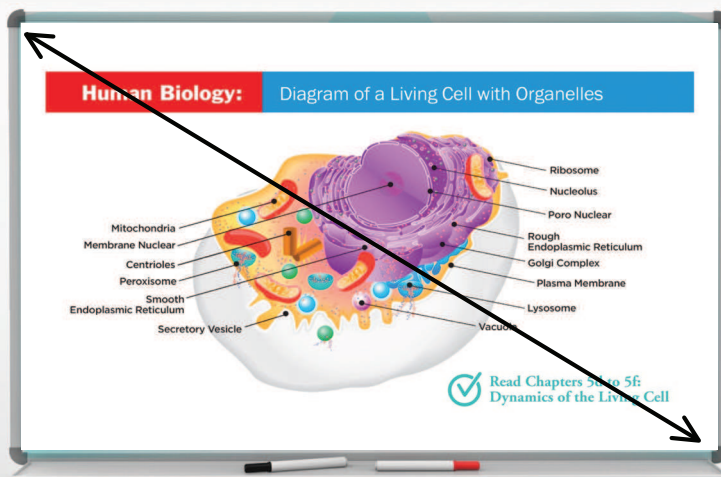


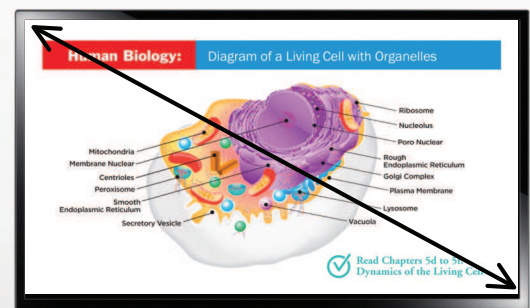
# Display Size Matters

*Selecting the Right Display Size for Classrooms*

100" Display



65" Display



## Contents

■ Key Factors for Selecting the Right Display	3
■ The 4/6/8 Rule	4
■ Classroom Configurations	5

### THE FINDINGS:

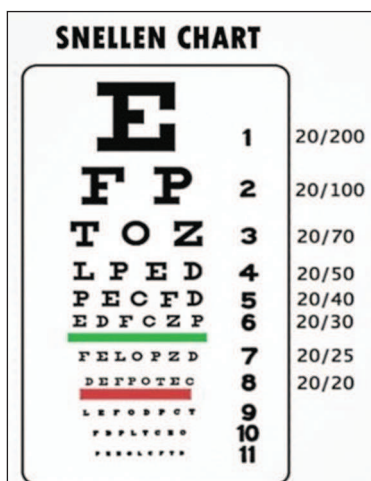
■ Square Classroom	6
■ Wide Classroom	7
■ Deep Classroom	8
■ Summation of Room Viewing Distances	10
■ Conclusion	10

Imaging technology has dramatically affected the experience of K-12 teaching and classroom dynamics. From a time when the primary ways to relay information were verbal, via a blackboard or overhead projector, to the current array of computers, tablets, flat screens and projectors – deciding what to select can be complicated. Today there is a lot of focus on flat panels and projectors. However the big dilemma isn't which technology to select, but how to support the right visual environments that help teachers teach and students learn. Whether the pedagogical style is sage on a stage, guide by the side, flipped classrooms, display-based or constructivist, getting everyone on the same page and keeping focus are key components in supporting student comprehension.

Regardless of the technology selected, this paper will help you understand the factors that impact student visibility and legibility of the display and how to select screen size based on classroom size. In today's K-12 classrooms, displays are used for a range of educational purposes 50% or more of class time, so ensuring that the technology is the optimal size and quality is critical.

## ■ Key Factors for Selecting the Right Display

The two key factors for selecting the right display in K-12 classrooms are 1: the potential size of the display; and, 2: the distance from which the students are viewing the display. Both display size and viewing distance are limited by the physical attributes of the space. Room height defines the maximum display height/size. Room width/depth and seating configuration define the viewing distance from the display to each student. If the content being presented for all to see is clearly visible, then all students in the classroom will ultimately better comprehend and process the information.



Snellen Eye Chart

The ability to see the content is based on human visual acuity and traditional eye structure. The widely recognized method to measure visual acuity is the Snellen Eye Chart. What does 20/20 mean? It means you can clearly see a standardized chart of letters from 20 feet away. The further away you are, the bigger the text must be to maintain 20/20 vision. This is a critical factor and states simply that something twice as far needs to be twice as big for equivalent visibility. So the further away a student is from the display, the larger the content needs to be to see it clearly.

This paper will use the well-established 4/6/8 rule to set display height (explained below). It will also use common classroom seating configurations and distance to understand total display size needed. To better understand how display size impacts viewing distance, three typical classrooms have been analyzed comparing a 65-inch diagonal display to a 100-inch diagonal display. The analysis will provide insight into the effectiveness for the student population. Both systems can include interactive capabilities, so the primary comparison is on the viewing distance.

## ■ The 4/6/8 Rule

In the Audio Visual (AV) installation world, there is a common standard for setting screen size known as the 4/6/8 rule. The advantage of using the 4/6/8 definitions for classrooms is that the distances can be measured according to classroom activities using the screen. The rule says that for different student engagement with the content presented, the viewer can be located at a distance that many times the screen height. The 4/6/8 rule recommends three types of viewing and the associated maximum multiple of vertical display height.

### **Analytical Viewing – Maximum Four (4) Times Vertical Display Height**

The student can make critical decisions from the ability to analyze details within the displayed image. The viewer is analytical and fully engaged with the details of the content (e.g., small-font text and numbers, drawing intricacies, photographic inspection). Examples: Charts & Web content browsing.

### **Basic Viewing – Maximum Six (6) Times Vertical Display Height**

The student can make basic decisions from the displayed image. The decisions are not dependent on critical details within the image, but there is assimilation and retention of the information so the viewer is actively engaged with the content (e.g., information displays, presentations containing detailed images). Fonts used are usually larger and intended for a group to view. Examples: Presenting multimedia curriculum, teacher and student whiteboarding.

### **Passive Viewing – Maximum Eight (8) Times Vertical Display Height**

The viewer is able to recognize what the images are on a display and can separate the text or the main image from the background under typical lighting for the viewing environment. The content does not require assimilation and retention of detail, but the general intent is understood. There is passive engagement with the content (e.g., non-critical or informal viewing of video and data). Example: movie watching.

At distances greater than eight times the display height, typical text, fonts and objects will not be readily visible to the viewer, resulting in a significant reduction in comprehension. Since it is not always possible to adjust screen size based on content, the ideal maximum viewing distance in a typical K-12 classroom should be less than or equal to six times the screen height to support typical classroom content. For the purposes of this analysis, we have selected the six times vertical display height as the desired standard. See Figure 1.

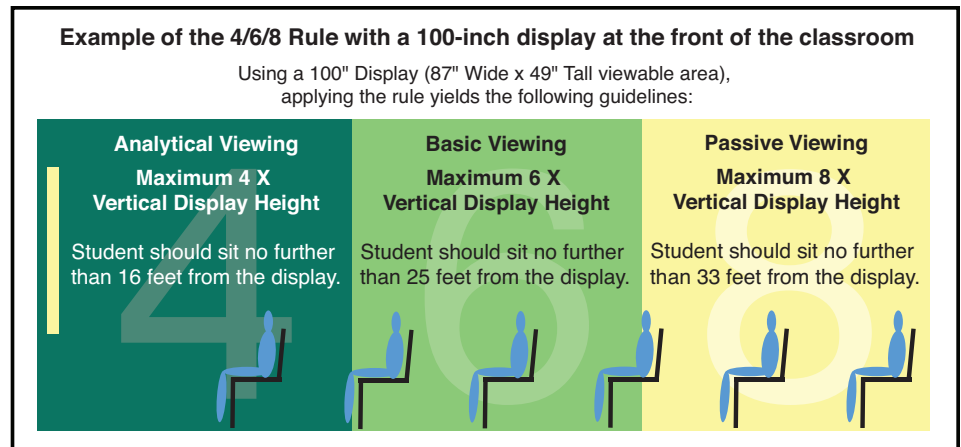


Figure 1

## ■ Classroom Configurations

This paper works through three classroom configurations – square, wide and deep. These are shown in Figure 2. We will call the first example “square” because it resembles this shape closest, even though the typical classroom shape is slightly wider in dimension. The general size for the classrooms is based on the California recommended classroom size of 960 square feet. [1] All classrooms are populated with 30 chairs/desks (except the wide one that has 32 due to the row count). The chairs and desks are based on typical K-12 sizes and spacing. For each classroom type, the relative viewing distances based on the 4/6/8 rule will be shown. As the analysis shows, the best educational outcomes will occur with all students at less than or equal to six times the display height as the maximum viewing distance. For completeness, the analysis will also include four times and eight times.

## Typical Classrooms Analyzed

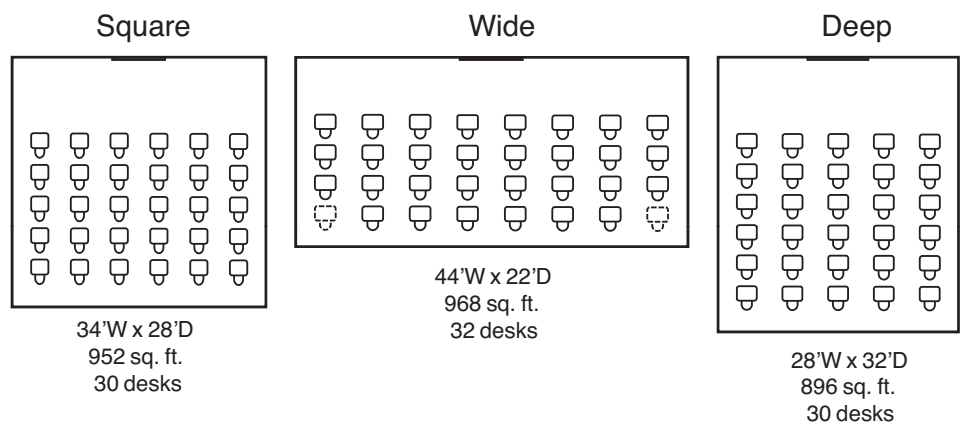


Figure 2 Typical Classroom Shapes

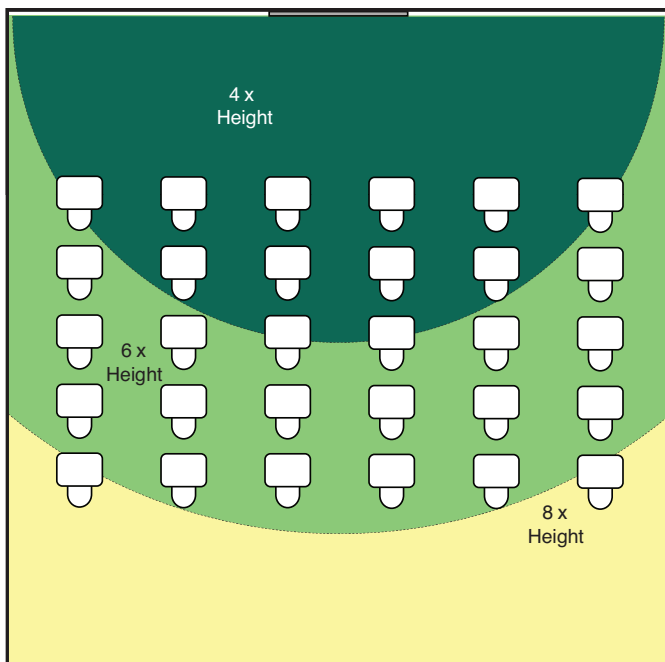
## THE FINDINGS:

### ■ Square Classroom

The Square classroom is approximately 960-square feet with 30 student seats arranged in a 5 x 6 desk arrangement. Space has been left at the front of the room for the teacher's desk and to provide adequate viewing distance for students in the front row. Figure 3 shows the relative viewing distances for both the 100-inch display and 65-inch display.

#### Typical 952 Square Foot Classroom with 30 Desks (30.85 feet W x 30.85 feet D)

Classroom with 100-inch display



Classroom with 65-inch display

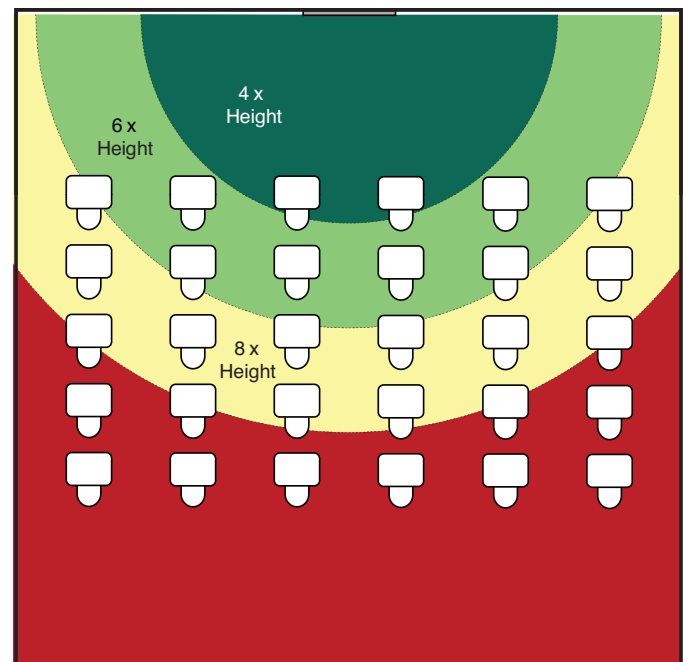


Figure 3 Square Classroom Viewing Distances

With the exception of the back row desks on either side, the 100-inch display provides the optimal six times viewing distance to 93% of the seats. In fact, with the 100-inch display, 27% of the students are within the four times distance, ideal for those with eye challenges or other issues.

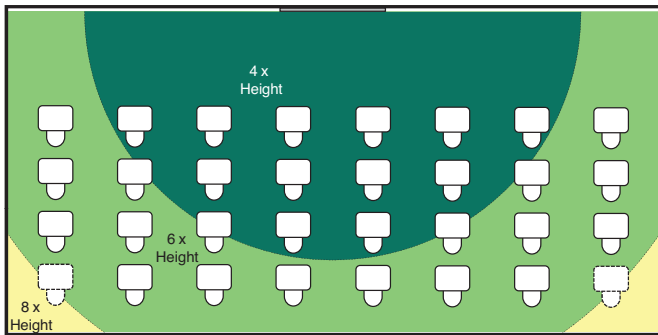
The 65-inch display has a much lower level of acceptability. Eighty percent of the students in this classroom will be over the six times distance and 40% will be outside the absolute eight times maximum recommendation. A 65-inch display is simply too small and results in inadequate viewing by too many students who may be seated beyond the second row.

## ■ Wide Classroom

Many newer classrooms have been built with a wider proportion to reduce the distance from the teacher to the students. In Figure 4, the wide classroom, the number of vertical rows has been reduced to four and the horizontal rows increased to eight, yielding 32 students.

### Typical 968 Square Foot Classroom with 32 Desks (44 feet W x 22 feet D)

Classroom with 100-inch display



Classroom with 65-inch display

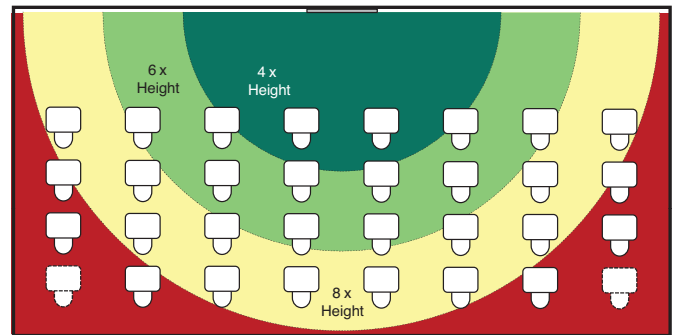


Figure 4 Wide Classroom Viewing Distances

In this case, all 32 seats are within the six times viewing distance for the 100-inch display, only two seats are outside of that range. In fact, 40% of the seats are within the four times viewing distance, making this an ideal arrangement for detailed work such as Web browsing. The 65-inch display has a much lower coverage, with only 30% of the seats within the six times viewing distance and 70% of the students beyond the six times. The room depth reduces the number of students beyond eight times to 20%, significantly better than the square room.

## ■ Deep Classroom

Older classrooms are often deep or long, reflecting a traditional design approach. Figure 5 shows a typical deep classroom with desks in six rows.

### Typical 896 Square Foot Classroom with 30 Desks (28 feet W x 32 feet D)

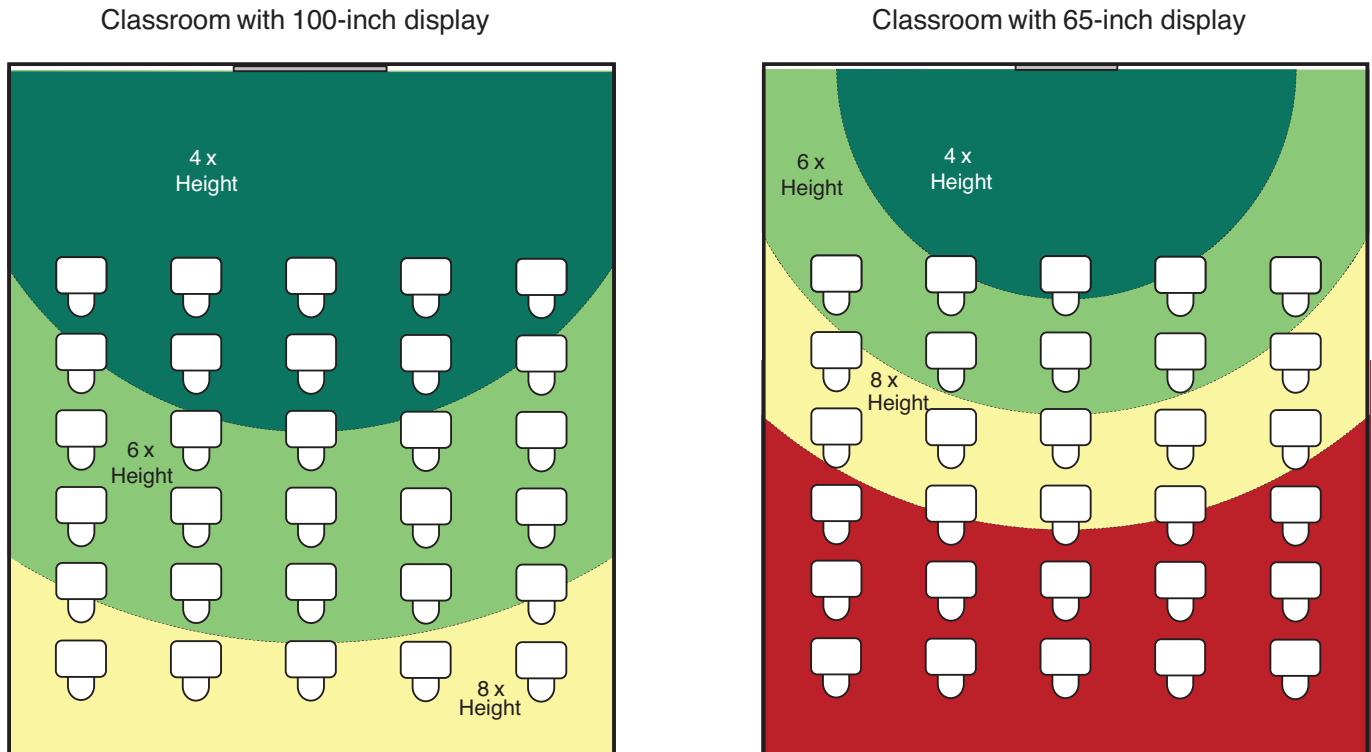


Figure 5 Deep Classroom Viewing Distances

In this longer room, the advantages of the larger display are also evident. The 65-inch display has 70% of the students beyond the six times viewing distance, but more importantly a full 50% of the students are outside the eight times viewing distance. Clearly, in this classroom, a smaller display will have a dramatic negative impact on visibility, learning and comprehension.

Figure 6 provides a summary showing each room type and its percentage of seats in relation to viewing distance for each display size.



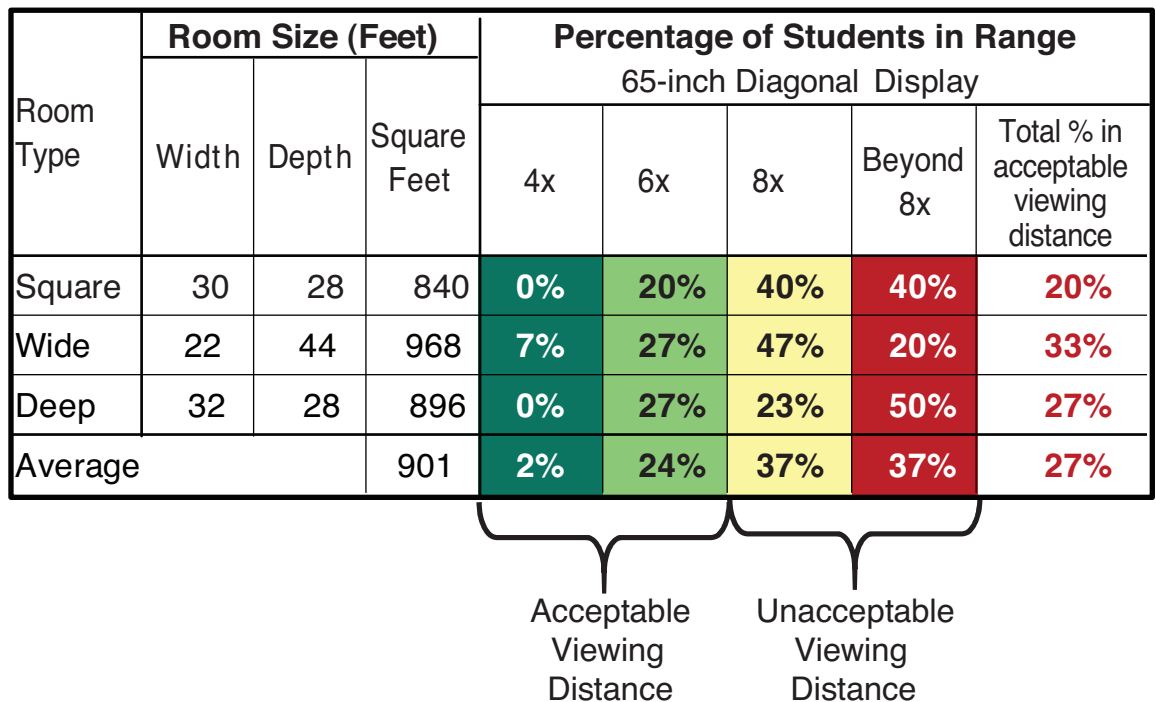
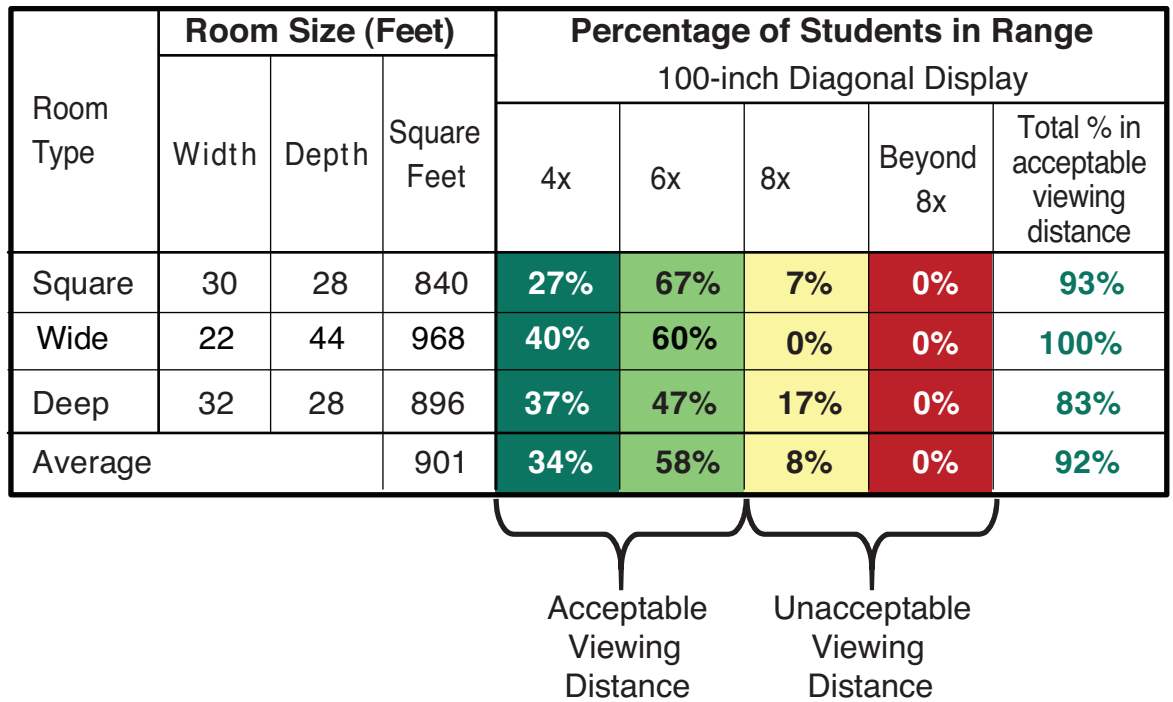


Figure 6 Classroom Viewing Distances Summary—The green columns are the 4 times and 6 times recommended viewing distances, the red indicates students seated beyond the 8 times viewing distance. At the bottom the room results are averaged.

## ■ Summation of Room Viewing Distances

A 65-inch display in an average classroom will result in over 70%, on average, of the students having an inferior experience. More than (one third) 1/3, on average, of the students sit completely outside the eight times absolute maximum for any viewing. This will hinder the students' ability to see and comprehend the information presented by the teacher on the display.

## ■ Conclusion

The size of the display in the classroom matters and the larger the screen size, the better. In any room configuration as shown, choosing the smaller 65-inch display will result in a significant reduction in the quality of the educational experience for K-12 students and may impede their learning. Students simply can't properly learn or retain what they can't clearly see. The 100-inch displays (and larger) are often more affordable with projection technology and have proven to be more impactful in the K-12 category.

1. California Department Of Education. (2015, October 2). Title 5, California Code of Regulations. Retrieved May 12, 2016, from <http://www.cde.ca.gov/ls/fa/sf/title5regs.asp>

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