A Survey of the Utilization of Color Dynamics in Metal Shop Laboratories of Selected Kansas Secondary Schools

Morris L. Reeves
Fort Hays Kansas State College

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A SURVEY OF THE UTILIZATION OF COLOR DYNAMICS IN METAL SHOP LABORATORIES OF SELECTED KANSAS SECONDARY SCHOOLS

being

A Master's Report Presented to the Graduate Faculty of the Fort Hays Kansas State College in Partial Fulfillment of the Requirements for the Degree of Master of Science

by

Morris L. Reeves, B.S.

Fort Hays Kansas State College

Date 7-20-60

Approved  
Major Professor

Approved  
Chairman, Graduate Council
ACKNOWLEDGEMENT

The writer wishes to express his sincere appreciation to Dr. C. R. Cain, who has supervised and directed the preparation of this Master's Report.
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CHAPTER I

INTRODUCTION

The subject of color dynamics in the metal shop suggested itself to this writer because he is engaged in teaching metalworking, and, therefore, is concerned with the environment of a metal shop.

At practically all levels of commercial and industrial life there is a growing understanding that there is more to color than meets the eye, therefore, in many areas painting is being done with various colors that are chosen for their properties which increase productivity, create a cheerful environment, reduce absenteeism, and lessen the dangers of costly accidents.

This study was prepared to bring information concerning color dynamics to interested metal shop instructors. This investigator was interested as to what extent various metal shop instructors have been utilizing color dynamics.

STATEMENT OF THE PROBLEM

The purpose of this study was to make a limited survey of metalworking teachers to determine to what extent they are utilizing color dynamics. To obtain data for this report a questionnaire was sent to twenty-five metalworking teachers in public high schools located in second class cities in Kansas. The items on the questionnaire were answered by 92 per cent of the recipients, and the information obtained
by these twenty-three completed questionnaires provided the data for this report.

The investigator entered into this study with the hope of benefitting interested metal shop instructors. The type of instrument employed to obtain the data and the compiling and analysis of the data obtained were all a part of the problem.

LIMITATIONS OF THE STUDY

This research was limited to those public high schools located in Kansas cities of the second class. It was further limited to those schools offering metalworking (includes welding, metals, or metalshop) that were listed in the directory, "Industrial Arts and Vocational Industrial Personnel, 1959-60."

SIGNIFICANCE OF THE STUDY

The importance of the use of color dynamics in the metal shop is evidenced by the benefits that have been obtained from its application in industry. This investigator believes that the school shop would benefit from color dynamics.

Color with its different shades of brightness and dullness, affects workers' efficiency and morale adversely or complimentarily depending upon its use. This generally accepted concept applies to school shops as well as to industrial plants and to other places where color is used.¹

DEFINITIONS OF TERMS USED

Certain terms in this report are peculiar to this study. To provide clarity for the reader these terms have been defined.

Color Dynamics: Science of the impact of color upon human beings. ²

Consultant: An expert in a specialized field, without administrative authority, whose advice is sought in improving an educational program, the facilities offered, or methods of cooperation. ³

Data: A collection of numbers, qualities, facts, or records used as bases for drawing conclusions or making inferences. ⁴

Hue: The name of a color, such as red, blue, or green. ⁵

Industrial Arts: A phase of the educational program concerned with orienting individuals through study and experience to the technical-industrial side of society for the purpose of enabling them to deal more intelligently with consumers' goods, to be more efficient producers, to use leisure time more effectively and enjoyably, to have a greater appreciation of material culture, and to act more intelligently in regard to matters of health and safety, especially as affected by industry. ⁶

Intensity: The degree of purity of a color, its strength, or saturation. This is determined by the quality of the dominate hue. Scarlet, which is a red of high intensity, is almost a pure red. ⁷

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³Ibid., p. 125.

⁴Ibid., p. 167.


⁶Good, op. cit., p. 215.

⁷McKechnie, op. cit., p. 954.
Metal Shop: A shop equipped with tools and apparatus for metalworking, and used for instructional purposes.  

Recipient: One who receives a questionnaire to be filled in.  

Respondent: Any recipient of a questionnaire who actually replies to the questionnaire.  

Shade: The degree of darkness of a color or a graduation of a color with reference to its mixture with black.  

Tint: A delicate color or a graduation of a color with reference to its mixture with white.  

Value: The lightness or darkness of a color.  

SUMMARY  

This study was prepared to gain information concerning color dynamics that may be of possible interest to metal shop instructors.  

The problem was to determine the extent the participating metalworking teachers were utilizing color dynamics in their metal shop laboratories.  

The survey was limited to those metal shop instructors teaching in public high schools located in Kansas cities of the second class. It

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8 Good, op. cit., p. 499.  
9 Ibid., p. 488.  
10 Ibid., p. 466.  
11 McKechnie, op. cit. p. 1664.  
12 Ibid., p. 1913.  
was further limited to those schools offering metalworking that were listed in the directory, *Industrial Arts and Vocational Industrial Personnel, 1959-60*.

A questionnaire was devised to gather information. The data were organized into tables and figures for subsequent analysis.

A review of literature pertinent to this study was obtained from literature available in Forsyth Library.

A discussion of related studies is found in Chapter II.
CHAPTER II

REVIEW OF RELATED RESEARCH

A certain amount of importance is recognized in studies related to color dynamics in the metal shop. The following discussion reviews some of the studies made on this subject.

Psychological effects of color. In order better to understand the problems involved in the effects of color in the school, this investigator feels that the first step is the understanding of the psychological effects of color on the individual. Niles illustrates how color affects the psychology of the individual. He states that colors are divided into two groups; the warmer colors being those of the longer wave length, or the red side of the spectrum, while their blue-green opposites are cool and relaxing. Another characteristic of color is the fact that dark-colored objects will almost invariably be adjudged to be heavier than light-colored objects.¹

An overall view of the effects of color dynamics on the individual is given by Hansen. His article states that the color yellow, and its accompanying tints gives the normal individual a cheering and a stimulating effect. Blue has a cooling effect and is used most efficiently where temperatures are higher than normal, while yellow would be most

effective where the climate is cooler and the sky is often overcast. Green projects the feeling of both yellow and blue, in addition to being restful to the eyes. Orange tints have the effect of warmth, while red brings the feeling of danger and excitement to the person looking at it. Violet and purple colors designate richness and luxury, and should be used in places calling for such factors.2

A similar study was made by Kephart of Purdue University. He deals with a study conducted at Purdue University to evaluate the effect of a school year spent in an experimental classroom by fourth- and fifth-grade school children. The experimental classroom was painted in colors that were prescribed by leading color experts from this university. The children in the experimental classroom were compared with a similar group of children who spent the same year in a traditional style classroom. It was concluded from this study that the experimental classroom environment had a definite beneficial effect upon the achievements of school children who spent a sufficient amount of time in it.3

Color effects on working efficiency is well-illustrated by Dr. Schweisheimer, where he discusses the influence of colors on people, and their application to schools. Dr. Schweisheimer gives an example of a dinner party with the guests seated at a banquet table loaded with appetizing dishes. The lighting was switched, thereby changing the

2 Hansen, loc. cit.

for colors should be a firm foundation for the color planning in the schools in which the children will work and play.\footnote{Ann Van Nice Gale, \textit{Children's Preferences for Colors, Color Combinations and Color Arrangements}, Chicago, University of Chicago Press, 1933, p. 2.}

The results of the Baltimore Experiment (an experiment concerned with the effect of color on the studying efficiency of students), conducted by the John Hopkins University Institute for Cooperative Research, was presented by Rice. This experiment was conducted under the supervision of Wendell R. Garner, director of the psychological laboratories, and his staff associates, Hudson J. Bond and Randolph Hanes. The conclusion drawn from this experiment was that the color environment has a definite effect upon the students studying efficiency. The Pittsburgh Plate Glass Company, one of the nation's leading producers of paint, financed this experiment.\footnote{Arthur H. Rice, "What Research Knows About Color in the Classroom," \textit{Nations Schools}, 52:1, March, 1955.}

\textbf{Lighting effects of color.} The lighting and color planning of a school building should be a single unit in the planning process. The use of color to complement the lighting system of a school is a must because the value of the lighting system is dependent directly upon the color environment.

Higley, dealing primarily with the problem of color selection in lighting planning, states that the advances in the practical application of color research demonstrates that the old-fashioned practice of
applying one color--usually buff--to the entire school interior results in wattage wastes and unnecessary eye strain.9

Very similar ideas were offered by Allen. He is the school lighting specialist for General Electric Company, Cleveland, Ohio. He states that if the visual efficiency is to be improved in the schools, it is best to change the color before you change the lighting system.10 A co-worker of Allen is Ickis, who published an article concerned with the problems that are encountered in finding the right color for classrooms in relation to the type of light. New problems are being encountered with the increased use of the several types of fluorescent lights, each giving off a different color of light. A well-planned decorative scheme is planned with both the wall color and the type of illumination in mind.11

Continuing the argument for the need to plan the lighting system of the school in conjunction with the color planning, there has been developed and tested multicolored lights with each hue having its own dimmer switch, thereby suggesting light adjustment to suit the color environment in any situation. A yellow light could be used to counteract a cold, foggy day; the pink light would give a warm hospitable glow for late afternoons; while the blue-white one would give a coolness to

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a room even on a warm summer day. This material was presented by 
Peters in cooperation with the Fifth Annual School Planning Institute 
of the Stanford University School of Education.¹²

Birren presents seven areas in the use of color in the school. They 
are illumination and brightness, primitive nature of color, color and 
emotion, school environment problems, the ideal color plan, school furni-
ture, and school decoration. The school environment should be painted 
in colors that have a reflectance value of 50 to 60 per cent with the 
exception of the ceilings which should be of a white or off-white color. 
When the brightness of the colors are in the proper ratio, seeing is 
comfortable and unencumbered.

In the area of the primitive nature of color, Birren points out 
that the stimulation of color is a good tonic to the senses and a good 
distraction from fears and apprehensions. Warmth and coolness in colors 
are dynamic qualities. The writer further says that bright, light, and 
stimulating colors are conducive to physical and muscular activity,
while the more subdued colors are relaxing for both muscular and mental 
activity.¹³

Use of color in school design. If schools are to be of a pleasant 
design and conducive to good studying, cognizance must be taken of the 

¹² Jon S. Peters (ed.), Trends in School Planning, Stanford, 

¹³ Faber Birren, "Color Must be Functional," Nations Schools, 
role that color is to play. It has been noted previously how color plays upon the psychic centers of the human being, and how color is directly responsible for the value of the lighting systems. The following material relates these two aspects of color planning to the overall school design.

Caudill shows the real need for proper color combinations in the school. The purpose of the color envelope is to modify nature, to bring the outside into the school building, and to bring sunshine inside the classroom even on the cold and dark days of winter. Caudill relates architectural problems to pupil needs, environment, economy, community planning, and the philosophy of effective education. There is a total of ninety-one illustrated case studies of actual approaches and solutions to a variety of architectural situations included.¹⁴

A study on the subject of color was a result of twenty-five years of note-gathering and study by Birren, who has tried a rather new approach which may one day lead to a more potent use of color in the field of architectural design and decoration. The study was centered around an attempt to find new value for color to aid human efficiency and well-being, to contribute to human comfort, and to control human moods. Birren is convinced that the old process of color selection based upon such vague things as good taste and personal feeling will one day

give way to more penetrating knowledge of the human psyche and of the factors in color that seem to influence it.\textsuperscript{15}

A book by Engelhardt devotes six pages to the use of color in the school. The material is technical in nature, and explains the relationship of color in the school to such characteristics of color as chromatic aberration, brightness contrasts, reflection factors, hue, value, chroma, mass, and artificial lighting. All schools need color, light, and a cheerful, open environment in such a combination that an atmosphere conducive to interest, stimulation, and growth of children will be developed.\textsuperscript{16}

Winslow has published an informative article dealing primarily with the problem of correct color selection for the entire school. He illustrates a color compass chart that he designed himself. The chart has the color specifications for school buildings, and may also be used for planning the decoration of homes and places of business. It is suggested in this book that when planning the color schemes of a school building, that samples of the colors, at least one foot square, be painted on paper or cardboard and tried on the walls before the final color is chosen.\textsuperscript{17}


A more bold and daring combination of color is suggested by Benda in a descriptive article on the methods and works of John Hopkins who is the color consultant for the University of Minnesota. Hopkins' work can be summed up by saying that he advocates the use of color in a bold and daring way. He is in favor of tearing ourselves away from antiquated forms and investigating better ways of fulfilling the needs of an educational plant through the media of color.18

Some other users of bold colors are the educational authorities in England according to Cowin. Cowin was profoundly impressed with the new ideas in planning, construction, and decoration of post-war schools that he saw in England, particularly the interesting combinations and bold uses of color. This article also includes some of the findings of the British Ministry of Education and various local educational authorities in using a scientific approach to the use of color in their schools while using the Munsell Color Reference System.19

The cost of painting a school building a variety of colors on walls and ceilings has been proven to be about the same as applying a single color. The preceding statement was concluded from an article by Firth. He gives a good general picture of the advantages of good color planning in the schools. In this piece of work he considers the aspects

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of psychological implications, cost, proved success, safety, activity in the area, size of the rooms, structure, exposure, climate, view, equipment, furnishings, and maintenance.\textsuperscript{20}

Ballard believes that a functional school building can be a good-looking building without losing its usefulness simply by proper care in the design of its various parts and details. In his article he states that a child will see the bright colors, and will relate them to pleasant experiences. The teachers react accordingly when they are given a pleasant and functional atmosphere in which to work.\textsuperscript{21}

The results of a committee in St. Paul, Minnesota, that investigated the problem of which color to use and what its effect would be in the school are presented by Pleason. The findings of this committee were that the faded monotones should give away to lighter colors, variously combined and accented here and there with a darker color to produce a cheerful, yet restful, atmosphere which is also efficient because it meets the environmental needs of the school. Another important finding was the fact that under the influence of a red environment, time is likely to be overestimated. Conversely, under the influence of a green or blue environment, time is apt to be underestimated. It was the opinion of the committee that classrooms where the work is considered


monotonous should be decorated in different values of blue or green. This would tend to hasten the time spent in the classroom.\textsuperscript{22}

The superintendent of schools at Ironwood, Michigan, Erickson cites an example of good color scheming in his schools. Because the school is situated in the Northern United States where the winters are often long and dark, it was decided to use the colors which would bring sunshine into the schools. Yellow harmonizes with nearly all color schemes, and will introduce into the schemes the qualities of light, cheer, buoyancy, and life.\textsuperscript{23}

A study similar to the one just mentioned is by Townsend, where he discusses the technique used in planning the painting of Howe School in Schenectady. The first step in the planning was the consultation of a paint specialist. Different colors were studied in relation to the psychological factors involved. In this case there was much pupil interest shown in the color planning, and in some instances, the pupils were given their choice of colors with satisfactory results.\textsuperscript{24}

Birren is of the opinion that the color of the lunchroom will definitely affect appetite. He credits the use of improper color combinations in the lunchroom (blood-red, ashen grey) to causing illness.


The credit should not all go to the colors used because the lighting, also, according to Birren, plays an important part in this respect.25

A similar point of view is shared by Frink, who is concerned with the color scheme that is introduced to the cafeteria of the schools at White Plains, New York. This author found that a color scheme centered around the color peach is the best for use in a cafeteria situation.26

In July, 1956, the United States Army at Fort Lewis, Washington conducted an experiment on color determination concerning the universal use of red as a danger signal. It was found that the color most readily recognized was the color yellow. It was correctly identified four to five times more often than any other color. Other colors seen in order of decreasing perceptibility were multi-colored plaid, orange, blue, red, and green. The results of this experiment were released to the public including sportsmen, hunters, safety experts, and medical men.

The traditional color that depicts danger was always red. It is believed that this concept dated back to ancient tribal wars because the spilling of blood signified distress. This experiment indicated the need for a new safety color. Due to this experiment and others like it, yellow is destined to come into its own.27


Use of color in the school shop. If the school shop is to be utilized to its fullest extent, designers and architects must take cognizance of the role that color must play. The psychological effects of color on the individual will bear directly upon the efficiency and morale of the students in these shops.

The least expensive and one of the greatest contributions to shop safety can be secured by the scientific painting of floors, walls, ceilings, and machines with light contrasting colors. Many school shops do not utilize this inexpensive method of saving precious light and thereby reducing damaging eyestrain.

Hausman conducted an experiment at the School of Engineering and Architecture, University of Kansas, where over a seventeen months period his staff trained over five thousand students and servicemen comprising a monthly total of 54,764 man-hours with only two accidents that required the student to miss classwork. It was noted that this color scheme was a radical change in many instances but the change will grow on an individual in a short period of time and then the individual will feel out of place in the old conventionally painted shop.\(^2\)

The creation of an environment in the school shop that is pleasant and stimulating is of primary importance according to Thompson. Two approaches must be used in the interior color treatment of a school shop. They are the creation of an environment that is pleasant and stimulating and the use of various finishes that have the resistance to withstand

\(^2\)Hansen, loc. cit.
repeated washings and cleanings without losing their original color and beauty. With the use of durable paints and the proper color combinations, much can be saved in expensive lighting.

The school maintenance engineer can do much for a shop if he understands the basic characteristics of color. This was illustrated in an experiment in the educational field at the Northrop Aeronautical Institute, Hawthorne, California. In this experiment the principles of color dynamics were used in the industrial training rooms. It was estimated that the efficiency of the students increased 60 per cent through the use of selected eye-rest and cheerful colors.

On the machinery in the shop, Thompson recommends that for the critical parts you utilize colors that move in strong contrast to the rest of the machine. Focal colors are of this type and include focal ivory, red, orange, and many others. The purpose of this is to focus the operators attention exactly where it belongs with the least possible effect on the eye muscles. The stationary parts of a machine must drop back or recede away from the critical parts. In the past, grey was considered the standard color for the machine body, but research has found a receding green shade is much more adaptable to this application. The walls, ceilings, and floors must also be considered, and with the proper eye-rest shades a most pleasing atmosphere can be obtained with the highest utilization of light.29

In an article by Soderberg it is found that color rendering, color conditioning, three dimensional seeing, and color dynamics are synonymous in meaning, and each term will depict the fact that the scientific method of color selection will high point and emphasize critical areas. There are three steps in transforming a shop from the dull, drab of the pre-war days to one that is alive and highlighted by color dynamics. The first step is highlighting the critical areas by increasing contrast. The second step is painting the noncritical areas a receding color. This color will make the parts seem to drop back or recede, thus presenting a relaxing effect to the worker. The third step is the finishing of the walls, ceilings, and floors in soft tones to relieve eyestrain and assure uniform brightness to the workers line of vision.30

Hansen presents the reasons why it is important for shop planners to know how and where color should be used to produce the most desirable conditions for the people who work in the shops. It is customary for most machines to be painted a shade of grey. To achieve the best results from machine operators, Hansen suggests that the machines be repainted and the critical parts painted in light contrasting colors. Hazardous parts of a machine could be painted orange to help focus special attention to these parts.31

31Hansen, loc. cit.
The use of color arrangement and selection as a safety measure in the school shop is presented by Kimbel. Kimbel has illustrated a color code for the school shop consisting of five colors—yellow, orange, green, red, and blue—each of which are easily recognized under all conditions of lighting. Yellow is used on any moving part of a machine or piece of equipment. Orange will identify all switch boxes and electrical equipment, in addition to its use on all guards. Red automatically means fire-fighting equipment, while the blues and greens are used for such things as walls, machine bodies, tables, and racks. It was found that the effects of good color dynamics and careful attention to the color code for safety will inspire better housekeeping and morale in the school shops.32

CHAPTER III

FINDINGS

Questionnaires were compiled and, with accompanying letters, were sent to twenty-five industrial arts instructors who were engaged in teaching metalworking. The questionnaire appears in Appendix A, while the accompanying letter is to be found in Appendix B. Twenty-three of these recipients responded with completed questionnaires for a response of 92 per cent. The data contained in these questionnaires was treated as the findings for this study.

The extent to which the respondents utilized a consistent color scheme in their shops is illustrated in Table I.

<table>
<thead>
<tr>
<th>Utilized Consistent Color Pattern</th>
<th>Number of Responses</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>15</td>
<td>65.2</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
<td>34.8</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>100.0</td>
</tr>
</tbody>
</table>
An inspection of the data contained in Table I indicates that 65.2 per cent of the participants utilized a consistent color pattern in their metal shops.

The reasons that the remaining 34.8 per cent of the respondents did not use a consistent color scheme are shown in Table II.

### TABLE II

**Reasons Respondents Indicated They Had No Consistent Color Scheme**

<table>
<thead>
<tr>
<th>Reason for No Consistent Color Scheme</th>
<th>Number of Respondents</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefer Manufacturer’s Colors on Various Items</td>
<td>4</td>
<td>50.0</td>
</tr>
<tr>
<td>School Board Limitations</td>
<td>1</td>
<td>12.5</td>
</tr>
<tr>
<td>Department Head Limitations</td>
<td>1</td>
<td>12.5</td>
</tr>
<tr>
<td>Not Specified</td>
<td>8</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The findings in Table II reveal that 50 per cent of the respondents that indicated they had no consistent color pattern did so because they preferred colors supplied on various items by manufacturers. Where the respondent did not specify a reason for not having a consistent color pattern occurred in 25 per cent of the cases. The remaining 25 per cent gave department head limitations and school board limitations as their reasons.
Table III is presented to determine the number and percentage of the respondents who would utilize the services of a color consultant if they were to build a new shop.

**TABLE III**

NUMBER AND PERCENTAGE OF RESPONDENTS WHO INDICATED THEY WOULD UTILIZE A COLOR CONSULTANT IF THEY WERE TO BUILD A NEW SHOP

<table>
<thead>
<tr>
<th>Would Use A Color Consultant</th>
<th>Number of Respondents</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>19</td>
<td>82.6</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>17.4</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>100.0</td>
</tr>
</tbody>
</table>

In Table III it may be observed that 82.6 per cent of the respondents would utilize the services of a color consultant if they were to build a new shop.

Information regarding the use of illumination tests in the metal shop is presented in Table IV.
Table IV reveals that none of the participants indicated that they utilized an illumination test in their metal shops.

The number of years that elapse between equipment repaintings is illustrated in Table V.
TABLE V

PERIOD OF TIME IN YEARS BETWEEN EQUIPMENT REPAINTINGS

<table>
<thead>
<tr>
<th>Number of Years</th>
<th>Number of Responses</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>4.35</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>13.05</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>17.4</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>8.7</td>
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<tr>
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<td>13</td>
<td>56.5</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>100.00</td>
</tr>
</tbody>
</table>

An examination of the data in Table V reveals that 56.5 per cent of the respondents repainted their equipment whenever they felt it was needed. Of the 43.5 per cent of the respondents who had regular intervals between equipment repaintings, the greater per cent repainted their equipment every three years.

Data in Table VI are provided to show the cost of paints and other materials used to maintain the color patterns per year.
<table>
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<th>Cost of Materials</th>
<th>Number of Responses</th>
<th>Per Cent</th>
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<td>13.05</td>
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<tr>
<td></td>
<td>23</td>
<td>100.00</td>
</tr>
</tbody>
</table>

In Table VI it may be observed that 26.05 per cent of the respondents did not know the cost of maintaining their color patterns per year. There was 13.05 per cent of the respondents that gave no response on this question while an equal percentage gave a cost of twenty dollars and twenty-five dollars respectively. There was one respondent that gave a cost of fifty dollars.
Information regarding the methods by which colors were chosen for walls and ceilings is illustrated in Figure I.

FIGURE I

METHODS BY WHICH COLORS WERE CHOSEN FOR WALLS AND CEILINGS

The findings in Figure I indicate that 43.5 per cent of the shops are still painted the same color they were when they were first occupied by the metal shop. It can be noted that 17.5 per cent of the respondents indicated they utilized the services of a color consultant in this matter. The remaining 39 per cent of the respondents indicated that the school board, administration, or the shop teacher selected the colors for the walls and ceiling in the shop.
Data in Figure II are provided to show the distribution of methods utilized to select the colors for the machines and tables in the metal shop.

![Pie Chart]

**FIGURE II**

METHODS BY WHICH COLORS WERE CHOSEN FOR MACHINES AND TABLES

From the data in Figure II it may be seen that 36 per cent of the respondents indicated that the shop teacher selected the colors for machines and tables. It may also be noted that an equal percentage of respondents left the machines and tables the same color they were when they were purchased from the manufacturer.
Figure III was included to show the distribution of methods utilized to select colors for first aid cabinets, switch boxes, hoists, electrical outlets, guards, and fire protection equipment.

The selection of colors for first aid cabinets, switch boxes, hoists, electrical outlets, guards, and fire protection equipment was done by the shop teacher in 44 per cent of the cases as shown by Figure III. The utilization of a color consultant was indicated in 28 per cent of the cases while the remainder of the respondents left...
these pieces of equipment the same color as they were when they were purchased from the manufacturer.

The distribution of the personnel responsible for painting in the metal shop is given in Figure IV.

![Pie Chart]

**FIGURE IV**

**DISTRIBUTION OF PERSONNEL RESPONSIBLE FOR PAINTING IN THE METAL SHOP**

From the data in Figure IV it may be seen that in 40 per cent of the cases, the instructor was responsible for the painting in the shop. Of the remaining 60 per cent, the students were responsible in 27.5 per cent of the instances, the maintenance help for 30 per cent, and there
was 2.5 per cent of the respondents who did not specify who was responsible for the repainting of equipment.

Data concerning the color of items in metal shops as indicated by the respondents are shown in Table VII.
<table>
<thead>
<tr>
<th>Respondents</th>
<th>Walls and Posts</th>
<th>Body of Machines</th>
<th>Critical Parts of Machines</th>
<th>Machine Guards</th>
<th>Switch Boxes for Machines</th>
<th>Lever Arms and Handwheels for Machines</th>
<th>Chalk Boards</th>
<th>Doors and Window Sills</th>
<th>Benches</th>
<th>Floors</th>
<th>Tool Panels</th>
<th>Fire Protection equipment</th>
<th>First Aid Cabinet</th>
<th>Electrical Outlets</th>
<th>Compressed Air Outlets</th>
<th>Water Pipes</th>
<th>Hoists</th>
<th>Restriction Lines on Floors</th>
<th>Hazardous Objects</th>
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<tr>
<td>1</td>
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<td>Red</td>
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<td>L B</td>
<td>L B</td>
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</table>

**Legend:**
- **LB** -- Light Blue
- **Yel** -- Yellow
- **Orig** -- Original
- **Nat** -- Natural
- **Y & B** -- Yellow and Black
- **NR** -- No Response
- **Alum** -- Aluminum
- **Orng** -- Orange
From the data presented in Table VII it may be seen that fire protection equipment was painted red in eighteen, or 78.25 per cent of the cases. This item showed the most consistency as far as color selection was concerned. The color green was the predominate color for walls and posts as it was designated by fourteen, or 60.9 per cent of the respondents. The next most frequently used colors for walls and posts were tan and grey with respective percentages of 8.7 each. The color grey was chosen as the color for machine bodies in 60.9 per cent of the cases, while 30.45 per cent of the respondents indicated that their machine body color was green.

Further study of Table VII reveals that the use of restriction lines on the floor of the shop was utilized by six, or 26.1 per cent of the respondents. First aid cabinets were predominately white, while the floors were left their natural color in 78.25 per cent of the cases.

SUMMARY

The findings of this study represent an attempt to present data concerning the utilization of color dynamics in the metal shop laboratories of twenty-three Kansas high schools. The information compiled into tables and figures for this report was provided by participating metal shop instructors through a questionnaire which was devised by the investigator under the supervision of his advisor, Dr. C. R. Cain.

An analysis of the findings, conclusions, and recommendations of these data are presented in Chapter IV.
CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study was initiated to provide information concerning the use of color dynamics in the metal shop laboratory for interested metal shop instructors.

The purpose of the investigation was to survey a limited number of metalworking teachers to determine the extent they were utilizing color dynamics in their metal shop laboratories in public high schools located in second class cities in Kansas. There were twenty-three completed questionnaires returned for a response of 92 per cent. The data derived from these twenty-three completed questionnaires provided the data for this report.

It was assumed that the findings of this investigation might conceivably be utilized by some interested metal shop instructor in the area of shop planning and organization.

The review of related research was confined to materials available in Forsyth Library, located on the campus of Fort Hays Kansas State College in Hays, Kansas. There was literature available on the psychological effects of color and the use of color in general. There was no literature found that dealt specifically with the use of color dynamics in the metal shop laboratory.
SUMMARY

It was determined that fifteen, or 65.2 per cent of the respondents, utilized a consistent color pattern in their metal shop laboratories. Of the 34.8 per cent of the respondents who indicated that they did not utilize a consistent color scheme, four or 17.8 per cent indicated preference for colors supplied by manufacturers.

There was nineteen, or 82.6 per cent of the respondents, who signified that they would utilize the services of a color consultant if they were to plan for a new metal shop laboratory.

Not one of the respondents indicated that he had utilized an illumination test in his metal shop laboratories.

It was revealed that thirteen, or 56.5 per cent of the respondents, repainted equipment when it needed repainting.

Nine, or 40 per cent of the respondents, did not specify the cost of annually maintaining their metal shop color patterns.

It may be noted that four, or 17.5 per cent of the respondents, indicated they utilized the services of a color consultant in choosing colors for walls and ceilings. Of the twenty-three respondents, ten indicated that the color of the walls and ceilings was the same as when the metal shop laboratory was first utilized in teaching metalworking subjects.

Shop teachers selected the colors for machines and tables in 36 per cent of the cases, while an equal percentage of the respondents
left the machines and tables the colors they were painted when received from the manufacturer.

Forty per cent of the repainting in the metal shop was done by the instructor. The students accounted for 27.5 per cent, while maintenance help accounted for 30 per cent. There was 2.5 per cent of the repainting that was not specified.

Fire protection equipment showed the most consistency as far as color selection was concerned. This is borne out by the fact that eighteen or 78.25 per cent of the respondents indicated that their fire protection equipment was painted red.

CONCLUSIONS

It was determined that fifteen or 65.2 per cent of the respondents utilized a consistent color scheme in the metal shop laboratories. It would seem advisable that perhaps the other eight or 34.8 per cent of the instructors might investigate the desirability of such a color scheme in their laboratories.

Of the eight respondents who indicated they did not utilize a consistent color pattern in their metal shop laboratories, four or 50 per cent indicated preferences for colors supplied by manufacturers. This would seem to denote that those metal shop instructors who prefer colors supplied by manufacturers would possibly benefit by purchasing equipment painted colors that will fit into the color pattern of their metal shop laboratories.
Not one of the respondents specified that he utilized an illumination test in his metal shops. A need for metal shop instructors to review the advantages of employing the services of an illumination expert seems to be indicative in this instance.

It was ascertained that fourteen, or 60.9 per cent of the respondents, designated the annual cost of color maintenance in their metal shop laboratories while the remaining 39.1 per cent did not designate the annual cost. This tends to imply that it would possibly be desirable for the remaining 39.1 per cent who did not specify the cost of maintaining the color pattern to investigate this matter.

It has been determined that nineteen, or 82.6 per cent of the respondents, would utilize the services of a color consultant if they were to build a new shop. Of the twenty-three respondents, four or 17.5 per cent specified that they utilized the services of a color consultant in the selection of colors for walls and ceilings, seven or 28 per cent utilized the services of a color consultant in the selection of colors for machines and tables. There was also seven, or 28 per cent of the respondents, who utilized the services of a color consultant in the selection of colors for first aid cabinets, switch boxes, hoists, electrical outlets, guards, and fire protection equipment. This seems to indicate that perhaps metal shop instructors would find it desirable to investigate the possibility of utilizing the services of a color consultant in these areas of shop planning.
Since the instructor was responsible for the repainting in the metal shop in nine or 40 per cent of the instances, it would seem advisable for the remaining 60 per cent of the metal shop instructors to investigate the desirability of having the instructor in charge of repainting operations.

In this survey, fire protection equipment was painted red in eighteen or 78.25 per cent of the instances. This would appear to indicate that it could be desirable for the remaining 21.75 per cent of the metal shop instructors to investigate the advantages of using red as the color for fire protection equipment.

RECOMMENDATIONS

From the data presented in this study, it would seem to be more desirable if a larger percentage of the metalworking instructors would investigate the desirability of utilizing a consistent color scheme in their metal shop laboratories.

If possible when purchasing equipment, metal shop instructors should specify that the equipment be painted colors that will fit into the color pattern of their metal shop laboratories.

Interested metal shop instructors who have not already done so, should contract a survey of the color and illumination needs in their metal shop laboratories by a qualified consultant or consultants.
It is recommended that metal shop instructors investigate the desirability of utilizing the color red in the designation of fire protection equipment.

It is hoped that these recommendations may be of some value to interested metal shop instructors in the planning and organization of their metal shop laboratories.
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C. PERIODICALS

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OTHERS


APPENDIX A

Questionnaire Form
1. Do you have a consistent color pattern throughout your shop? Yes ___ No ___

2. How were the colors chosen for the walls and ceilings? Color consultant ___, Shop teacher ___, School board or administration ___, or Same color as it was when you occupied this shop ___.

3. How were the colors chosen for the machines and tables? Color consultant ___, Shop teacher ___, School board or administration ___, or Same color as it was when purchased ___.

4. How were the colors chosen for first aid cabinets, switch boxes, hoists, electrical outlets, guards, fire protection equipment, and etc? Color consultant ___, Shop teacher ___, School board or administration ___, or Same color as it was when purchased ___.

5. How often is the equipment repainted? (Check one.)
   a. 1 year ___
   b. 2 years ___
   c. 3 years ___
   d. 4 years ___
   e. Other ___

6. If you have taken a foot candle or lumen test of shop area indicate illumination found: (Check one.)
   a. No test made ___
   b. Illumination foot candle ___, or lumen ___.

7. How was painting done in the shop? (Check appropriate items.)
   a. By instructor ___
   b. By students ___
   c. By maintenance help ___

8. Indicate the cost of paint and other materials and supplies to maintain color pattern per year, or original cost.
   a. $10.00 ___
   b. $15.00 ___
   c. $20.00 ___
   d. $25.00 ___
   e. Other ___ Specify. ___
9. If you were to build a new shop would you specify the use of a color consultant for the room and equipment? (Check one.)
   Yes_____  No_____ 

10. If no consistent color scheme is used in your shop indicate the reason. (Check appropriate items.)
   a. Cost too high______
   b. Color has no effect on shop efficiency______
   c. Prefer colors supplied on various items by manufacturers______
   d. School board limitation______
   e. Other____ Specify______________________________

11. Please designate the color of the following items (if the item is not in your shop, please mark "none.")
   a. Walls and posts______________________________
   b. Body of machines______________________________
   c. Critical parts of machines (Provides background color for work)______________________________
   d. Machine guards______________________________
   e. Switch boxes for machines______________________________
   f. Lever arms and hand wheels (for machines)______________________________
   g. Chalk boards______________________________
   h. Doors and window sills______________________________
   i. Benches______________________________
   j. Floors______________________________
   k. Tool panels______________________________
   l. Fire protection equipment______________________________
   m. First aid cabinet______________________________
   n. Electrical outlets______________________________
o. Compressed air outlets

p. Water pipes

q. Hoists

r. Restriction lines on floors

s. Objects that create a hazard of striking, tripping, or falling
APPENDIX B

Correspondence

Dear Mr. Henders,

I would like to submit a request in writing for the enclosed paper. The paper writing will require a day or two. Please return the enclosed report to the office by April 1st. Please complete the enclosed questionnaire and return it to me. If you have additional comments, I would be happy to hear them.

Thank you for your cooperation. Without the ability to have questions, this report would be impossible.

incerely yours,

Write to Minute
221 North Pennsylvania
Anthony, Kansas
March 25, 1960

Mr. Daryl Haegert
Harper Rural High School
Harper, Kansas

Dear Mr. Haegert

I would like to solicit your cooperation in filling out the enclosed questionnaire. This questionnaire will supply data for a masters report on the use of color dynamics in the metal shop. Please complete the enclosed questionnaire and return it to me in the enclosed envelope on or before April 13, 1960. A summary of this report will be sent to you upon request.

Thank you for your cooperation. Without it a study of this nature would be impossible.

Sincerely yours,

Morris L. Reeves