CUTHBERTSON, ANN STATON. Adequacy of Lighting in the Home Study Areas of Junior High School Students in Greensboro, North Carolina. (1974) Directed by: Dr. Jane H. Crow. Pp. 56.

The purpose of this study was to identify areas in the home where students study and to evaluate the adequacy of lighting in those areas. Standards for adequacy of lighting and for factors relating to lamps, luminaires, and study place were a composite of recommendations of the Illuminating Engineering Society, Better Light Better Sight Bureau, and General Electric Company. Participants' views on lighting adequacy and sources of information on lighting were recorded. Subjects were 50 boys and girls, aged 13 to 15 years, and one of their parents. Subjects were drawn from selected boy and girl scout troops in Greensboro, North Carolina by using a table of random numbers. Data were collected by means of interview and measurement and recorded on a schedule developed as a part of this study. Results were descriptively analyzed and reported. Standard error of the mean was used to analyze selected factor means.

It was found that two-thirds of the parents and almost all of the students believed lighting was adequate in the home study area. Slightly over one-half of parents and students had seen no information on lighting; one-fourth had received information at school. The places for study, in order of decreasing incidence, were the bedroom, family room, kitchen, and dining room. Night was the time for study by 86 percent of the students. While the major source of general illumination was a ceiling luminaire, 12 percent had no source of general illumination.

About two-thirds had a portable study luminaire; however, one-fourth had no study task luminaire. The portable study luminaires were conventional table, gooseneck, high intensity, and fluorescent, in descending incidence. There was no study area that met all recommendations for lighting adequacy. Only twelve percent had adequate general illumination levels and eight percent had adequate average task illumination levels. There were no luminaires that met all design characteristics necessary to achieve recommended quality and quantity illumination. None were Better Light Better Sight Bureau approved. Those factors which were significantly different ($p < .05$) from standards recommended for a study area were: the placement of the conventional table luminaire on the study surface, distance from eye level of student to the task, all illumination readings on the task, and the width dimension of the study surface.

ADEQUACY OF LIGHTING IN THE HOME STUDY AREAS OF JUNIOR HIGH SCHOOL STUDENTS IN GREENSBORO, NORTH CAROLINA

by

Ann Staton Cuthbertson

A Thesis Submitted to
the Faculty of the Graduate School at
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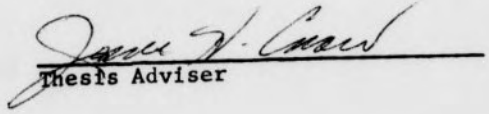

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CHAPTER I

INTRODUCTION

A suitable visual environment is necessary for quick, accurate seeing. The science of lighting provides a precise definition of adequacy of lighting for specific tasks which people perform. The prime objective of lighting design is to create an environment that will permit the eyes to operate optimally for the individual. The IES Lighting Handbook (1972, p. 3-1) states that "without light we cannot see; with inadequate light or the wrong kind of lighting, seeing may be inefficient, uncomfortable, or hazardous."

Studying is one of the most difficult tasks the eye is called on to do in the home (Illuminating Engineering Society, 1958). Home study begins at an early age and increases as the educational level progresses. Emphasis on developing a location specifically for study assumes importance when one recognizes (1) the difficulty of the eye task, (2) the formative years in which home study is required, and (3) the impact study environment has not only on study habits and attitudes of children but their carry-over into adulthood. Research has proven that balanced lighting (suitable in quantity and quality) is one of the most important aspects of an environment which promotes and encourages learning (Seagers, 1963). Balanced lighting may reduce physical tension and conserve energy. Inadequate lighting is known to often cause fatigue and inability to concentrate; therefore, it

may make homework tedious and tiresome, and may also affect the student's attitude toward study and his performance (Better Light Better Sight Bureau, 1966).

The study area in the home should be evaluated for adequacy of lighting in terms of quality and quantity. Adequacy of illumination is determined by: level of illumination (amount of light in footcandles); proper diffusion, direction, and distribution of light; freedom from glare; and freedom from severe contrast and shadows. Weber (1949) correlated good lighting conditions with good study environment (desk placement, size, and finish, and student eye position) to aid good seeing, good posture, and mental concentration.

Recommended standards for residential lighting and designs for home study centers are available. However, it is generally believed that this information is neither well known nor optimally utilized by homemakers or students. Residential lighting has no set lighting system and there is little research indicating actual lighting conditions existing in homes.

PURPOSE

This study was designed to identify the areas in the home where students study and to evaluate the adequacy of lighting in those areas. Are people aware of conditions that are necessary for an adequate study environment? Do homes have suitable quality and quantity of illumination for home study? What conditions are present in the study area at the time studying is accomplished?

Answers to these questions could be of value to educators, parents, personnel in the lighting industry, and other professional people such as medical personnel dealing with sight in the formative years. This information could be helpful in determining the degree of emphasis to be placed on proper lighting and related study conditions in the home.

The objectives of this study were to:

1. Identify the location within the home where studying is accomplished.
2. Evaluate the study area for quantity and quality of illumination.
3. Examine related conditions (desk placement, its size and finish, chair, student eye position, and wall, floor, and ceiling reflectance) affecting the study area.

DEFINITIONS

Terms used throughout this study are defined as follows:

Study area--an area within the home that is most often used by the student for reading, writing, typewriting, drawing, or any combination of these activities.

Adequate lighting--lighting that meets standards developed by the Illuminating Engineering Society, Better Light Better Sight Bureau, and General Electric Company for residential use. These standards relate to quality and quantity of illumination.

Lamp--a man-made source of light, often called a "bulb" or "tube."

Luminaire--"a complete lighting unit consisting of a lamp or lamps together with parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply" (IES Lighting Handbook, 1972, p. 1-12).

BASIC ASSUMPTIONS

The basic assumptions made in relation to this study are as follows:

Students have a study area in their homes.

Students do most of their studying at home after exterior darkness.

CHAPTER II

REVIEW OF LITERATURE

For all people light and vision are interdependent; the ease, comfort, efficiency, and accuracy with which the eyes perform are dependent on the quantity and quality of illumination in the visual field and on the visual task. Larson (1964, p. 4) stated that lighting has a responsibility to the human being "to be of such a nature that it enables the eye to function freely, without undue strain, fatigue, or discomfort."

The conditions for optimum visual performance have been determined in the laboratory. In prescribing a suitable visual environment, the psychological, as well as the physiological components, were considered. However, these conditions vary within each home since each family differs. Weber in 1959 reported that less than 15 percent of the homes met established lighting standards. Homes had an insufficient number of bulbs to meet recommended levels of illumination. According to Kelly (Iverson, 1969), most homes suffer from inadequate lighting from the time they are in the blueprint stage and less than one percent of the average family's income is spent on lighting.

Weber (1959) identified problems which existed in residential lighting. Some of these problems were: few people were experienced enough to provide the quantity and quality of illumination needed in the home; good lighting was too expensive for the average homeowner;

most families considered low levels of illumination homey and relaxing; and equipment was inadequate to provide suitable illumination.

Consumers need to know how to discriminate between good luminaires and poor ones and should be aware of how luminaires should be placed to assure visual comfort. Page (1964) expressed concern about the lack of consumer's awareness of and interest in lighting quality and performance.

One of the most critical tasks that a student must perform in the home is that of studying. Studying involves critical eye work, fixed position, and mental attentiveness. A proper environment for studying is important if good study habits and attitudes are to be developed.

Surveys have indicated that 20-40 percent of students need some kind of vision care to pursue their studies effectively ("Prevalence of Eye Defects," 1965). Defective eyes need 2-3 times as much light as normal eyes (Peet, 1963). Working under poor lighting does not permanently injure the eyes; however, one can work faster and more effectively when lighting is good. As illumination levels increase, the eye sees better and faster, the ability to see small detail increases, and depth perception increases (Better Light Better Sight Bureau, 1964).

Home study areas were investigated by Weber in 1949. It was reported that there was a prevalence of low wattage luminaires and lack of study space, with many students using locations such as the dining table or card table. In an unpublished master's thesis by Harlan (1960), graduate students were found to have inadequate home study lighting.

A set of conditions for home study has been established as a result of research done by Illuminating Engineering Society (IES) committees. From this information, a concept of the home study task and its surroundings was developed. This related to the average size of the human form, the normal attitudes for reading and writing, desirable conditions with respect to posture, and other physical conditions conducive to comfortable, yet efficient studying (Campbell, 1965).

The most inclusive set of standards available to evaluate study areas were those established by IES for providing quantity and quality illumination needed for residential study tasks (IES, 1965). The IES developed performance criteria independent of the lamp design for any portable luminaire. To assure maximum efficiency, the luminaire must be located in the proper position in relation to the specified study task (reading pencil writing). There were certain conditions which had to remain constant: the eye level 14 inches above the task, the shade no more than 15 inches above the task, and a desk at which to study. In addition to the IES standards, Better Light Better Sight Bureau (BLBS) and General Electric (GE) specified conditions for study environment and task lighting. However, both of these incorporated the performance criteria established by IES.

Utilizing the standards of the IES for lighting performance, the Better Light Better Sight Bureau established a testing laboratory to evaluate luminaires for these performance qualities. Luminaires that met BLBS Bureau requirements carried a BLBS tag to assure consumers that it had these characteristics: "provide wide light distribution over the critical working area, soft shadows without direct or

reflected glare, upward and outward light and a range of footcandles within scientifically acceptable limits" (BLBS Bureau, 1968). Campbell (1965) stated that a BLBS lamp certification guarantees quality of lighting and simplifies the consumer search for a good study lamp. BLBS also specified environmental conditions necessary for a good study situation.

GE developed the Light Book to aid people in planning, selecting, and locating lighting in the home for maximum efficiency, beauty, and comfort. It incorporated IES standards in its lighting designs.

QUANTITY AND QUALITY OF ILLUMINATION

Adequate illumination for home study can be described as consisting of several characteristics under two basic categories: quantity and quality.

Quantity of illumination refers to the level of illumination on a given task at a given time. The level of illumination for residential study tasks was established by the "commonly used most difficult task of pencil handwriting" (Crouch, 1958, p. 416). Prior to 1958, 40 footcandles at any one place on the study task was the minimum IES recommendation. Blackwell in 1958 evaluated No. 2 pencil handwriting on white, blue-lined paper to permit rapid assimulation of information with 99 percent accuracy. It was found that a minimum of 70 footcandles of glare-free illumination was needed at each point on the test plane at any one time. This took into consideration the four fundamental factors of seeing: size of detail, contrast of detail with background, time interval of seeing, and brightness of the task

(Crouch, 1958). This level of illumination was adopted by the IES. Blackwell and Blackwell in a report to IES in 1968 emphasized the importance of the beneficial effect that increased illumination has on visual performance.

Quality of illumination is designated as light that is comfortable and free from glare, annoying shadows, and contrasts. "IES Lighting Performance Requirements for Table Study Lamps" (1965) included quality provisions concerning loss of contrast in the task due to veiling reflections, diffusion of shadows, shade brightness, brightness at lamp top, and a maximum-to-minimum ratio of footcandle readings on task of 3:1.

According to the "IES Lighting Performance Requirements for Table Study Lamps," IES Engineers Crouch and Kaufman (1967, p. 480) developed six practical questions to use when evaluating a portable table luminaire for home study.

1. Can the lamp provide a minimum of 70 footcandles on the study task with no greater variation than 3 to 1 between the maximum and the minimum values on the task?

2. Is there a lighted room effect; that is, is 10 percent of the lamp output emitted above the level of the bottom edge of the shade?

3. Does the lamp produce glossy reflections that hide the visual task, and are there subtle veiling reflections that decrease the contrast of the task, or is there ample illumination to compensate for these reflections?

4. Are there harsh, distracting shadows produced on the task or is there a pleasant distribution of light?

5. Is the shielding media so bright that it will produce glare or so dark that it will reduce our ability to see by changing the state of adaptation of the eyes?

6. Is the top of the lamp low enough in brightness to minimize the glare for someone standing at the desk?

ILLUMINATION LEVELS

Lighting design must be planned for general and task illumination. General lighting is the amount of light throughout an entire room and is for general seeing purposes. The IES Lighting Handbook (1972) states that the general illumination of a room should be no less than 1/10 the task illumination for visual comfort and concentration.

Task lighting is the amount of light needed to perform a specific task with maximum efficiency. For study purposes IES (1965) recommended a minimum of 70 footcandles at any one of five points on a 12 by 14 inch square at any one time.

LUMINAIRE DESIGN AND PLACEMENT

IES specified lighting performance; however, certain design characteristics are necessary for a luminaire to provide quantity and quality illumination. These were stated in terms of one single portable luminaire since surveys had indicated that this was commonly used by the student at home when studying (Campbell, 1965). However, these characteristics could also apply to more than one luminaire (BLBS, 1968). A luminaire should provide side light distribution without direct or reflected glare, upward and outward light, and recommended level of illumination.

The shade of the luminaire should have certain characteristics to provide adequate illumination. IES (1960) stated that a portable lamp should be at least 16 inches or greater across the bottom to allow a sufficient spread of light on the task. GE (1968) gave the minimum dimensions of the shade top as 8 inches and the depth as 10 inches. According to IES (1965), the bottom edge of the shade should be 15 inches from the study surface to permit optimum spread of light while low enough to cut off a direct view of the bare bulb and under-shade brightness. The shade should be translucent, open at the top and bottom, light in color, and have a high reflectance lining. IES (1965) stated that the brightness of the shade should not be less than 50 footlamberts or more than 150 footlamberts. Crouch and Kaufman (1965) reported that some light must be emitted upward by the luminaire to produce a "lighted room effect" and to prohibit excessive contrast between lighted and unlighted areas.

For seeing comfort, the luminaire should provide well diffused light which would soften or scatter light and reduce glare. To obtain this, there must be a diffusing, reflecting, refracting, or shielding element to provide quality of illumination (IES, 1965). These elements below the bulb may be of several types, such as a white plastic or white glass bowl, a white plastic disk, or a refracting lens to be accepted by BLBS (1968). Crouch and Kaufman (1965) state that a top shield may be used to reduce glare to the person standing and provide some light upward.

The level of illumination needed may be provided by a 200 watt incandescent lamp (IES, 1966). GE (1968) also recommended the use of

a 50/250 watt 3-way incandescent lamp. One 40 watt or two 30 watt flourescent tubes with a stationary frame may be used (GE, 1968 and BLBS, 1968). IES stated that more light reaches the task if the bulb is placed close to the bottom of the shade.

The placement of the luminaire is important for the illumination of the study task. Kaufman (1965) stated that the lamp should be placed 15 inches to the right or left of the task center to obtain the best diffusion and level of illumination. The luminaire should be placed to the left of center for a right-handed person and to the right of center for a left-handed person. IES (1965) specified that the luminaire be placed 12 inches from the front of the study surface.

GENERAL DESIGN CONSIDERATIONS FOR THE LIGHTING OF STUDY TASK

To assure visual comfort, the surroundings of the study task must be considered in the lighting design. Brightness patterns in the visual field have been found to be of great importance. IES (1966) stated that wall surfaces should be light in color with a reflectance of 40 percent or more and without a strong pattern. The floor should be above 25 percent reflectance and the ceiling above 60 percent reflectance. If a person faces an open room while performing a critical eye task, the general illumination should be increased. All sources concur that the wall should be non-glossy and free from contrast.

Students need a definite place or area in the home to study to make work less tedious and to enhance productivity. IES (1966) recommended a flat top study surface that is light in color (30-50 percent reflectance) and non-glossy. The study surface should be a

minimum of 24 inches by 36 inches. If the surface is too dark or glossy, a pastel blotter may be used to avoid distracting differences between the study surface and the task (BLBS, 1968). The desk should be placed against a wall to utilize diffuse reflection from the wall and to control the visual field. The study surface should not face an open room, a mirror, or a window because the brightness cannot be easily controlled and would provide mental and visual distraction. BLBS (1968) suggested the bedroom as a good place for study since it is away from noise and other activities.

BLBS (1968) recommended the use of a straight back, armless chair. The chair should be high enough for the student to sit erectly with both feet on the floor, and for the eyes to be 14 inches from the study surface (IES, 1965). The IES Lighting Fundamentals Course (1971) stated this as the distance the eye most easily focuses to perform efficiently a given task.

LUMINAIRES AVAILABLE FOR HOME STUDY

Campbell (1965) stated in 1964 that there were no luminaires on the market at that time that would meet IES footcandle levels for the task of studying. However, there were luminaires on the market advertised as study lamps. Crouch and Kaufman (1967) stated that the consumer is confused by the many advertisements and articles on various types of lamps for home study. A question raised was how is the consumer to determine what he should purchase?

In 1967, Crouch and Kaufman compared three types of luminaires commonly sold as study lamps: a BLBS study lamp, a high intensity lamp,

and a gooseneck lamp. They evaluated lighting performance according to IES specifications. Only the BLBS study lamp met all performance requirements. Both the high intensity and gooseneck luminaires met only the requirements of low veiling reflections and that the top of the luminaire be well shielded. Consumer's Report (1968) and IES agreed that the high intensity luminaire was good as supplementary lighting for very detailed work, but not good as the only source of task lighting.

CHAPTER III

PROCEDURE

This was an exploratory study designed to gain information about lighting and study conditions in home study areas of junior high school students in Greensboro, North Carolina. The data regarding lighting and other conditions affecting studying were recorded on a schedule developed for this study.

THE SCHEDULE

The review of literature provided the basis for the items included in the schedule that were considered important to a good study area. Personal data items included: (1) family characteristics, such as number in family, educational level of parents, income, and home ownership, and (2) student characteristics, including age, sex, and hand used for writing. This section also identified items in the room used for studying, time of study, other activities carried on within room at time of study, parent's and student's opinions about adequacy of lighting in the study area, and any information sources utilized to obtain knowledge about light needed for study. Data regarding measurements and descriptions of factors affecting the lighting of the study area were recorded. These consisted of: general and task illumination and luminaires; wall, floor, ceiling and study surface reflectances; placement of study surface, and luminaire; the size of study surface and chair; and specific characteristics of any study luminaire--such as shade, lamp, and diffuser. These characteristics relate to quantity and quality of illumination.

The schedule was pretested with three families in Greensboro, North Carolina, for clarity and adequacy in soliciting information needed and to estimate the time required for an interview. The schedule prepared and used in collecting data is given in Appendix A.

EQUIPMENT USED

Standard measurement equipment was secured for this study. Equipment consisted of a footcandle meter, a glossmeter, a simulated task, General Electric Reflectance Value Chart, and a metal tape measure.

Footcandle Meter

The footcandle meter used was the General Electric Type 213 Light Meter which is color-and cosine-corrected. The meter is capable of reading up to 500 footcandles on its basic scale and to 5000 with the use of the multiplying switch. All of the readings were taken on the basic scale. Readings taken were considered approximate values and were rounded off to the nearest whole number. The footcandle meter was used to determine the level of illumination and the brightness and reflectance of surfaces.

Glossmeter

The Gardner 60° Portable Glossmeter, Model No. GG9042, was the instrument used to obtain specular gloss measurements of the study surface and the walls in accordance with the American Standard Testing D523 test method (ASTM). Three readings were taken randomly and an average computed.

Simulated Task

A twelve by fourteen inch sheet of matte board was used throughout the study to represent the task. This is the size used by the Committee of Residential Lighting of the Illuminating Engineering Society in testing the lighting on a study task. The longer dimension was placed parallel to the front edge of the study surface. The position was determined by the student as he sat at the place of study in his normal position for studying.

General Electric Reflectance Value Chart

The GE Reflectance Value Chart was used to estimate the reflectance of surfaces. It was used to check against computational errors in reflectance of desk and wall. By comparison of color chips with existing interior finishes, reflectance could be evaluated to within approximately five percent.

Metal Tape Measure

A metal tape measure was used throughout the study to take measurements of the lamp, study surface, height of student's eyes when seated, and placement of lamp in relation to task.

POPULATION

The population consisted of General Greene Boy Scout Council and Tarheel Triad Girl Scout Council in Greensboro, North Carolina. Directors of each scout organization chose troops that they considered representative of diverse socio-economic membership within these organizations. This consisted of eight Cadette Girl Scout troops from a total

of 20 troops, and twelve Boy Scout troops from a total of 103 troops. There were 153 girls in these eight troops and 195 boys in the twelve troops that ranged in age from 12 through 14 years. Fifty girls and fifty boys were selected by using a table of random numbers. A letter was sent to each student and his parents to seek their cooperation (Appendix B). An appointment to obtain data from each child and one of his parents was made by telephone except in cases of no telephone; then contacts were made by a personal visit. The first twenty-five of each group willing to participate in this study were interviewed. All interviews were conducted after exterior darkness so that all lighting would be completely by artificial means and conditions would be the same for all participants.

Following the interview, participants were given a booklet on study lighting, published by BLBS Bureau, entitled "Reddy Kilowatt says - better light, better sight, better grades." Suggestions were made on site as to how the particular study area might be improved.

MEASUREMENTS AND CALCULATIONS

Calculation of Average General Illumination of the Room

The method used for calculating average general illumination was the one recommended in the IES Lighting Handbook (1966) for a room with a central ceiling luminaire. Readings were taken with the footcandle meter halfway between each corner of the room and the center of the room. An average of the four readings was computed. The meter was held face-up, 30 inches from the floor in an horizontal plane. The same method was used for all rooms.

Calculation of the Average Illumination over Task

The method used in "IES Lighting Performance Requirements for Table Study Lamps" was utilized to calculate average illumination over task. Footcandle readings were taken on each of four corners and in the center of the simulated task. An average of the five readings was computed, and the ratio of the high to low readings was computed.

Calculation of Reflectance Values

The reflectance value was calculated by use of the following method as stated by Allen (1961) using the GE Light Meter. The incident light was obtained by placing the base of the meter against the surface being measured. To obtain the reflected light value, the meter cell was placed against the wall and then drawn back two to three inches. This reading was divided by the incident light to obtain the percentage reflectance value.

Calculation of Brightness of Shade

The brightness of the shade was found by placing the meter cell against the exterior of the shade at the top, middle, and bottom. An average was computed to obtain average shade brightness.

TREATMENT OF DATA

After all 50 students and a parent of each were visited, data were coded and transfered to data sheets. Standard error of the mean was calculated on data which could be compared to specific recommended standards. Findings of the study were analyzed descriptively and reported.

CHAPTER IV

FINDINGS

Findings are discussed as characteristics of respondents, sources and amount of light for general and specific illumination, descriptive characteristics and placement of portable table luminaires, and related conditions to a good study environment. Standard error of the mean indicates level of significance for selected data.

CHARACTERISTICS OF RESPONDENTS

A description of respondents is shown in Table 1. Eighty percent of the 50 participating families had four to six family members. Students were predominantly from families whose income was $10,000 or more and who owned their own home. An income of less than $5,000 was characteristic of 10 percent of the families, while 22 percent had incomes between $5,000 and $9,000. For 80 percent of the parents, the highest educational level of either spouse was at least one year of college; the educational level of the father was slightly higher than that of the mother. Student participants were primarily 13 to 14 years of age. Of the 50 student participants, 44 percent wore glasses, and 88 percent used the right hand for writing.

Place and Time for Studying

Over one-half of the students used their bedroom as the place for studying. Other places utilized for this purpose in order of incidence from high to low were the family room, kitchen, and dining

Table 1. Description of Participating Families

Characteristic	No.	%
Family size		
Three or fewer members	5	10
Four to six members	40	80
Seven or more members	5	10
Age of Student		
Twelve	8	16
Thirteen	19	38
Fourteen	23	46
Highest Educational Level of Either Parent		
Did not complete high school	5	10
Completed high school, no college	5	10
One or more years of college	40	80
Family Income		
Less than $5,000	5	10
$5,000 to $9,999	11	22
$10,000 or more	34	68
Home Ownership		
Owned home	43	86
Did not own home	7	14
Students Wearing Glasses for Study	22	44
Hand Used for Writing		
Right	44	88
Left	6	12

room (Table 2). Forty-two percent were alone in the room and participating in no other activities. An additional 16 percent were also alone but had television on while studying. Someone else was in the room either studying, working, or playing in approximately one-third of the situations.

Table 2. Place and Time for Studying and Simultaneous Activity

Characteristic	No.	%
Place		
Bedroom	29	58
Family Room	10	20
Kitchen	7	14
Dining Room	4	8
Time		
Night	43	86
Day	7	14
Simultaneous Activity		
Television	8	16
Others studying, working, or playing	21	42
None	21	42

Night was the modal (86 percent) time for studying (Table 2). This indicates that most students were dependent upon artificial light during home study time.

Concept of Lighting Adequacy

Sixty-six percent of the parents and 96 percent of the students believed their lighting conditions for study purposes were adequate. There were no students and only one parent who indicated that lighting

for study was inadequate. Lighting was considered less than adequate, but not inadequate, by 32 percent of the parents and four percent of the students. All participants were willing to improve lighting conditions in the home study area.

Source and Location of Information on Lighting

One-half (50 percent) of the students and over half (56 percent) of the parents had had no information on lighting for study purposes (Table 3). Among those aware of information, magazines were the prime sources for students and books for the parents. Approximately 15 percent of students and parents had received some information from teachers. No information had been acquired through newspapers or physicians. By and large, students received information on lighting at home whereas parents received it at school.

Table 3. Information on Lighting

Information (N=100)	Student	Parent	Total	%
Source				
Book	0	10	10	10
Magazine	13	1	14	14
Pamphlet	2	3	5	5
Nurse	1	0	1	1
Teacher	7	8	15	15
Demonstration or Television	2	0	2	2
None	25	28	53	53
Location				
Home	16	2	18	18
School	6	19	25	25
Other (office, club, other)	2	0	2	0

ILLUMINATION SOURCES

General Illumination

General illumination was provided predominantly by ceiling luminaires (Table 4). Others used for general lighting in order of decreasing frequency were portable table, wall, and pole luminaires. There was no source of general illumination in five rooms where study took place.

Table 4. Illumination Sources

Type Luminaire	General Illumination	Task Illumination
Ceiling	42	1
Pole	1	3
Wall	4	3
None	5	12
Portable	10	31
Conventional table	(10)	(16)
Gooseneck		(5)
High intensity		(7)
Fluorescent		(3)

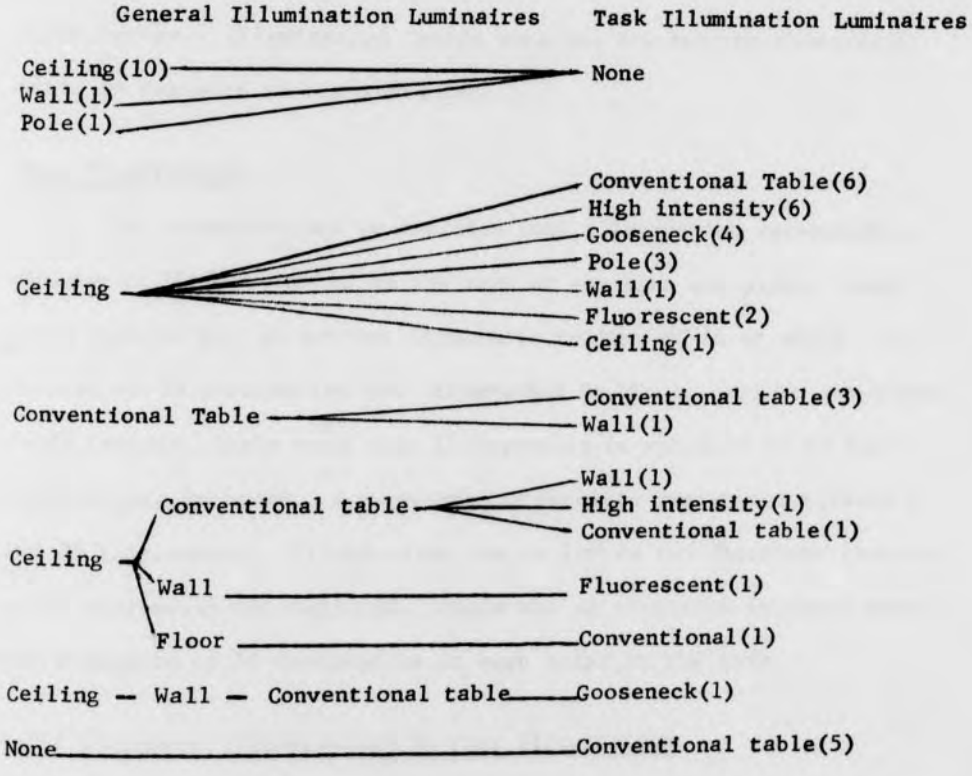
Task Illumination

Lighting in the study area was provided by portable table luminaires in almost two-thirds of the homes; one-half of these were the conventional table type (Table 4). High intensity and gooseneck were the next most frequently used; fluorescent luminaires were rarely used. In 12 instances, there was no task lighting provided.

Combinations of General and Task Illumination

When general and task lighting within a room were considered together, no patterning was evident (Figure 1). The following profiles show combinations of the two which did exist. The numbers in parenthesis indicate frequencies of the combinations. In all instances there was only one source of task lighting, but in four situations two or three sources of general lighting were utilized.

Figure 1. Combinations of General and Task Illumination Sources by Type Luminaire (N = 50)



GENERAL AND TASK ILLUMINATION LEVELS AND THEIR RATIOS

General and task illumination levels are stated as average footcandles. Data for this section appear in Table 5.

General Illumination

Footcandle readings for general illumination should be a minimum of 1/10 of the task illumination level; therefore, the minimum level of general illumination for studying should be no less than seven footcandles. This minimum level was met or exceeded in only 12 percent of the situations. Three-fourths had one to 6.9 footcandles of general illumination. Illumination levels were too low for the footcandle meter to register in six instances.

Task Illumination

The standard used to evaluate task illumination recommends a minimum of 70 footcandles on the task at any time and place. Only eight percent had an average footcandle reading of 70 or above. A minimum of 30 footcandles was recommended by IES to perform any visual task; however, there were only 15 instances in which 30 to 69 footcandles were recorded. A majority (58 percent) registered between 1 and 29 footcandles. Illumination was so low in two instances that the meter used would not register. There was no situation in which there was a minimum of 70 footcandles at each point on the task.

Ratio of General Illumination to Task Illumination

A ratio of 1:10 is recommended for general illumination to task illumination to provide a good field of brightness. Fifty-four percent met this recommendation. Other ratios ranged from 1:10 to 1:49.9.

Table 5. General and Task Illumination Levels in Footcandles and Their Ratios

Characteristic	No.	%
Illumination Levels (average footcandles)		
General[a]		
1- 6.9	38	76
7- 9	6	12
Task[b]		
1-29	29	58
30-69	15	30
70 and above	4	8
Ratio of General Illumination to Task Illumination[2]		
1:0 - 1:9.9	27	54
1:10 - 1:19.9	9	18
1:20 - 1:29.9	4	8
1:30 - 1:39.9	3	6
1:40 - 1:49.9	1	2
Ratio of High to Low Footcandles on Task[c]		
1:1 - 3:1	24	48
4:1 - 10:1	16	32
11:1 and above	5	10

[a] In six situations general illumination level too low to register on meter used.

[b] In two situations task illumination level too low to register on meter used.

[c] Five tasks had areas where illumination levels were too low to register on meter used.

Ratio of High to Low Footcandles on Task

The standard used to evaluate the ratio of high to low footcandles on task was a maximum ratio of 3:1. Forty-eight percent met this recommendation. All other ratios were 4:1 and above except for five instances in which the illumination level was so low at some point on the task that the meter was unable to record it.

STUDY LUMINAIRE CHARACTERISTICS

The recommended standards used to evaluate the study luminaires are stated in terms of one portable table luminaire that has a fixed shade height. Two luminaires may be used if they have the same general characteristics of the single luminaire. Gooseneck and high intensity luminaires do not meet recommended standards for a good luminaire for study. Fluorescent luminaires provide good illumination only when in a fixed position above study surface.

Data used in this section to describe luminaire characteristics that relate to lighting adequacy appear as Appendix C, Table 9. Summary data are shown in Table 6. Interpretations made are those of the researcher.

Base Material

Recommended standards state that the base of the luminaire should be dull to avoid glare and distraction of the eyes. In this study all portable luminaires bases were predominantly shiny; however, 44 percent of the conventional table luminaires and 40 percent of the other portable luminaires met this recommendation.

Table 6. Portable Table Luminaires Meeting Design Recommendations

Design Characteristic	Conventional Table (N = 16)	*Other Portable (N=15)
Base Material	7	6
BLBS Approved	0	0
Shade		
Material	13	0
Color	12	1[a]
Brightness	3	0
Height from study surface	5	b
Dimensions		
Top	8	0
Bottom	1	0
Depth	7	0
Lamp Wattage	1	1[a]
Diffusion Element	1	1[a]
Placement		
According to hand used for writing	8	6
Distance from task center (right or left)	0	0
Distance from front edge of study surface	0	2

*Includes gooseneck, high intensity, and fluorescent.

[a]Fluorescent desk luminaire.

[b]Students frequently changed height of shade.

BLBS Approval

None of the luminaires possessed a BLBS tag of approval to state that it would provide quality and quantity of illumination needed on the study task. Details of this standard are cited in the Review of Literature.

Shade

Standards used to evaluate the shade of the luminaire recommend that it be open at top and bottom with minimum dimensions of 16 inches in diameter at the bottom, eight inches in diameter at the top, and 10 inches deep. Conventional table luminaires met or exceeded the recommendations as follows: eight for the top dimension, one for the bottom, and seven for the depth.

The shade should be translucent with a brightness reading between 50 and 150 footlamberts to avoid glare spots and excessive brightness contrast. Eight-six percent of the conventional table luminaires had translucent shades but only slightly over 20 percent of these met recommended brightness levels. All of the other study luminaires had opaque shades with brightness readings below 50 footlamberts.

The interior and exterior of the shade should be light in color to produce maximum reflectance and minimum contrast with surroundings. Three-fourths of the conventional table luminaires met this recommendation. Other portable luminaires had shades with predominantly dark exteriors and light interiors.

A luminaire can provide more light on a task if the bulb is close to the bottom of the shade. None of the luminaires met this recommendation.

The bottom edge of the shade should be no more than 15 inches above the study surface to assure visual comfort. There were none that met this recommendation; however, only seven conventional table luminaires were 16 inches or above.

Lamps

To provide the quantity of illumination needed, a 200 watt or a 50-200-250 watt incandescent lamp, or two 30 watt fluorescent lamps may be used. In this study, lamp wattage ranged from 30 to 250 with only three portable study luminaires meeting wattage recommendations. One conventional table luminaire had a 50-200-250 watt lamp and one had two 100 watt lamps; one fluorescent luminaire had two 30 watt tubes.

Diffusion Element

A diffusion element is recommended to reduce glare and soften the light. Only one conventional table and one other portable luminaire met this recommendation.

Placement

The luminaire should be placed opposite the hand used for writing to reduce shadows. Slightly less than half of the students had their luminaires placed on the proper side according to hand used for writing.

Recommended location for portable luminaires is 15 inches to the left or right of task center and 12 inches from the front edge of study surface to provide quantity of illumination and not be too close to student or wall. No situation was in accordance with the first part of the recommendation and three qualified for the latter part.

GENERAL DESIGN CONSIDERATIONS FOR THE LIGHTING OF STUDY TASK

A study area should possess certain design characteristics to be properly lighted and provide a suitable place for study. These include the study surface, chair, wall, floor, and ceiling. Raw data appear in Appendix C, Table 10. A summary of characteristics meeting recommendations is shown in Table 7.

Table 7. General Design Considerations for the Lighting of Study Area Meeting Recommendations

Design Consideration	No.	%
Study Surface		
Flat	47	94
Desk	27	54
Color (light)	19	38
Gloss (low)	6	12
Placement (against wall)	18	36
Size		
Width (36 inches)	37	74
Depth (24 inches)	21	42
Chair (straight)	39	78
Eye Level of Student from Task (13-15 inches)	15	30
Wall		
Reflectance (40% or more)	44	88
Gloss (low)	42	84
Finish (subdued)	48	96
Floor Reflectance (25% or more)	42	84
Ceiling Reflectance (60% or more)	43	86

Study Surface

The study surface used by the student was evaluated by type, color (reflectance), gloss, placement, and size. According to recommendations, the study surface should be flat, (preferably a desk), non-glossy, light in color, a minimum of 24 by 36 inches, and placed facing a wall.

Type of study surface. Fifty-six percent of the students studied at a desk; therefore, meeting recommendations. Other surfaces used in order of decreasing frequency were the dining table (30 percent), dressing table (six percent), notebook on lap (four percent), night stand (two percent), and arm of chair (two percent).

Color and gloss. Thirty-eight percent of all study surfaces met the recommendation of being light in color. Seven students had used a blotter to produce a light surface. The amount of gloss was predominantly in the medium range (72 percent). High and low gloss surfaces were about equal in number, resulting in only 12 percent meeting the recommended standard for gloss.

Placement in room. The highest incidence (44 percent) of study surfaces faced an open room. Thirty-six percent met the recommended standards of being flat against a wall. There were nine that faced a window and one that faced a mirror.

Size. Seventy-four percent of all study surfaces met or exceeded recommendations for width; however, only 19 (forty percent) of these were desks. The study surface depth recommendation was met or exceeded by 42 percent of all study surfaces of which seven were desks.

Chair

Standards recommend that a straight chair be used for studying and that a cushion may be used to make it more comfortable. Over two-thirds of the students used a straight chair and of these, over one-fourth used a cushion on it. Other chairs used in order or decreasing frequency were easy chair, swivel chair, bed, sofa, stool, and rocking chair.

The height and size of chair are dependent upon the student. Adjustments are recommended if the student's eye position is not 14 inches from the task. Thirty percent of the students held their eyes 13 to 15 inches from the task. A majority (66 percent) held their eyes 12 inches or less from task.

Wall, Floor, and Ceiling

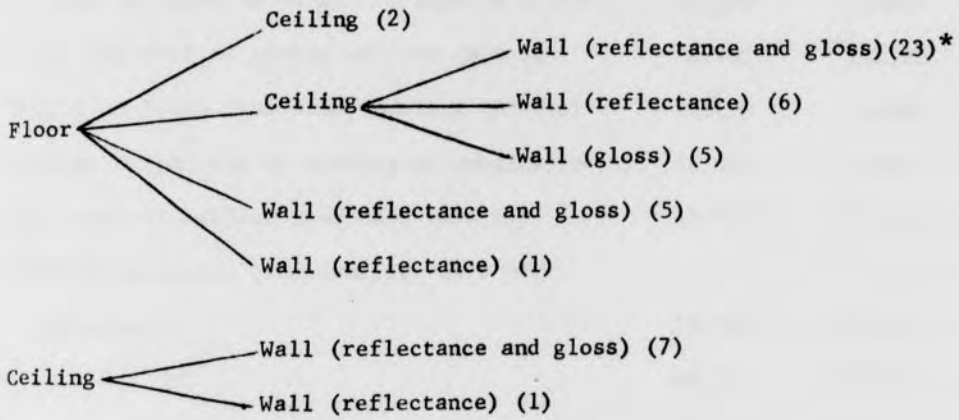
According to the standards used to evaluate the general surroundings, the wall should be light in color (40 percent or more reflectance) and non-glossy to take advantage of maximum reflected light and minimum glare, and to provide even light spread. The pattern of the wall should be subdued to avoid distraction and light absorption. Eighty-eight percent of the walls in the study area met recommendations for being above 40 percent reflectance, 80 percent were non-glossy, and 88 percent had a non-distracting finish.

The reflectance recommended for the floor is 25 percent or more and for the ceiling 60 percent or more. Eighty-four percent of the floors and 86 percent of the ceilings met the standards used.

When the walls, floor, and ceiling within a room were considered, certain patternings were evident. Forty-six percent of all study areas

met all recommendations for walls, floor, and ceiling. Other combinations are shown in Figure 2. The number in parenthesis indicates frequencies of combinations meeting recommendations.

Figure 2. Combinations of Walls, Floors, and Ceilings Meeting Recommendations (N = 50)



*All, except two, walls were subdued in pattern.

STANDARD ERROR OF THE MEAN

Selected factor means were compared with the specific recommendations to test for significance (Table 8). These included placement of luminaire in relation to task, height of shade from study surface, average brightness of shade, eye level of student from task, task illumination at each point and average, and width and depth dimensions of study surface. Those factors which were significantly different ($p < .05$) from the standards recommended were the placement of the conventional table luminaire to the rear of task center, eye level of student from task, all footcandle readings on task, and the width dimension of study surface. The means of these items are likely to be

Table 8. Deviation of Selected Factor Means from IES Recommendations (Standard Error of the Mean)

Factors (in inches unless otherwise stated)	$\bar{M}$	SE
Placement of Luminaire		
Left or right of center of task (N = 16)	14.456	1.9046
To the rear of center of task (N = 16)	10.765	*1.2181
Height of shade from study surface (N = 16)	16.676	1.6298
Average brightness on shade(footlamberts)(N=16)	16.676	1.6298
Eye level of subject from task (N = 50)	12.100	* .2972
Task Illumination (footcandles) (N = 50)		
Location 1[a]	28.730	*4.9366
2	29.240	*5.4202
3	16.750	*3.3001
4	18.630	*3.0717
5	26.460	*4.4647
Average	23.962	*3.4619
Dimensions of study surface (N = 47)		
Width	49.027	*3.4720
Depth	25.521	1.3569

[a]Locations one through four are corners of simulated task, in clockwise sequence; location five is center of task.

*$p < .05$ significance.

the same as the standards in less than five instances out of 100. The standard error of the mean was computed only on conventional table luminaire placement since other portable luminaires have no standard placement recommendation.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary, conclusions, and recommendations are discussed as separate groupings. Implications for further study are included in recommendations.

SUMMARY

This study was designed to identify the areas in the home where students study and to evaluate the adequacy of lighting in those areas. Evaluation criteria were derived from recommendations of the Illuminating Engineering Society, Better Light Better Sight Bureau, and General Electric Company. Data were collected in the home study areas of junior high school students in 50 families in Greensboro, North Carolina, in the spring of 1969. Both a junior high school student and a parent in each household were participants. The researcher collected data by means of interview and measurement.

Adequacy of illumination in terms of quality and quantity was determined by level of general and task illumination and their ratios, study luminaire characteristics, and related conditions such as chair, study surface, walls, floor, and ceiling. There was no situation which met all recommended standards for quantity and quality of illumination for home study lighting.

Neither students nor parents were aware of or able to determine adequacy of lighting in the home study area. Ninety-six percent of the

students and 66 percent of the parents believed lighting in the study area to be adequate but, in fact, not one study area met recommendations. This may be due to the fact that half of the respondents had had no information on lighting. Those who had had information received it primarily from magazines and teachers. It was interesting to note that no information was received from physicians even though 44 percent of the students wore glasses. All participants indicated that they were interested and willing to improve lighting conditions in areas of the home where students studied.

The place in the home most frequently used for studying was the bedroom. Other locations included family room, kitchen, and dining room. There were equal numbers who studied alone in a room with no other activities taking place and those who had someone else in the same room either studying, working, or playing. Almost all students studied predominantly at night (86 percent), used right hand for writing (88 percent), and held eyes too close to taks (66 percent).

General illumination was provided by ceiling luminaires in a majority of the situations; however, there were five rooms that had no general illumination. Study task lighting was supplied predominantly by portable luminaires of which half were the conventional type with a fixed shade height. Almost half of all portable table luminaires possessed flexible shade heights which are characteristic of gooseneck, high intensity, and fluorescent desk luminaires. One-fourth of the participants had no study luminaire and 14 percent had either pole, wall, or ceiling study luminaires. There were numerous combinations of luminaires for general and task illumination, but no patterning was evident.

There were no conventiinal table luminaires which met all descriptive recommendations for a portable study luminaire. High intensity, fluorescent, and gooseneck luminaires are not acceptable as study luminaires, yet they were used by one-third of the students.

A majority of the conventional table luminaires met only the standards for shade material and color; however, only three of these had sufficient brightness readings on the shade. The shade was an improper height and size in the majority of the situations. A shiny base, low wattage, no diffusion element, and incorrect placement on study surface were prevalent. Approximately one-half of those who used a conventional table luminaire had it placed on the correct side of the task, based on which hand was used for writing. None of the task luminaires were BLBS approved.

Illumination levels for general and specific task lighting were inadequate in a majority of the situations. Only 12 percent met minimum recommendations for general illumination. Eight percent of the tasks had an average illumination level high enough to meet recommended levels, but not at each point on the task.

Even though illumination levels were low, the ratio of general to task illumination met recommendations in slightly over half of the situations. When looking at the task alone, high to low footcandle ratio recommendations were met in slightly under half of the situations.

The conditions related to a good study center were generally adequate. Students studied predominantly at some flat surface (94 percent) while seated in a straight chair (78 percent). In over half of the situations a desk was used, thus meeting recommendations. Other surfaces

utilized were dining table, dressing table, and night stand. A majority of the study surfaces were dark in color, glossy, and placed incorrectly for the best field of vision. Most (78 percent) of the surfaces were wide enough but not deep enought to meet recommendations.

Characteristics of the room where study took place met recommendations in most of the homes. The walls were mainly light in color, non-glossy, and without pattern and in most instances the floors and ceilings had adequate reflectance readings.

The standard error of the mean was computed on selected factors to test for significance. Statistically significant differences ($p < .05$) were found between recommended standards and the means of: luminaire placement to rear of task center, eye level of student from task, all footcandle readings on task, and the width of study surface.

CONCLUSIONS

By recommended standards for the lighting of a home study area to provide quantity and quality illumination, actual lighting conditions in home study areas are not adequate. The inadequacy was due primarily to lack of sufficient sources and footcandle levels for general illumination, improper type of study task luminaire, and low wattage for task illumination. Most of the study luminaires utilized by students were designed for decorative and general purpose use, not for the critical eye task of studying. Quality and quantity of illumination could often be improved by simple corrective means such as: relocation of study surface, relocation of luminaire according to hand used for writing and in relation to study task, increase in lamp wattage, increase in general

illumination level, use of more than one study luminaire, use of blotter on study surface (to increase reflectance and reduce glare), and placement of cushions in chairs (to raise eye level of student). The elimination of other simultaneous activities in the room would also improve the study situation.

Few students and parents know of available information on lighting a home study area. Students and parents need help in understanding the importance of a planned home study area, in selecting luminaires for specific tasks, and in developing a good study area in the home.

RECOMMENDATIONS

Students and parents need to be made aware of the importance of a planned home study area with the quantity and quality of illumination needed for the individual to perform optimally. It is important that this awareness be developed early in a child's life since lighting has such extensive influence on the student's habits and attitudes.

The following questions could be answered through further study. How much studying takes place at home? Does the present crusade to conserve energy affect the amount of light and type of lamp used for home study? Are people willing to pay the price for adequate illumination in the study area? How aware are people of the BLBS study luminaire? Do people inquire about the best type of luminaire for studying when actually purchasing one? Are salespeople well enough informed to help people with the purchase of a good study luminaire? Do students hold their eyes too close to a task because

of inadequate illumination, chair and desk height, or defective vision? To what extent are sources of information on lighting generally available to the consumer?

Home economists in extension, classroom, and industry, child care directors, doctors, nurses, and other professional people dealing with children and/or light and sight need to aid parents and students in acquiring and understanding proper vision care, especially for critical eye tasks such as studying. There is a great opportunity for the above professionals to provide programs, literature, and guidance to families on developing good study lighting conditions in the home.

Perhaps a mass communication effort such as public service announcements on television and radio about "what are your child's study conditions" could be launched. Sources where people could receive help and literature would be given. Cooperating newspapers could print a special on study lighting and provide a list of sources of information on lighting. During this same time period, emphasis could be placed on developing a proper home study area by the schools in the form of demonstrations and workshops in the classroom or Parent-Teacher-Student Associations. Literature on study lighting could be made readily available to the general public by being provided in retail outlets where luminaires are sold, doctor's offices, public health departments, utility companies, and schools.

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APPENDIX A

SCHEDULE

I. Family Characteristics

_____number in family

_____number of children at home

_____highest education of husband:
_____highest education of wife:
1. did not complete high school
2. completed high school - no college
3. one or more years of college

_____total family income per year after taxes:
1. less than $5,000
2. $5,000 - $9,999
3. $10,000 or more

Owns home:
_____yes
_____no

II. Student characteristics

_____age of student
Sex:
_____male
_____female
Wears glasses:
_____yes
_____no
Hand used for writing:
_____right
_____left

_____room within home where student most often studies

_____

_____other activities carried on within room while studying

Most study occurs during:
_____night
_____day

Do you believe lighting in study center is:

Parent	Student	
_____	_____	adequate
_____	_____	less than adequate
_____	_____	inadequate

Willing to improve lighting in study area:
_____yes
_____no

III. Information sources utilized

Has parent or student had any information about lighting for study?

Parent	Student	Source:
_____	_____	book
_____	_____	magazine
_____	_____	pamphlet
_____	_____	newspaper
_____	_____	doctor
_____	_____	nurse
_____	_____	teacher
_____	_____	other (specify) _____

		Where (location):
_____	_____	home
_____	_____	school
_____	_____	office
_____	_____	other (specify) _____

APPENDIX A (continued)

IV. Types and number of luminaires for general illumination in room:
_____ceiling
_____pole
_____wall
_____table
_____floor
_____other (specify) _____

V. Study luminaire
Type:
_____table
_____gooseneck
_____ceiling
_____wall
_____floor
_____pole
_____high intensity
_____other (specify) _____
BLBS approved:
_____yes
_____no
General description: (sketch)

_____height
_____height from floor to lower edge of shade
_____height from study surface to lower edge of shade
_____base material(shiny-dull)
Placement of luminaire in relation to task:
_____"to the right of center of task
_____"to the left of center of task
_____"from front edge of study surface
_____"to the rear of center of task
Shade:
Exterior: _____% reflectance chart rating* color- _____light _____medium _____dark
Lining: _____% reflectance chart rating* color- _____light _____medium _____dark
Material:
_____plastic
_____metal
_____fabric
_____glass
_____other (specify)_____
_____translucent
_____transparent
_____opaque
Brightness reading on shade:
_____1 _____2 _____3 _____average footlamberts
Placement of lamp within shade:
_____close to the top
_____middle
_____close to the bottom
Dimensions of shade:
_____diameter of top of shade
_____diameter of bottom of shade
_____depth of shade
Eye level of student when seated:
_____"from floor
_____"from study surface
Lamp (bulb):
Type:
Incandescent-
_____number
_____wattage
_____Finish:
_____white
_____inside frosted
_____other (specify) _____
Shape:
_____A
_____R40
High Intensity- _____wattage
Fluorescent-
_____color
_____wattage
Diffusion bowl:
_____CLM
_____opal bowl
_____polished metal cone
_____pressed white glass
_____plastic disc diffuser
_____plastic disc diffuser with top shield
_____diffusing or refracting dish (BLBS)
_____none
_____other (specify) _____

APPENDIX A (continued)

VI. Chair
Type:
_____straight
_____easy
_____swivel
_____other (specify)_____
Height of chair seat:
_____inches
_____cushion

VII. Study furniture surface
Type:
_____dining table
_____desk
_____card table
_____other (specify)_____
Dimensions:
_____height
_____width
_____length
Location within room:
_____flat against wall
_____faces open room
_____corner of room
_____other (specify)_____
Finish of desks or study surfaces:
Reflectance:
_____reflected light
_____incident light
_____%computed reflectance #
_____%chart rating*
Color:
_____light
_____medium
_____dark
Gloss reading (specular reflection):
_____1
_____2 _____blotter
_____3 _____average

VIII. Wall finish
Type:
_____wood paneling
_____wall paper
_____painted
_____other (specify)_____
Reflectance:
_____reflected light
_____incident light
_____% computed reflectance #
_____% chart rating*
Color:
_____light
_____medium
_____dark
Gloss reading (specular reflectance):
_____1
_____2
_____3 _____average

IX. Reflectance - study area:
_____% floor reflectance*
_____% ceiling reflectance*

X. Level of general room illumination with lights normally used while studying in room: (measurements taken between center and each corner of room)
_____1
_____2
_____3
_____4

_____average footcandles
_____ratio of general room illumination to task illumination

XI. Task illumination:
_____1
_____2
_____3
_____4
_____5

_____average footcandles
_____ratio of highest to lowest
Task brightness:
_____footlamberts

*General Electric Reflectance Rating Chart
#Reflectance is equal to $\frac{\text{reflected light (footlamberts)}}{\text{incident light (footcandles)}}$

APPENDIX B

THE UNIVERSITY OF NORTH CAROLINA
AT GREENSBORO

School of Home Economics

February 21, 1969

Dear Parent and Boy Scout:

Miss Ann Staton, a graduate assistant with us, is undertaking a study of lighting at locations within the home where students do their school homework.

You have been randomly selected from the age twelve to fourteen year Scout membership in the Greensboro area to participate.

We believe this will be an interesting experience for you as well as one helpful to us and sincerely hope that you can cooperate with us.

Sincerely,

/s/ Jane H. Crow

Jane H. Crow
Professor and Chairman
Housing and Management Area

JHC-k

APPENDIX B (continued)

February 21, 1969

Dear Parent and Boy Scout:

A study on lighting in home-study areas is being conducted in the School of Home Economics at the University of North Carolina at Greensboro. The purposes of this study are to identify the area within the home where studying is accomplished, and to determine the quantity and characteristics such as glare, reflectance, and distribution of lighting in this area.

You were randomly selected from the age twelve to fourteen-year Boy Scout membership in Greensboro, North Carolina, to participate in this study. All information will be kept anonymous and confidential. Data will be used in determining what types of information would be useful to persons developing or changing a study center at home and to persons concerned with teaching home lighting. Wnen the study is completed, all who participate will be sent a copy of the results.

I would like to arrange an interview with you and your child to visit in your home to obtain desired information. I will try to reach you by telephone within the next week to make an appointment. I look forward to your cooperation which will be greatly appreciated.

Sincerely,

/s/ Ann Staton

Ann Staton
Graduate Assistant

APPENDIX B (continued)

THE UNIVERSITY OF NORTH CAROLINA
AT GREENSBORO

School of Home Economics March 10, 1969

Dear Parent and Girl Scout:

Miss Ann Staton, a graduate assistant with us, is undertaking a study of lighting at locations within the home where students do their school homework. You have been randomly selected from the Cadette Scout membership in the Greensboro area to participate.

Miss Staton would like to arrange a short interview with you and your child in your home. She will try to reach you within the next two weeks to make an appointment, either by telephone or stopping by. All information will be kept anonymous and confidential. It will be used in determining what type of information would be useful to persons developing or changing a study center at home, and to persons concerned with teaching home lighting.

When the study is completed, all who participate will be sent a copy of the results. We look forward to your cooperation which will be greatly appreciated.

Sincerely,

/s/ Jane H. Crow

Jane H. Crow, Professor
Housing and Management Area

/s/ Ann Staton

Ann Staton
Graduate Assistant

JHC/et

APPENDIX C

Table 9. Descriptive Characteristics of Portable Table Luminaires

Characteristic	Conventional Table (N=16)	Other (N=15)
Base Material		
Shiny	9	9
Dull	7	6
BLBS Approved	0	0
Shade		
Material		
Plastic - translucent	1	0
opaque	0	2
Metal - opaque	1	13
Fabric - translucent	6	0
Glass - transparent	1	0
Parchment - translucent	6	0
opaque	1	0
Color		
Light interior and exterior	12	1
Medium exterior and light interior	2	4
Dark exterior and light interior	2	10
Average brightness readings in footlamberts		
0	3	15
1 - 49	7	0
50 - 150	3	0
150 +	3	0
Dimensions in inches		
Top: 0 -7	8	15
8- 15	8	0
Bottom: 0 - 15	15	15
16 +	1	0
Depth: 0 -9	9	15
10 - 17	7	0
Distance of bottom from study surface		a
Less than 14 inches	4	
14 - 15 inches	5	
16 inches +	7	
Placement of Lamp Within Shade		a
Close to top	2	
Close to Bottom	0	
Middle	14	

Table 9 (continued)

Characteristic		Conventional Table (N=16)	Other (N=15)
Lamp Type	Total Wattage		
Incandescent	40	2	1
	60	3	2
	75	1	1
	100	5	1
	150	3[b]	0
	200	1[c]	0
	50-200-250	1	0
(High intensity)[d]			(7)
Fluorescent	15		1
	30		2
Diffusion Element			
Plastic (used with two 15 watt fluorescent)			1
Opal bowl (used with one 150 watt Incandescent)		1	
Distance from Task Center (left to right)			
Less than 15 inches		8	12
15 inches		0	0
16 inches or more		8	2
Distance from Front Edge of Study Surface			
Less than 12 inches		0	2
12 inches		0	1
More than 13 inches		16	12
Placement to Right or Left of Task			
Right		7	5
Left		7	6
Center		2	4

[a]Does not apply to high intensity, gooseneck, or fluorescent luminaires.

[b]Includes two 75 watt lamps.

[c]Includes two 100 watt lamps.

[d]Wattage varies and is unidentified.

Table 10. General Design Considerations for the Lighting of Study Area

Design Consideration			No.	%
	Study Surface			
Type				
Desk			28	56
Dining table			15	30
Dressing table			3	6
Notebook on lap			2	4
Nightstand			1	2
Arm of chair			1	2
	Desk	Other Surfaces		
Color (according to percent light reflectance)[a]				
[b]Light (30% and above)	12	7	19	38
Medium (15 - 29%)	12	8	20	40
Dark (0 - 15%)	4	4	8	16
Gloss (according to glossmeter reading)[a]				
High (70.0 and above)	4	1	5	10
Medium (6.0 - 69.9)	18	18	36	72
Low (0 - 5.9)	6	0	6	12
Placement in Room				
Flat against wall	17	1	18	36
Faces open room	3	19	22	44
Faces window	8	1	9	18
Faces Mirror	0	1	1	2
Size (in inches)[a]				
Width: less than 36	9	1	10	20
36 or more	19	18	37	74
Depth: less than 24	21	5	26	52
24 or more	7	14	21	42

[a]Does not include arm of chair or notebook on lap.

[b]Seven used a blotter on study surface.

Table 10 (continued)

Design Consideration	No.	%
Chair		
Straight	39	78
Easy	3	6
Swivel	2	4
Bed	2	4
Sofa	2	4
Stool	1	2
Rocking chair	1	2
Eye Level of Student from Task		
0 - 12 inches	33	66
13 - 15 inches	15	30
16 inches and above	2	4
Walls, Floor, and Ceiling (reflectance in percent)		
Walls		
0 - 39.9	6	12
40 and above	44	88
Floor		
0 - 24.9	8	16
25 and above	42	84
Ceiling		
0 - 59.9	7	14
60.0 and above	43	86
Wall Gloss and Pattern		
Gloss (reading as on glossmeter)		
High (70.0 and above)	0	0
Medium (6.0 - 69.9)	8	16
Low (0 - 5.9)	42	84
Wall Finish		
Strong pattern	2	4
Subdued pattern	48	96