HOW BIG SHOULD IT BE?

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IT IS an inescapable fact that in order to be useful as a *visual* aid any aid must be *visible*. The smallest significant detail must be visible to the student the greatest distance from the aid. It is not enough that the student be able to see the whole item—he must be able to make out the little things about it that will help him to learn.

Most instructors have learned the tricks of using real objects in the classroom and have learned to overcome the limitations of size in posters, films, and other training aids which have been supplied them. However, with more and more instructors making their own transparencies for overhead projection, it is important to point out a few significant things about visibility.

General Considerations

Several things affect the visibility of an object. In the first place, a relationship exists between the object to be viewed and the person viewing it. That relationship has to do with object size, distance, the visual acuity of the viewer and the brightness or amount of light which is reflected from the object. Viewing angle, extraneous light, color, and certain other factors all enter into the problem. Because most instructors have learned to project aids properly and to control extraneous light and to seat classes where all can see the screen without distortion, we can delimit our discussion to the problem of "How big must the smallest significant item in a transparency for overhead projection be made in order that it can be seen by every member of the class?"

In order to arrive at the size of the item, we must take into consideration the magnifying power of the overhead projector, the distance between the projector and the screen, the distance of the furthest student from the screen, and the visual acuity of the student.

Visual Acuity

With few exceptions men in the Navy have 15/20 vision or better. The eye doctors tell us that people with 20/20 vision can see an object which subtends an arc of 5 minutes (1/12 of a degree). To introduce a safety factor and to accommodate the man with 15/20 vision, we will enlarge our object to subtend an arc of 8 minutes.

The mathematically inclined reader may wish to go to his table of trigonometric functions to determine the size-distance relationship (2 Tan 4′) but for others suffice it to say that from the facts stated above the size of an object may be determined for any given distance. Therefore, if we know how far away from the screen our furthest student is going to be, we can figure out how big any image on the screen must be.

Projector Magnification

What determines how big the screen image is going to be? There are two things. The first is the size of the object being projected and the second is the ratio of projector magnification to projector distance from screen.

Because essentially we are trying to determine how big the object to be projected must be, we will look next at the projector magnification.

The overhead projector used by the Navy will enlarge a ten by ten (10″x 10″) transparency to the sizes shown for the various distances in table 1. It is hardly necessary to point out that any part of the transparency will be magnified to exactly the same degree. Examination of the table will show that for each foot of distance between the screen and the projector, the image is magnified .8 times. That is, if an object 1 inch high is projected from a distance of six feet it will be 4.8 inches high on the screen.. (1x6x.8 equals 4.8).

Solution

We know that the minimum height of the screen image which can be seen readily by the student with 15/20 vision at 15 feet is 8-3/4mm. or slightly less than 3/8 inch. We can also calculate the size of the screen image resulting from the projection of a transparency image of given size at a certain projector distance. Since the screen image seen by the student is the same as the image projected, we can use Figure 1.

We can put our several factors together and arrive at a formula for computing any of the required factors. The formula may be stated in three different ways, as follows:

$$D = \frac{d}{26i}$$

$$i = \frac{d}{26D}$$

$$d = 26Di$$

D = distance from overhead projector to screen in feet;

d = distance of furthest student from screen; stated in feet;

i = size of smallest significant detail in the transparency image, stated in inches.

Examples

If, then, the instructor finds a ready-made transparency which he wishes to use, but he is doubtful of the size of the things he wishes his student to see, he measures the smaller dimension of the object (the detail, not the whole transparency) and assumes or estimates how far the last row of students will be seated from the screen. For sake of example let us say that the detail is ¼ inch and, because his class is very large, the last row of students will be forty feet from the screen. If we go into the formula with these figures, we can com-

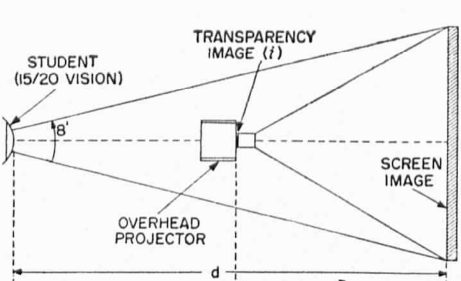

Figure 1

pute how far from the screen the projector must be placed.

$$D = \frac{40}{26 \times .25}$$

D equals approximately 6¼ feet.

The projector should not be closer to the screen than 6¼ feet. It may be placed further away but it is not necessary and if light is a problem it would be advantageous not to do so.

If an instructor is developing his own transparencies, he will want to know how large any detail must be in order to be seen in his classroom circumstances. If his furthest student will not be more than 20 feet and he can only get his projector back 6 feet (because of screen size or other limitation), he uses the formula:

$$i = \frac{d}{26D}$$

$$i = \frac{20}{26 \times 6}$$

i equals .13 inches

From table 2, .13 inches equals ⅛ in.)

Applications

If the instructor has prepared the material for the transparency by hand, the lettering undoubtedly will be legible. However, if he is using printed text, such as a table of numbers, it is very important that the type be enlarged sufficiently in the transparency to be legible on the screen. It must be borne in mind that the width as well as the height of the object is enlarged in the same ratio in making a photographic enlargement. This will be clear from Figure 2.

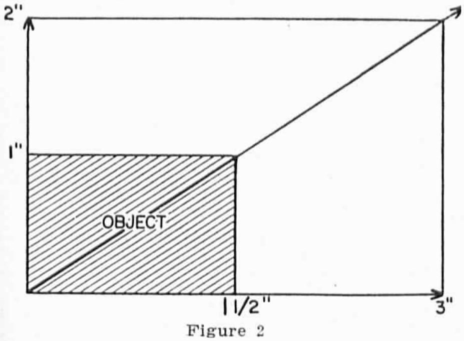

Figure 2

The instructor may find it advisable to have only the significant part of the material enlarged. An additional transparency will highlight the important details.

In making a poster or chart, for example, into a 10″ x 10″ transparency for projection, the significant detail may be reduced too much in size. Measure the height or width of the important part of the chart, divide it by the amount of the reduction necessary to make the 10″ x 10″ transparency, and check with the formula to be sure it will be visible when projected.

TABLE 1

Magnification Table for Overhead Projector

Dist. from Screen	*Magnification*	*10″ x 10″ Transparency*
4′	3.2X	32″ X 32″
6′	4.8X	48″ X 48″
8′	6.4X	64″ X 64″
10′	8.0X	80″ X 80″
12′	9.6X	96″ X 96″

(The magnification is .8X per foot of projection distance)

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PART II

TRAINING AIDS

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Visual

Wall Pieces
Control Charts
Flow Charts
Flip-flop Charts
Slap-board (flannel or magnetic)
Blackboard Work
Perspective Drawings
Section Drawings
3-View Drawings
Shop Sketches
Blowups
Montages
Slide Projection
Silent Motion Pictures
Film Strip Projection
Reflected Transparency Projection
Opaque Projection
Professional Magazines
Manuals and Handbooks
Stapled Cases
Work Sheets
Misc. Pass-outs
Operation Procedures
Supervisory Newsletters
Reference Reading Assignments
Written Tests

Audio

Disc, Tape, and Wire Recordings
Lectures
Radio

Audio-Visual

Sound Motion Pictures
Sound Slide-films
Television

Mechanical

Working Models or Mock-ups
Mechanical Tests
Special Devices
"The Real McCoy"

SALES TRAINING

In several districts, sales on ABC Company's commercial refrigerators have been far short of expectations for the past year. This is especially serious because that item is their biggest profit-maker. A need for special attention to this condition, through training, is indicated.

What training should be recommended?

Group Training?

Who should receive it?
What content?
Where should it be given?
Who should conduct it?

Individual Training?

Who should receive it?
How should it be conducted?
By whom?