The students, supervisor of student teachers, student teachers, and the author decided that either the three-view working drawing or the pictorial drawing was satisfactory if the drawing had adequate dimensions to show clearly the shape and size of the project. A drawing is a universal language, by means of which the form, size, shape, finish, and construction of an object can be accurately and clearly described.  

Giesecke, Mitchell, and Spencer say, "Together, the drawings and the specifications are the instruments which enable the designer to convey his ideas to the builder, and which enable the builder and the owner to agree on a definite undertaking." Likewise, the student's drawing and plans enable him to convey his ideas to his instructor, and then it is possible for both to agree upon any changes for improvement in his project.

Schumann says,
The art of representing thoughts or objects on paper or other flat surface is as old as recorded

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3C. H. Schumann, Technical Drafting, p. 3.
history and probably as old as man himself. It may be done by writings or by drawings, or both. When it is necessary to transfer exact thoughts on paper, drawings must be used, often augmented by descriptive matter in the form of writing.

Still another method discussed was the advisability of having mechanical drawing as a prerequisite to woodwork. However, it could not be worked out in this situation. Therefore, we had to give the students the necessary instructions in drawing that they would need in working up their projects.

The question arose concerning the boy's ability to read a blueprint or a three-view working drawing accurately enough to use in working on the projects. This ability would have to be taught to the boys as they selected and drew up their plans for their jobs. Possibly this process would be met with disapproval from the student at first since actual work on his project would be delayed; however, it is the instructor's job to see that the student understands that he will save time in the end by learning and attaining the skill and ability to work from a drawing or a blueprint.

The plans for beginning the new semester were drawn up in the first group meeting of the boys, instructor of teacher training, student teachers, and the author. Among the first things discussed was the division in which the boy wanted to work, woodwork or metal work. It was greatly stressed

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that he should give this serious consideration, since he
was to stay in the division he chose until the end of the
semester.

The major part of this meeting was spent in having the
boys discuss and list the undesirable things that happened
in the class last semester. This list included such facts
as:

(1) Some of the boys wasted too much material.
(2) Part of them lost interest in their jobs and did
not complete them.
(3) A few projects were started that required more abil-
ity than the student had.
(4) Some of the work on projects was not well construc-
ted.
(5) Some boys started making projects out of unsuitable
material.
(6) A few visited around the shop and disturbed other
boys at their work.
(7) The attendance of a few boys was bad.
(8) At times they could not get help on their project
when they most needed it.
(9) Some students would insist upon too much help.
(10) Part of the students failed to get to use the lathe.
(11) Projects that were being glued would have the glue
clamps removed too soon.
(12) The finish room was not kept clean.
(13) Many boys did not return tools to the tool room.
(14) Some parts of the projects were misplaced.
(15) Student teachers would vary in their suggestions and decisions.
(16) There was a need for better cooperation among the students.

The boys who wanted to begin work with the machines had to make a trial project first in order to show their ability and knowledge of working with hand tools.

After listing these undesirable things that occurred the previous semester, there was a discussion in which the students and teachers began analyzing the reasons for these things and how they could be overcome. The next part of this study describes these difficulties, showing how they were carried on and presenting a tentative solution for overcoming them.

Some students wasted materials by not knowing what dimensions to square their stock and also by not having the correct dimensions in width and length worked out before cutting their material. Material was also wasted because the boys did not know the most suitable material to use for their particular project before beginning to cut out the stock. A few boys would saw out part of the material and then find there was not enough in the shop stock room with which to finish the work. This fact caused a loss of time in waiting for some material to be
brought in from the store room or having to begin again using some other wood. When the boys did not have their designs drawn out proportionately or their patterns cut correctly, material was again wasted. A tentative plan was discussed to prevent wasting materials. It was decided that a drawing of the job would give the students the correct dimensions to use in cutting out their projects. By having drawings they could work out their jobs in good proportions. Another aid in saving materials would be to plan the jobs adequately before beginning as to the most suitable material and to be sure that there was an ample supply in the stock room. A full size drawing would also be beneficial in getting a pattern cut out for irregularly shaped pieces.

Some of the boys lost interest in their jobs and did not complete them because they did not consider the cost element. After they had their project started, they found it was going to cost too much. By having each boy's bill of material figured according to his drawing before beginning the job, this difficulty could have been eliminated.

Some projects that were started by the boys required more ability and experience to construct and complete than they had. For example, some jobs would consist of several difficult joint and drawer constructions. In some instances they wanted to make larger furniture, but after beginning they found it too difficult. The boys then started on a small
job to become more skilled and experienced. This difficulty could have been avoided by their first making a trial project containing many difficult parts. On the completion of this project the student and teacher together could determine if the boy was capable of making larger projects, such as pieces of furniture. Adequate planning would also aid the boys in making difficult jobs.

Some of the work on the projects was not well constructed in that the joints did not fit well enough for the glue to hold the parts together. The project was not well proportioned and failed to have a nice appearance, nor was it well enough constructed to have adequate strength. These difficulties could also be avoided by adequately planning the jobs and by the teacher giving demonstrations showing the construction of joints.

Some of the jobs were not sanded sufficiently with sand paper to remove dents, surplus glue, and marks, in order to secure a smooth and even finish. Also, in assembling the job some pieces were not fit closely enough for screws to have good holding power or to pull together small cracks and openings. This fact was due to inaccurate laying out and improper fitting together before assembling the project. Students could have eliminated this difficulty by following their drawings more closely.

A few of the boys were in such a hurry to start their jobs that they did not find out the most suitable material
to use for their work. They cut part of their material and began work on it before finding the wood was too soft to be of best service in that particular project. Some of the boys wanted their projects to match the rest of the furniture at home, but before being sure it was suitable, they started getting out the material. Often they had to change, thus wasting the first pieces that had been cut. This difficulty could have been avoided by planning the purpose which their job was to serve and by matching the materials.

A few boys wanted to visit with other boys, disturbing them by asking insignificant questions, picking up tools and carrying them to other tables, insisting upon a conversation, sitting on work benches, and thus hindering them in their work. They would also wander about the shop, doing no part on their jobs. This was the result of a lack of interest and could have been remedied by more detailed plans. These plans would enable the student to have a definite procedure to follow in his daily work.

The attendance of a few boys was bad. They would miss a few days, and on returning they would need most of the period to get their project in mind well enough to continue their work. They also seemed to lose interest in their jobs because they did not progress as rapidly as the others. By failing to have a definite place to put their projects, the boys would return to find their jobs had several dents
and marks in them from glue clamps and contact with other projects. Articles left in the glue or finishing room would have to be moved several times during a certain period. The boys should assume individual responsibilities in making their projects, realizing that absences cause delay and that they can not finish their work as soon as the students who are present every day.

Often student teachers would have too many students to assist individually. This obstacle would cause delay, and time would be lost that could have been spent in working on the projects. For example, some boys wasted thirty or forty minutes of a period in waiting to have some small detail worked out before proceeding on their project. On the other hand, some students insisted upon too much help from the student teacher, who, in the end, would be doing part of the boys' work. This fact could be overcome by the pupils' having an adequate drawing and plan of procedure to follow, thus eliminating the necessity of receiving so much assistance from the student teacher.

Some boys monopolized the lathes by making all of their projects on it and therefore caused others to fail to have the opportunity for this experience. Since there were not enough lathes to accommodate all the students at the same time, students agreed to take "turns" on the lathes.

Glue clamps were removed from several projects before the material was properly glued and dried, causing a
dark streak in the work. This error also caused the job not to be square. In some cases, joints popped open and had to be rejointed and glued again. This difficulty could be remedied by more cooperation with students in other classes in removing clamps and by carefully moving objects about the glue room.

After the students had sanded their projects and were ready to finish them, it was difficult to keep the finishing materials clean and ready to apply. It was also difficult to keep the finish room clean as students would not put the many rags, paper, and dirty finishing materials in the waste containers. If each student would see that the finish room was clean after he had used it, this difficulty could be avoided.

Many of the students did not return their tools to the tool room either after they finished using them or at the close of the period. Tools that were left on work benches would have to be put away by some of the other students, causing them to be late for their next class, or the student teacher would have to return the tools and clean off the benches. This was a considerable task for one person, and could have been done in a few minutes with the cooperation of all the boys.

Several parts of the boys' projects were misplaced and lost in the time between class periods. One problem was the disadvantage of the boys not having individual lockers and places to store their materials. Some boys
would leave parts of their jobs on their work benches, and the next class coming in would misplace these parts. Finally, they would be thrown out when the shop was cleaned up. This problem could have been avoided through a more adequate working out of the general shop plans so as to provide places in which to store the work.

At times some student teachers' suggestions varied. For example, a student would want to know what material was most durable for foot stools and chairs, failing to state the full purpose the project was to serve. The teacher's response, therefore, might be mahogany on one occasion and oak on another. This could have been avoided by the student's having his job well planned before beginning.

Several boys had taken woodwork before and felt that they were ready to use machines in making their projects. The boys and teachers agreed, however, that a trial project should be one factor in determining qualifications for using the machines. They were first to fully plan a job, make a drawing, and construct the project with hand tools. This project was to determine if they had gained enough skills and knowledge in using hand tools to begin using machines as an aid in making their projects.

In summarizing these tentative solutions to overcome the undesirable things that happened in previous shop classes, three main suggestions were offered by the students and teachers that would enable these improvements to be accomplished.
First, there was a need for cooperation among students within the class as well as students in other shop classes. Each boy should return the tools he used instead of leaving them on other boys' work benches. It would be necessary to consider other students when using those tools which every boy was not provided with and to cooperate in leaving material in glue clamps until thoroughly dried.

Second, the boys felt the need for more individual responsibility. For example, boys waited several minutes on the student teacher for information on some minor detail, when they could work the problem out with the aid of an adequate drawing and the intelligent thinking through of their difficulties and problems. One who is competent in reading the drawings and is qualified to make the projects can then carry out the designs in every detail without any additional instructions.5

Third, the boys should plan their jobs adequately and discuss with the teacher the purpose their projects are to serve in the home. Their drawings should be worked out, preferably on a scaled drawing, with all necessary details included. A full size working drawing in many cases helps the boys to have a clearer understanding of their jobs. Another phase of planning would be to figure the bill of material from the drawing and to work out the size and number of pieces to be used in the job from the dimensions.

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of this drawing. Along with the drawing, the students and teachers thought it necessary to have a plan sheet of procedure to follow as an aid in constructing the projects. The students suggested that the teachers make out a form sheet of procedure that they could fill out and follow in planning their jobs. The teachers took the students' suggestions for improving shop classes, and with the aid of the instructor of teacher training from the industrial arts department, worked out this plan sheet to be used as one aid in accomplishing a more effective method of attaining these suggestions for improvement through general planning.

The next meeting was held in the shop, and the author worked with the boys in making their drawings as each individual voluntarily performed his part in conforming with the adopted plan. The boys were grouped around a centrally located table and assistance was given on their beginning problems in attaining information to determine the best type of drawing to use, a working drawing, sketch, or pictorial drawing. The materials needed for making drawings were furnished the boys in the shop and were centrally located at the work bench. These materials included paper, combination drawing board and stand, T square, triangle, and rule.

As was stated in the plan agreed upon, the boys in advanced woodwork who wanted to use machines in making their projects were to make a trial project of a drawing board and stand combination that could be fastened at any desired
height in a work bench vise. This process was to help them become better acquainted with the tools and was to show their ability and knowledge in handling them. The drawing of this trial project could be made from a model that had been completed. The boys in beginning woodwork made drawings of projects they selected. This first course in beginning woodwork consisted of hand-tool work.

It was necessary to acquaint the boys with the basic principles in making an adequate working drawing. This was done by explanations and demonstrations to the group around the work table. One question raised by the boys was the meaning of an "adequate drawing." An adequate drawing contains all the dimensions and views showing size and proportions necessary for the boy to complete a project.

Another question which was brought up concerned the placement of views on the sheet. In placing views on a working drawing, the method that is followed is to place the front view in the lower left corner of the sheet, the top view in the upper left corner, and the end view or side view in the lower right corner. The upper right corner may be used for detail drawing or explanatory information.

The dimensions should be placed in a position that can be easily read which is usually between two views of a drawing. They should be placed outside the object drawn rather than on it. Any unnecessary lines should be avoided
to keep the drawing as neat as possible and to make the views of the object stand out.

The boys also asked why there should be arrow heads on dimension lines. The arrow heads on dimension lines denote the particular part of the object that the dimension covers. These arrowheads should extend directly up to stop lines and extension lines for exact measurements.

After the student became acquainted with the procedure of making a drawing and completed it, the student teacher assisted him in filling out his plan of procedure in laying out and cutting pieces for his project. The student teacher also assisted him in selecting the kind of material and in considering the cost, the durability, and the matching of his job to other pieces of furniture in the home. Using the dimensions in his drawing, the bill of material was figured and the number and size of the pieces were determined.

One of the difficulties encountered was that after receiving group instructions concerning the making of their drawings, too many boys were grouped around the central table to produce the best results. Then, too, the lack of follow-through in their general planning and continuous working on their problems was evident. After completing their drawings they were referred to the student teacher for further assistance and then back to the author for instructions and explanations. This process caused some confusion and delay on the part of the pupil in beginning
his project.

In the light of these generalizations at the end of the two weeks period, it was apparent that the students did not work well on their drawings in a group around a table, because there was a crowded condition and usually interference as the boys would move about and make unnecessary noises.

There was considerable confusion and misunderstanding in the plan adopted of having the student report to the author for certain information and to the student teacher for further instructions. The reasons for this confusion were that the student teacher often did not have time to get around to every student before he began his project, and the student did not always understand the author's instructions well enough to explain his plans to the student teacher. Also there was a lot of time wasted by having the student go from the author to the student teacher, since this necessitated some waiting.

After discussing the difficulties of group instructions with the students, student teachers, and supervisor of student teachers, the plan was evolved to allow the boys to work at their benches and to receive individual assistance.

To eliminate the disadvantages of the students' changing from the author to the student teacher after completing
his drawing, it was decided that the author should continue work with part of the boys on their drawings, in addition to assisting them with their general planning, while the student teachers performed the same duties with the remaining boys.
CHAPTER III

THE SECOND STAGE IN PROCESS OF CONDUCTING STUDY

In putting into effect the proposals that were mentioned in the preceding chapter, the author talked with the student teachers, supervisor of industrial arts student teachers, and the director of teacher training in the college. It was decided that he should take one half of the students of the woodwork class. This group included boys in both beginning and advanced woodwork. The plan was to assist them in their general planning, in addition to helping them make their drawings at individual work benches, while the student teacher performed similar duties with the remaining half of the boys. The students could use the combination drawing board and stand, which could be adjusted to their height, at their work benches instead of grouping themselves around a central table to make their drawings. The purpose at this stage was to establish a better correlation between the students' drawings and their plans.

Ericson, director of industrial arts at the Teachers College in Santa Barbara says,

The time for actual manipulative work will be materially reduced as soon as the students are put to the task of doing their own planning, and many are not able or willing to do it. The question may be raised, however, whether more preparation for life and vocation would not come to larger numbers from more planning and less execution. For students, even of junior
high school ages, to make out the list of tools and equipment needed, the bill of material or supplies, and the proposed steps of procedure before attacking their problems is, indeed, excellent practice; and while it may not be possible or wise to demand such a procedure in all work, a certain amount of such planning can well be considered.¹

The students asked for the meaning of "a plan." They were told that a plan of a project should consist of the purpose it is to serve and the place in which it is to be used. In the plan consideration should also be given to the best type and the most suitable material to be used. The project should be properly proportioned as to height, width, and length. The drawing or blue print should consist of a complete working drawing, possibly some special detail drawings, and a plan of procedure in constructing the project. At this stage, general planning included finding the purpose for the job, making an adequate drawing, determining the most suitable materials to use in the job, figuring the bill of material, and filling out the plan sheet of procedure in constructing the project.

The purpose of the project was generally obtained by the holding of individual conferences between the author and the students. Usually the student teacher was present. The importance in discussing the purpose was to create interest by clearly establishing the details of their projects. One student remarked, "I didn't know we had to

¹E. E. Ericson, Teaching Problems in Industrial Arts, p. 75.
have a purpose, but now I can see that a lot of these
details would not have come up until too late." There
were also possibilities of working out other problems from
the discussion concerning the purpose. For example, from
the purpose of a radio stand, many types of joints were
brought up. They were sketched by the student with the
author's assistance and discussed as to strength, appear-
ance after assembling, and practical construction with the
tools they had access to. After deciding upon the type of
joint he was to use, the boy planned the best way to lay
out the cuts to be made and the tools to use in making
this joint.

Having the purpose fully established, the student
should have a mental picture of the project including the
requirements to fulfill the purpose. The next step was
the transferring of the mental picture of the project to
an adequate drawing. A statement from two boys was, "We
don't need a drawing because we have in mind just what we
want to make. We will make one, but we're sure it's a
waste of time." Their projects were cedar chests with two
swinging drawers at the bottom. After starting on the
drawings they began questioning how they were to draw such
a construction, and finally how they were going to make
the swinging drawers. These problems developed:

(1) How to keep the drawers from dragging.
(2) How to keep the hinges from showing.
(3) How to make the circular parts at the back of the drawers.

(4) How to put stops on the drawers.

Another question was, "We know what we want to make and how we want to make it. Why do we have to make a drawing?" It was concluded in conferences with the director of teacher training, supervisor of student teaching in industrial arts, the student teachers, and the students that a drawing gets the project more clearly established and helps in working out the details. Elizabeth Burris-Meyer, Professor of Design at New York University says,

A definite plan, model, or sketch should be made before an execution of the design is begun, and in that plan should be worked out (1) the most important element of design or composition and the center of attention, and (2) the means of employing it. The successful completion of the design depends upon STICKING TO THE PLAN.2

Many details were brought up after the process of drawing had begun that had not entered the discussion before. For example, in making the drawings, the design was considered and the correct proportion was worked out in basic dimensions. Proportion is usually based upon appearance and strength, such as on a long, six-leg table where the inside pair of legs is spaced at the mid-point between the two end pairs rather than being spaced nearer one end of the table. Good designs and proportions were

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received from several sources, such as magazines, books, blue prints, suggestions from the student teachers and ideas from other projects constructed in the shop.

In helping students begin their drawings, it was necessary to give individual instruction, and in order to clear up some points that were confusing to several boys, the author gave demonstrations covering these problems. Some of these demonstrations included the drawing on the blackboard of three sketches of a block showing the front, top, and end views in the correct position on the paper. Illustrations were made of the purpose and distinction of the different lines, such as object, projection, dimension, stop, center, and lines denoting invisible surfaces, which are used in a working drawing. Some students made their drawings full size in order to see exactly how the design and proportion were going to look before actually beginning work on them. Others drew designs on a smaller scale. In regard to this phase of planning, several students said, "With a drawing we can remember dimensions, shape and size. We also have a picture of how it looks."

Having completed an adequate drawing for their jobs, the students could refer to them in obtaining dimensions, size, the number of pieces to cut, and the exact pattern from which to cut irregular pieces for certain jobs.

The next point discussed was how to determine the most suitable material to use in making the project. The
type of project and the use it was to serve had to be considered in order to select the most durable type of wood. For example, the projects that were to be built massively should be constructed of a more durable wood, such as oak, while more delicate projects might be made of fancy and especially beautiful woods, such as Honduras mahogany, or birdseye maple. The size of the project entered into this discussion to determine the kind and the amount of material that was needed. The most common question asked by the boys was, "How much will this project cost?" To determine this, the size of the project and the kind of wood used had to be decided.

In order to find the cost of the boy's project, his bill of material was figured. This was done by using the dimensions and the number of pieces needed as shown on the working drawing. Stock is expressed in terms of board feet, and it was necessary at this time for the author to explain the formula for figuring the bill of material. He demonstrated its use by taking some examples and finding the total number of board feet and multiplying by the cost per board foot, thus giving the bill for the wood used. A certain per cent had to be added to take care of the waste incurred in getting out pieces for the job. The hardware had to be added to this total along with the cost of finishing materials. The cost of finishing varied according to the kind of finish used on the project.
The next problem faced was the filling out of the plan sheet of procedure that the student teachers worked up at the students' suggestions. This plan sheet was made up of several spaces to be filled in, analyzing the major parts of the job to be constructed. The students indicated the steps they were to take in doing the job, as well as the order in which they should perform them. On the plan sheet they listed the tools and materials required in making the job. Information was supplied, suggestions were given, and actual demonstrations were made in order to teach pupils to plan the procedures of their jobs so as to make them increasingly independent. Pupils became conscious of the need for such help. Each major part of the job consisted of several steps for the boys to make in construction. For example, in making a table, the first major part would be the construction of the legs, and the minor duties under that head would be getting out material, squaring to dimensions, laying out the mortise for the rails, laying out the correct finished length, cutting to the correct length, and scraping and sanding before gluing together. Another major heading would be the construction of the rails. Still another, the construction of the stretchers to hold the legs together near the bottom. After a trial assembly, if all parts fit, it is glued together. Under another major heading the fact is stated that the top may be constructed while the skeleton of the table is being
glued. The top should be made last to avoid any denting or marring by being pushed about in the locker room. Another reason for constructing it last is that the exact size of the skeleton may be determined, and the top can then be squared to the exact dimensions.

Assistance was given by the author and the student teachers to the pupils in the filling out of the plan sheet of procedure. The advanced students required less attention than did the beginning boys, because they had constructed similar projects before.

After the students completed the steps included in the general planning of their projects, they were ready to select the material from the stock room. They were assisted in marking out and cutting their material to working lengths by the student teachers, and further work on their projects was under the supervision of the student teachers.

Here again occurred the difficulty of changing from the author's supervision to that of the student teachers. The teacher was not present at all preliminary discussions concerning plans for the particular projects and was not familiar with the details. Another difficulty of the author's turning the boys over to the student teacher was that he could not witness the stages of progress that the student made in constructing his project. He was also unable to check the results of the general planning of their procedures.
To eliminate the disadvantages mentioned above, it was decided after conferences with the director of teacher training, supervisor of industrial arts student teachers, and the student teachers that the author continue to assist the students until the completion of their projects. The result of adequate planning could be further substantiated by observing the progress that the students made on subsequent projects.
CHAPTER IV

THE THIRD STAGE IN PROCESS OF CONDUCTING STUDY

At this time approximately six weeks of the semester had passed. In order to see the progress of the students through the completion of their projects and the improvement made in beginning other projects, it was decided that the author would work with some boys through their whole job. The students were helped with the care and knowledge of working with hand tools and machines, and the construction and finishing of their projects. F. T. Struck, Professor of Industrial Education in Pennsylvania State College says,

The general aims of instruction through projects is to have the projects serve as real, practical, life-like settings that will tend to stimulate and promote in learners some or possibly all of the following:
1. Desirable habits and skills.
2. Significant related knowledge.
3. Ability to analyze and solve new problems.
4. Develop appreciations and ideals.¹

After the boys selected from the stock room the materials they were to use in making their projects, they marked off the material and the author checked with them to see that the dimensions were correct as given on the working drawing. Then the material was cut to working lengths,

¹F. T. Struck, Methods and Teaching Problems in Industrial Education, p. 54.
which allows an inch for squaring stock. The difficulty encountered by some students was their failure to allow this margin. This was remedied by the students' making a list of the number of pieces and the length they were to be cut, including the allowance for squaring.

The plan of procedure in constructing the project was consulted in order to determine which pieces should be squared first. Then it was necessary for the student to refer to his bill of material and working drawing to get the dimensions for squaring stock. If a particular piece of the project necessitated the cutting of a joint, it was marked off on the stock and cut to dimensions. In respect to the part that the plan played in the construction, two boys made this statement: "We figured out our bill of material before we started work, and in so doing we got a clear idea of how many pieces we would need, the size of each piece, and how each would have to be cut."

A difficulty at this stage was the inaccuracy of the boys in squaring their material to exact dimensions. One statement sometimes heard was, "This piece of board will fit good enough; I'll just use it like it is." Another element which entered was that the beginning boys lacked the experience and knowledge of using hand tools well enough to square materials to exact dimensions, therefore causing the pieces of the project to fit inaccurately. The students and the author decided that this error would increase the errors of the entire project. These problems
were partially overcome when the students saw that they must exercise accuracy in squaring stock.

When the students had all of the parts of their projects squared to dimensions and the joints cut, they scraped and sanded the surfaces that would be difficult to work on after the project was assembled. One boy discovered this need and said, "I'd better sand the inside of these table legs before I put them together because it will be hard later." The next step was the assembling of the parts and the checking of each joint for accuracy in fitting. The wood surfaces must be in contact before the glue joint will hold. If the student and the supervisor were pleased with the fitting of the project after this trial assembly, the parts were glued together. In applying glue on the parts, care was taken to avoid excess glue and to remove any such excess with a damp cloth. After assembling the projects, clamps were adjusted and placed to hold the joints firmly until dry. In applying the clamps, the boys checked the joints for accurate fit and with a tri-square checked the project for squareness. The projects were left in the clamps until the next class period in order to be sure the glue was dry.

One of the difficulties incurred was the students' filling ill-fitting joints with glue, expecting to cover up their mistakes in cutting. One boy remarked, "These joints don't quite fit, but after it's filled up with glue
it won't be noticeable." The result was a black streak of crystallized glue that cracked under slight pressure. The students averted this problem in the future by more accurately marking the joints and by being careful to cut to the mark.

Another problem encountered was the students' wishing to use butt joints and dowell joints in places which did not afford sufficient gluing surface and when the project did not hold together. One student's reason was, "I want to use a butt joint because there are no difficult cuts to make." To prevent this recurrence, the students were guided to select joints that were durable and suitable to the particular projects.

A few of the projects were clamped so tightly that there were dents in them when the clamps were removed. The boys suggested that in the future this could be avoided by placing small blocks of wood under the jaw of the bar clamp to relieve the pressure directly from the project. Other projects were pulled out of shape by uneven tension on the clamps. The students found that this was a result of careless testing for squareness and therefore were more painstaking in this detail in other projects.

After the project had been in the clamps long enough for the glue to become hardened, the boys removed the clamps. Care was taken in scraping the project to remove excess glue and machine marks. In regard to this step one
boy said, "I wish I'd been more careful in spreading the glue on. It is hard to scrape it off without making dents."

Some of the boys used too much glue and failed to wipe the excess off with a damp cloth. This resulted in a black streak of crystallized glue along the joint and the spilling of more glue down the sides from the joints. It was difficult to scrape this off without marring the project and the boys who encountered this problem were more particular about removing excess glue on other projects.

A lack of cooperation with students in other classes resulted in several of the projects being removed from the glue clamps before the glue was dry, causing the projects to slip, break open, or get out of line. A satisfactory solution to this problem was not adequately worked out.

In sanding the projects with sandpaper, a sanding block was used to avoid waved surfaces. To remove marks and scratches the material was sanded with the grain of the wood. After attaining a smooth surface, the boys applied a finish to their projects. Close grain wood was sometimes coated with linseed oil to bring out the grain. The excess was wiped off and the project allowed to dry until the next class period, at which time it was shellacked. Open grain woods necessitated filling with a paste filler. Linseed oil was first applied to the project and followed by a paste filler. This was allowed to dry a few minutes, then
wiped off across the grain to prevent rubbing the filler from the pores of the wood. It was allowed to stand until the next class period, when the shellac was applied.

After the preliminary steps in finishing were done, a coat of shellac was applied and allowed to dry until the following day. Then the surface was rubbed down with fine sand paper or steel wool to remove air bubbles and minor irregularities and another coat of shellac applied. Allowing the same time for the second coat to dry, the shellac was rubbed down again. If the student desired a more durable finish, he used two additional steps. After sanding the second coat of shellac, a coat of varnish was applied and allowed to dry for a day. This was rubbed down in the same manner as the shellac and another coat of varnish applied. After this coat was thoroughly dry, a polish was attained by rubbing the surface with a paraffin oil and a fine pumice stone.

The major difficulty encountered in finishing the projects was the applying of the shellac or varnish unevenly by the students. One boy said, "I'll use lots of shellac so I won't have to apply another coat." This caused the finish to run in streaks and dry as thick places, which were difficult to rub down. Often the finish had to be completely removed and applied correctly. Another problem was that some failed to rub the finish down well enough and had rough surfaces on their finished projects. One student's
attitude toward this was, "I don't need to sand this any more because the other coat of shellac will cover it up." These problems remained eminent since no satisfactory solution was worked out.

In summarizing the problems of actual construction, it was evident that the students were careless in marking the dimensions on the stock and in cutting out the joints, thus causing the projects to fit poorly. Assembling and gluing the projects together presented another problem because the students found it difficult to get their projects square after using the bar clamps. Sanding and finishing required so much work that the students wanted to quit before completing their projects.

After discussing these problems with the students, student teachers, director of teacher training, and the supervisor of industrial arts student teachers, it was decided that these difficulties could be minimized by the students on other projects by being more accurate and painstaking in their construction work.
CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The semester's industrial arts program was planned and conducted to meet the needs of the students. In determining these needs, the pupils listed their problems, which were used as a guide to construct the plan. It was evident that the students were sincere in the enumeration of their difficulties of previous shop experiences, since they tended to occur in this experiment.

In consideration of the fact that this study was made under conditions that were adaptable to the necessary changes made throughout the study, it is evident that the following outcomes are typical of most industrial arts shop classes. From the generalizations of the problems of planning and construction projects as reported in Chapters II, III, and IV, the following conclusions were drawn:

(1) The students' attitudes toward planning were desirable because they had an active part in making the plans. The different problems of entire planning can not be isolated, for they all are closely related and work together.

(2) Cooperation was attained by democratic methods of working with the students. It was concluded that democratic techniques are efficient.

(3) Students recognized their difficulties in constructing
projects, because in the manner in which they worked they did better work than they did when the teacher pointed out these difficulties to them.

(4) The boys did not work well in a group in making their plans and drawings, but when changed to individual work benches there was a noticeable improvement. It is concluded that the individual benches are better in making the drawing for the projects.

(5) Students worked better when one supervisor gave all of the assistance in their planning than when they had to go from one teacher to another for different phases of assistance in their work. This difficulty would probably not occur in the average shop since there would be only one teacher.

(6) It was evident that it was more possible for the author to observe the progress of the students by working with one group to the completion of their projects. It is concluded that when students work on real problems in isolating different elements such as drawings, it is not as effective as when they do all of the planning in terms of the project itself.

(7) Students were able to recognize the advantages of the plan of procedure and profited by these experiences in working on subsequent projects.

(8) The students' planning was in keeping with the ideas of progressive education.
(9) Students had more difficulty in finishing projects than they did in the major construction. The plan of procedure included detailed parts in construction, but failed to take care of the problems adequately in attaining a good finish on their projects. This was the result of failure to continue planning procedure through this stage of the project.

(10) The detailed plan of procedure prevented the loss of time by the students in waiting for instructions from the teachers, helped maintain their interest, prevented the starting of projects for which there was insufficient material, prevented the building of too expensive projects, and eliminated some of the major material wastes.

(11) The author succeeded in his purpose of developing certain skills that were needed in improving his own techniques of planning with shop students. Two of these skills were getting students to plan their work more effectively and knowing whether or not the students had their project planned sufficiently to begin work on them. Another was getting the students to realize the importance of working out their plans from which they could work during the construction of their projects.

After reviewing the difficulties encountered in determining more efficient ways of working with students in shop classes, the following suggestions and recommendations are made:

(1) Industrial arts teachers should endeavor to attain
a method of assisting students that will include detailed information in finishing projects, as well as in general construction.

(2) Shops should be equipped with facilities for students to work on their drawings individually.

(3) The equipment of shops should provide sufficient storage space and lockers for the students' use in keeping their materials together.

(4) A democratic situation should be established in industrial arts shop classes to attain better order and discipline. The students' ideas should also be respected in formulating plans for working.

(5) A plan of procedure similar to the one used in this study would prove beneficial in teaching industrial arts if worked out to suit the particular situation.

(6) More theses should be worked out on this experimentation plan in order to set up the situations and to actually see the results rather than assuming results from hypothetical cases.

The method used in working out this thesis problem provided experiences and observations of situations typical of other shop classes. The evidence presented here is sufficient to indicate the conclusions of the semester's study, but there is need for further study in this and related problems.
BIBLIOGRAPHY


