Alphabet-Board Display as Part of the Classroom Learning Space

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Alphabet-boards are commonplace in lower grade classrooms in elementary-schools. If designed correctly, alphabet-boards can help internalize letters into memory. The purpose of this study was to examine alphabet-board characteristics that should be considered by teachers for providing a clear, readable, and applicable pedagogical tool. The research is a mixed qualitative and quantitative study. The former provides a definition of alphabet-board readability characteristics and a scale for analyzing this readability. The latter provides a readability evaluation using a survey (n=399) and statistical analyses. This article provides practical recommendations for implementation of clear and effective alphabet-board pedagogy.

Introduction

This article deals with the design of alphabet-boards (or letter-boards) on the walls of elementary school classrooms. Such boards are part of children's learning space, and teachers use them as infrastructure for teaching and learning (Milo-Shussman, 2016). Hence their importance, alphabet-boards contribute to alphabet assimilation at the beginning of the reading acquisition process, through their active use and based on the perception that the passive viewing of content over time enables repetition and memorization that could lead to encoding and assimilation in visual memory (Clark & Paivio, 1991; Neisser, 1967; Greig and Zimbardo, 2010).

Given that a large variety of alphabet-boards exists, teachers can choose the type of alphabet-board they wish to buy or design. A quick scan of classroom walls reveals different characteristics, such as with or without illustrations, printed or hand-written letters, hand-made or store-bought, etc. – resulting in a variance in design quality and readability level.

This article does not discuss the methods for teaching reading and writing and assumes that alphabet-boards are ubiquitous in most lower elementary school classrooms. The trigger for this study was the understanding that teachers invest time, effort, and even money in these boards, yet no guidelines exist for ensuring a suitable and effective alphabet-board, and most teachers have no practical tools for

choosing or creating a truly readable one (Milo-Shussman, 2016). Readability is an especially important aspect of alphabet-boards, as they are intended to be an auxiliary tool for achieving the internalization and assimilation of letters into memory, and as such are displayed on classroom walls year-round. The main purpose of this study, therefore, is to provide practical recommendations for creating optimal and readable alphabet-boards, for the benefit of young learners.

Alphabet-Boards as a Reading and Writing Aid

In order to acquire reading and writing skills, learners need to remember all letter symbols of a given alphabet. Therefore, teachers use a variety of techniques and methods to help, support, and embed these symbols among students – including placing an alphabet-board on the classroom wall. This type of method can be seen as early as the 16th century in paintings of classrooms (Educational Encyclopedia, 1971), where, for example, a Rabbi is shown pointing with a stick to one of the letters hanging on the wall, and the students' gazes are directed at the letters. Today, hundreds of years later, letters of the alphabet can still be seen on the walls of many classrooms via alphabet-boards.

A recent study surveyed hundreds of kindergartens and first and second grade classrooms throughout Israel and found alphabet-boards in almost all of the rooms. Moreover, all teachers in the study (N>200) stated that the classroom wall display plays a role in their teaching process, as well as imparting knowledge. The teachers also noted that the classroom display allows repetition, memorization, and assimilation of the learning content, and encourages students to produce information from the surroundings (Milo-Shussman, 2016).

In this study, our observations and interviews conducted during our visits to 52 schools across Israel revealed an

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active use of alphabet-boards by teachers. As one teacher explained (as seen in Figure 1), "We use the alphabet-board every day. I have sticks with different vowel signs on them, and we take a trip along the letters." (The Hebrew language does not have vowel letters, but rather vowel symbols that are added to the letters.) Another teacher said, "We sing the names of the letters while pointing to them, and the children use the board as a memory support."
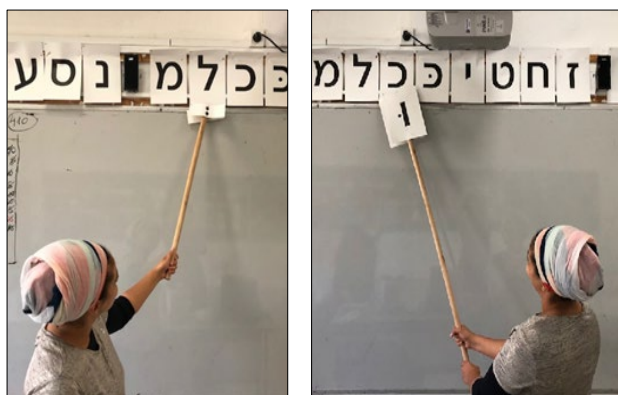

Figure 1. **On the left, the teacher points at a Hebrew letter and adds a vowel sound at the end of a stick; on the right, the teacher points at a different Hebrew letter and adds a different vowel sound.**

Literature Review

Alphabet-boards can contain different types of letters, such as printed letters, hand-written letters, a combination of typed and hand-written letters, and letters combined with visual-representation such as photographs, drawings, or illustrations. Regardless of the type of letters used, all alphabet-boards present specific letters and are aimed at acting as a memory support aid for the learners. Therefore, while the visual characteristics may differ from board to board and from teacher to teacher, it is important that all graphic elements are legible (also known as readable) – a term that relates to the capability and ease with which the reader's eyes can identify a letter (Tarasov, Sergeev, & Filimonov, 2015). In order to discuss the legibility of the letters, this study refers to an alphabet-board as a picture, composed of colors, lines and shapes (Weinfeld, 1990), and analyzes the legibility of its components and characteristics accordingly.

Characteristics of Alphabet-Boards

With regards to *color*, this study addresses the color of both the letters and their background on the alphabet-boards. According to guidelines provided by the Israel Ministry of Transport and Road Safety (2012), which are based on Canadian road-safety guidelines, the background

color of a road sign has a specific meaning, indicating the type of road ahead. The color of the letters on these signs are therefore chosen depending on the color of the background, not the other way around. For example, if the background is yellow, white, or orange, then the letters should be black. In the case of road signs, their prominence and legibility are of the utmost importance and could be a matter of life and death. Although this is far from the case with alphabet-boards, much can be learned from road safety guidelines. According to Locker (2011), an expert in designing museum exhibitions, black letters on a white background are the most legible. Every line and shape we see has a color, even if it is black or white (Weinfeld, 1990), and it is those colors that help us identify objects and shapes (Mishori, 2000). To create a harmonic use of colors, it is important to pay attention to color diversity (e.g., red or blue), degree of brightness (dark or light), level of color saturation or intensity, and even cold and warm colors (Mishori, 2000).

Letter *size and thickness* is another important characteristic that should be addressed. Letters are measured in inches; each unit of measurement is called a point, which equals 1/72 inches (or 0.3533 millimeters.) The size of the letter determines its height (Hassid, 2013A). Unlike a book or a business card, classroom alphabet-boards are a large graphic product that requires the size of the caption to be in line with the reading distance. Larger text sizes are usually considered more readable than smaller ones (Bernard, Chaparro, Mills & Halcomb, 2003). The thickness of the letter is determined by its weight; on the computer, bold and regular letters in the same font (type of lettering) differ in thickness, whereby bold letters are of greater thickness than regular letters. Different thicknesses provide flexible formatting options and can offer a hierarchy of information such as headings, subheadings, and quotes (Hassid, 2013A). Studies indicate that the thickness of the letter has an effect on the degree of its readability from a distance (Ministry of Transport, 2012).

Additional letter characteristics include *typography* and *fonts*. Typography refers to the visual arrangement of the written letters and words, whereas fonts refer to the appearance of each letters, such as the relation between the length, width, and thickness of the letter, or between horizontal and vertical condensation, etc. (Butterick, 2016; Lannon, 2000; Tamari, 1985). Fonts play an important role in graphic design (Bessemans, 2016), as they enable the transmission of visual information in addition to the actual text itself (Tarasov *et.al.*, 2015.) Studies have examined the effect of different typography characteristics on the degree of readability (Woods, Davis, & Scharff, 2005; Wagner & Noy, 2012). These differences can improve or decrease readability and reading speed (Bernard et.al., 2003) by up to 30% (Chauncey, 1986). Nowadays, teachers can choose from an endless pool of fonts thanks to computers.

In addition to the appearance of the letters themselves, *spacing* between letters is also important, especially with the aim of achieving readability and not just design appeal. Therefore, when deciding on spacing, the location and size of the area on which the letters will be displayed must be considered. The adjusting of the spacing between two letters is called Kerning (Hassid, 2013B). According to the Israel Ministry of Transport (2012), both too little and too great a space between letters can result in decreased readability.

When learning to read and write, children make great efforts to become familiar with a large range of symbols. A suitable *visual load*, therefore, is of the utmost importance. In recent years, visual overload in classrooms has been greatly criticized (Dudek, 2000; Emanuel, 1996 & Politi, 1984 in Cohen, *et.al.* 2006; Fisher, Godwin, & Seltman, 2014; Komendat, 2010; Milo-Shussman, 2017; Saarela, 2007; Sebba, 2004; Tarr, 2001, 2004) – and even referred to by some researchers as visual cacophony (Tar, 2004). Visual overload in the alphabet-board surroundings may lead to significant distraction as it delivers a flood of information, decorative elements, and visual representations. Psychologist Edgar Rubin studied the phenomenon of *image background* that relates to the relationship between positive elements and negative backgrounds. In order to interpret what the eye sees, the human mind separates objects from their background. Depending on the ease with which the object can be identified, the relationship between an object and its background can be perceived as stable or unstable. The more stable the relationship between the object and its background, the easier it is to direct viewers to focus on what we wish them to see (Hebrew Typography Bureau, 2014). In some classrooms, the background on which the letters appear is accompanied by a pattern, yet according to Anitha (2017), decorated backgrounds decrease readability as they reduce the level of *contrast*. The different colors of texts and backgrounds also affect the degree of *color contrast*, and in turn – the degree of readability. The degree of contrast depends on the ratio between the brightness of the object and of the background. When the contrast level is low, the reading level is reduced (Ministry of Transport, 2012). When the contrast between the color of the letter and the color of the background is high, it is easier to delineate different regions and distinguish between form (i.e., letter) and background. Moreover, the encounter between two different colored areas creates a suggestive line that leads our minds to see a certain shape that does not actually exist. This occurs when two different colors meet (Mishori, 2000) and is helpful in creating a greater contrast.

Additional aspects of alphabet-boards relate to the placement or *hanging* of either the board of the letters. When placing the letters on the board, teachers must choose whether to place all letters in one row or more, in a straight or curved line, how many letters to place on the board, etc. In museums, exhibitions are organized in a manner that conveys certain messages. These messages are communicated through our senses – especially those relating to sight through cognitive and cultural processes (Kaplan, 1995).

Nowadays, hanging exhibitions in museums can be achieved through a range of possibilities (Gen, 2017), yet guidelines for the Tate Gallery in England state that hanging exhibitions should consider the amount of free space, how the object is related to what is hanging around, the room size, the lighting, and the color of the walls (Charman, Rose, & Wilson, 2006). Moreover, when the hanging creates a balanced composition, a sense of calm is created, and it is easier to look at the placed object (Mishori, 2000).

Carney and Levin (2002) discuss different types of pictures based on the role they play in text processing; the alphabet-board belongs to the Organized Picture Category, as it offers a structure for the written text that provides learners with a logical sequence. Since teachers use the alphabet-board during lessons, and as it provides teaching scaffolding (Milo-Shussman, 2016), it would be logical to hang the board on a wall that is both near the teacher's desk and provides students with a readily-accessible viewpoint. Thus, the wall most suitable for displaying the alphabet-board would be the wall with the blackboard (or whiteboard) on it, behind or next to the teacher's desk. Once the wall is chosen, the alphabet-board could be suspended above or on either side of the blackboard.

In order to preserve the alphabet-board for years to come, *lamination* may be used to provide a protective yet transparent covering. However, the lighting in the classroom may not always be compatible with the laminated board, creating undesirable flashes of light and reflections that interfere with the reading. Locker (2011) therefore states that when deciding where to hang the board, the classroom lighting should be taken into account, and the surface of the board should have a matte, not glossy, finish.

With regards to *framing*, teacher may choose to use this method to separate and distinguish between letters. This can be helpful in the classroom, as stated by the Ministry of Transport (2012): "Creating a frame around the scope of the sign creates a clear demarcation between the sign and its surrounding background". Moreover, in order to emphasize the letters and enhance the contrast between each letter and the background, *contours* can be used – a line that outlines the border of a letter, as it forms a closed peripheral shape that is easier to identify (Mishori, 2000; Weinfeld, 1990).

In some cases, letters on the alphabet-board are accompanied by *visual representation* (e.g., photographs or illustrations) that provides memory support, and as such should be designed to assist students in their learning and

not cause any unnecessary frustration in their attempt to decipher and understand the letters. In other words, when choosing a visual representation for the alphabet-board, it must support the text without diverting from the message (Locker, 2011; Mayer, 2005). As shown in Visual Literacy and Iconography, fields that study the interpretation of images and analyze the interaction between the visual image and the expressed idea (Carny & Levin, 2002; Mishori, 2000), combining texts with visual representations create broad networks of associations (Mayer, 2005), and help create a "dual coding" in our memory (Clark & Paivio, 1991).

The *composition* of the letter is an additional characteristic of alphabet-boards, referring to the placement or arrangement of the various visual elements in one work of art so as to create the desired experience. The creator places the objects (lines, shapes, images, and colors) to direct the observer in a certain manner (Eureka Encyclopedia; Mishori, 2000). The alphabet-board is a composition of the letters, it displays and depends on how the teacher decides to arrange all of the elements. When the board is composed of uniform colors, sizes, and lines, there is greater uniformity and balance. As explained by the Ministry of Transport (2012): "road signs should strive for systematic organization." Finally, in line with the attempt to achieve uniformity on the alphabet-board, teachers must decide whether to display printed letters or hand-written ones, or perhaps even combine the two. In a study conducted by the Ministry of Transport (2012) on bilingual signs, findings showed that it is easier to read the text when the two languages were displayed in a vertical manner (i.e., with one language above the second) rather than horizontally (the two languages appearing side-by-side).

The Research

As seen in the literature review above, readability of the letters is determined by a combination of characteristics, such as font type, letter size, and contour letter and color background, composition, and lamination, which in turn impacts the learners' ability to utilize the alphabet-board when acquiring reading and writing skills. However, just one unsuitable component out of many may suffice to impair legibility, rendering the alphabet-board almost useless. The purpose of this study, therefore, was to examine which characteristics are important for creating a classroom alphabet-board that is coherent and readable, thereby achieving its pedagogical purpose.

Two research questions were addressed: (1) Is there a relationship between the readability characteristics and the readability evaluation of the alphabet-board? We hypothesized that there is a significant relationship between these two aspects, as readability characteristics describe the letters' features, and the integration of all characteristics

combined defines readability as a whole that will be reflected by the evaluators (e.g., Ministry of Transport, 2012; Wagner & Noy, 2012; Woods et.al.); (2) Which characteristics significantly contribute to the predicting of the alphabet-board readability level and what is the relative contribution of each? Dealing with the marginal contribution of each characteristic, we hypothesized that the size, thickness, and contrast between the letters and their background will be the most significant contributors to the readability evaluation prediction (Hassid 2013A; Ministry of Transport, 2012; Mishori, 2000).

Methodology

This study employed a mixed qualitative and quantitative method. The former was used to analyze alphabet-boards and create a list of characteristics that promote readability, while the latter was used to measure alphabet-board readability based on survey estimations and analysis of the ability to predict readability levels based on readability individual and combined characteristics.

Participants

Of the 399 people surveyed, 30% were elementary school teachers and about 68% were parents. Almost 80% of the participants were female. Ages ranged from 17 to 83 years, with an average of 43.03 years (SD=15.78). About 24% reported having some knowledge about design.

Research tools

1. **Readability Survey**. Over a two-week period, educators, graphic/interior/product designers, parents, and students were asked to complete an online questionnaire about 52 pictures of alphabet-boards. These photographs were all taken during our visits to 52 elementary schools across Israel. For each board presented, the participants were asked to rate the readability of the letters displayed, on a scale of 1 to 6 (1=not clear at all; 6=very clear). They could also add a written comment about the readability of each given picture, if desired. We then calculated a readability grade for each picture, based on the participants' ratings. While the survey was anonymous, participants were asked to provide some information, such as age, gender, and previous knowledge of design.

2. **Readability Characteristics**. A list of 15 attributes was created (see Table 1), based on theories relating to the readability of letters and the analysis of alphabet-boards. Two experts in designing learning environments then validated the list.

Table 1. Alphabet-board readability characteristics	
Characteristics	**Scale**
Background	0-colorful; 1-smooth
Letter color	0-colorful; 1-solid color
Typography & fonts (type of letter)	0-unreadable; 1-readable
Letter framing	0-not exist; 1-exist
Hanging mode	0-curved; 1-straight
Spacing between letters	0-no space; 1-pleasant space
Visual load	0-overload; 1-pleasant load
Page size consistency	0-varying sizes; 1- one size
Missing letters	0-missing; 1-all
Laminated covering	0-with; 1- without
Background color	0-colorful; 1-solid color
Separation between printed and hand-written letters	0-no separation; 1-with separation
Color contrast between letters and background	0-weak; 1-medium; 2-strong
Letter size	0-small; 1-medium; 2-large
Letter thickness	0-thin; 1-medium; 2-thick

To validate this tool, three education and design experts analyzed and characterized five alphabet-boards (that were not included in the online survey) using our readability characteristics list. The results showed that all three experts described each of the five boards using similar characteristics as their peers, thereby validating this tool's consistency and reliability. Based on this validated list, we then analyzed the 52 alphabet-boards from the survey. Statistical analysis was then conducted, to examine the relationship between each alphabet-board's characteristics and readability grade.

Results

In this section, we will first describe the 52 alphabet-boards used in the survey, and will then relate to the two research questions presented above, regarding characteristics and readability of the alphabet-boards.

The Alphabet-boards

In most of the classrooms (46 out of 52), the alphabet-boards were hung on the same wall as the blackboard, with more than 43% placed above the blackboard, about 33% placed on top of the blackboard, and some were placed to the right (20%) or left (4%) of the blackboard. About 56% of the alphabet-boards were handmade, meaning the teachers had either designed or printed the letters and/or the background themselves. The remainder (44%) were store-purchased. Most boards did not include visual-representations besides the letters (89%). In most case, the letters were in black (65%) and the background was white (87%), with the most common combination being black letters on white background (56%). In most cases (79%), the letters were arranged in a straight line. Some boards were arranged as a rectangle (13%) and railroad cars (6%), and one board was in the shape of a wave. The average readability grade of all 52 alphabet-boards, based on the scoring of all participants (N= 399), was 3.63 out of 6 (SD=1.01).

Relationship between characteristics and readability scores

Independent sample t-tests were conducted to examine the relationship between each of the 12 (out of 15) characteristics that have two possible conditions (0 or 1), such as *Letter frame* (0-does not exist; 1-exists), and the readability level. Table 2 presents the readability level means and t-test results.

The remaining three characteristics have three possible conditions (0, 1, or 2). To examine the relationship between these characteristics and their readability level, we conducted an analysis of variance (ANOVA) test. Table 3 presents the readability level means and the ANOVA (F) results.

The results presented in Tables 2 and 3 reveal that the readability level means of all the characteristics with 0 value were lower than those with 1 or higher values. Furthermore, in nine out of the fifteen characteristics, significant differences were found in alphabet-board readability levels between boards with different characteristic values, indicating a significant relationship between those nine characteristics and the readability level of the alphabet-boards.

Predicting the readability grade by using the readability characteristics

A stepwise regression was initiated to examine the relative contribution of each characteristic to predict the alphabet-board's readability grade. All characteristics were converted into dummy variables based on their values. Regression results, presented in Table 4, reveal five significant characteristics for predicting alphabet-board readability level: *Pleasant visual-load*, *solid letter color*, *clean background*, *small letter size*, and *slim letters*.

Table 1. Means and t-test results for readabilty characteristics with two conditions			
Characteristics	**Scale**	**Readability Level Mean**	**$t_{(50)}$**
Background	0-colorful	3.16	*2.24
	1-clean and clear	3.94	
Letter color	0-colorful	2.70	**2.44
	1-solid color	3.90	
Fonts (Type of letter)	0-unreadable	2.80	***3.46
	1-readable	3.99	
Letter framing	0-not exist	3.81	.42
	1-exist	3.80	
Hanging mode	0-curve	3.38	**2.70
	1-straight	4.09	
Spacing between letters	0-no space	3.48	*1.99
	1-pleasant space	4.01	
Visual load	0-overload	3.36	***3.94
	1-pleasant load	4.31	
Page size consistency	0-varying size	3.78	.68
	1-one size	3.81	
Missing letters	0-missing	3.51	.54
	1-all	3.82	
Laminated covering	0-with	3.66	1.16
	1-without	3.98	
Background color	0-colorful	3.11	nc
	1-solid color	3.66	
Separation between printed and hand-written letters	0-no separation	2.80	nc
	1-with separation	3.52	
* p≤.05; ** p≤.01; *** p≤.001			
nc = t value was not calculated due to limited number of zero scores			

Pleasant visual-load, *solid letter color*, and *clean background* significantly increase the readability level, while *small letter size* and *slim letters* significantly decrease the readability level. The total explained variance of the five significant predictors is 57%. The relative contribution of *pleasant visual-load* to the explained variance is 24%; *solid letter color* contributed more than 17%; *small size of letters* adds 11%; *slim letters* explains 3% more, and *clean background* increases the explained variance by 2%.

Finally, examining the relationships between all 15 characteristics only revealed two significant relationships: Between *Typography & Fonts* and *letter thickness* [$\chi^2(2)=6.778$, p<.05], and between *Typography & Fonts* and *visual load* [$\chi^2(1)=4.309$, p<.05.]

Discussion

The purpose of this study was to examine the characteristics required for ensuring readable alphabet-boards that support their pedagogical goal. To do so, two questions were asked, regarding the (a) relationship between alphabet-board readability characteristics and readability evaluation, and (b) the contribution of each characteristic to predicting the readability.

The relationship between readability characteristics and evaluation

Examining the relationships between each of the 15 alphabet-board characteristics and their degree of readability revealed that alphabet-boards with more characteristics that were found to be related to readability achieved a higher score in the survey readability evaluation, and vice versa, thereby reinforcing the validity of our measurement scale. Moreover, the characteristics that significantly predicted readability can be divided into two groups: *individual letter* and *letter surroundings*.

Characteristics of individual letters

The results of this study highlight the importance of characteristics associated with the letters themselves. For example, *letter color*, *letter size*, *letter thickness*, and *typography* are closely related to readability:

Letter and background color are of great importance. As with road signs, alphabet-boards should include black letters on white or yellow backgrounds to ensure readability. These safety guidelines are not random, but have been formulated based on human engineering and extensive research (Ministry of Transport, 2012).

Table 3. Means and ANOVA results for readabilty characteristics with three conditions			
Characteristic	**Possible values (condition)**	**Readability Level Mean**	**$F_{(2,49)}$**
Color contrast between letters and background	0-weak	3.18	6.77***
	1-medium	3.90	
	2-strong	4.48	
Letter size	0-small	3.21	8.23***
	1-medium	3.95	
	3-large	4.44	
Letter thickness	0-thin	3.44	4.81*
	1-medium	3.84	
	2-thick	4.39	
** p≤.01; *** p≤.001			

As alphabet-boards are considered a large graphic product, *the size of the letters* should be derived from the distance at which the students are required to read – especially the student seated farthest away from the board. According to the Ministry of Transport (2012) "The height of the letters… [font size] is the primary factor which affects the distance from which the sign can be read… hence the great importance of the font height". Moreover, the size of the letters on alphabet-boards should also be dependent on the size of the classroom. Finally, as the wall size is also dictated in advance, the minimum letter height should be at least 12cm, which corresponds to a font size of 450 points.

Our findings that *thickness of the letter* also has a significant connection to the readability of the alphabet-board are in line with the directives of the Ministry of Transport (2012), stating that studies indicate that the thickness of the letter has a significant effect on the degree of readability from a distance. In other words, the thicker the letters, the more legible they are.

In addition, this study indicates that the *typography and fonts* of a single letter plays an important role in the degree of readability – a finding this is in line with addition studies. The Ministry of Transport (2012) clarifies that studies indicate the font type as a dominant readability factor, and recommends considering the ratio between height and width of the letter, and using full font (not a hollow font with only an external framing). Even decades ago, Leaf (1950) recognized the importance of a letter's typography, claiming it to be "a first and fundamental condition."

Characteristics of the letter's surroundings

The environment or surroundings of the letter refers to where and how the board is hung, and to the spacing between letters, background, contrast between the letters and their background, density, and visual-load around. The study found a relationship between the letter's surroundings and the alphabet-board's readability.

Consistent with the Ministry of Transport's guidelines (2012), which indicate that too spacious or overcrowded letters impair the readability, the findings revealed that suitable *spacing between letters* (i.e., not too crowded and not too far away) increases readability. Moreover, *density* and *visual load* of the background surrounding the alphabet-board are clearly related to readability. Attempting to decipher the alphabet-board requires great effort on the part of young children who are just beginning to identify these new symbols. If the board is placed on top of the blackboard, for example, visual overload may occur simply by the teacher writing something on the blackboard. Therefore, placing the alphabet-board on top of the blackboard is not recommended. According to the Ministry of Transport (2012): *"When there is minimal visual noise on the road's surroundings, the probability of the driver noticing certain target objects on the side of the road increases significantly compared to driving in surroundings with visual noise"*. In the classroom, even students who do not usually have difficulty concentrating may find it difficult to concentrate when the surroundings are overloaded.

Table 2. Stepwise regression results for predicting readability level using all readability characteristics				
	B	**Std Err**	**β**	**t**
Pleasant visual load	0.65	0.22	0.33	2.98***
Solid letter colors	1.61	0.36	0.44	4.42***
Small size of letters	-0.71	0.22	-0.35	-3.18**
Thin letters	-0.49	0.17	-0.26	-2.37**
Clean background	0.45	0.27	0.23	2.26*
R	.75			
R²	.57			
F	15.46**			
df-regression	5			
df-residual	46			
* p≤.05; ** p≤.01; *** p≤.001				

We also found that *clean background* is clearly related to readability, as backgrounds that are decorated with visual images, color transitions, or other patterns may interfere with the readability by reducing the contrast between the letters and their background. Attempting to identify letters

that have minimal *contrast* with their background may result in students having to exert visual effort, as well as cognitive. Finally, the *hanging mode of the letters* on the board and their composition are also important, in order to create a necessary balance. For example, if some letters have fallen off the board, or are placed in the shape of a curve or wave, an imbalanced composition may occur, causing undesirable interference for the viewer.

Non-significant characteristics and their relationship to readability

Four out of the fifteen characteristics (*plastic laminated covering, letter framing, letter-page size consistency*, and *missing letters*) were not found to be significantly related to readability. The following provides possible explanations. First, the impact of *lamination* may not have been conveyed in the photographs presented to the participants via a computer, compared to looking at the boards in real life. The lighting in the classroom, which may or may not cause such reflection, is influenced by the natural lighting outside (which depends on the time of day that the photograph was taken and if the classroom curtains were open or closed), the artificial lighting in the classroom (e.g., fluorescent or incandescent light bulb) and the location of the students (as the laminated board may cause a reflection from one seating viewpoint but not from another.) Teachers should, therefore, remember that lamination could lead to undesirable and distracting reflections.

Second, the *framing* of the letters may not affect readability if there is sufficient space between the letters then the frame contribution is marginal. One participant did, however, comment that the alphabet-board was not readable because there was a missing letter-frame. It would therefore seem that using framing can help separate between letters, but may not be necessary. Finally, *consistency in letter-page size* and presence of all letters are intended to reduce the visual-load by maintaining a uniform and continuous structure that prevents distractions. Although these characteristics were not found to have a significant impact on readability, they are part of visual-load and the mode of hanging characteristics, which were discussed earlier.

Readability prediction

In the study, two research questions were asked. In the first question, *Is there a relationship between the readability characteristics and the readability evaluation of the alphabet-board*? the readability characteristics were examined individually. In the second question, *Which characteristics significantly contribute to the predicting of the alphabet-board readability level and what is the relative contribution of each*? all characteristics were examined together.

The findings indicated that five distinct characteristics contribute significantly to the readability prediction: *visual-load, letter colors, letter size, letter thickness*, and *background*. Moreover, the lack of density and visual-load, as well as the maintaining of uniform and solid colored letters, with a clean background, are sufficient to predict a higher level of readability. In addition, smaller and slimmer letters were found to reduce readability.

In an attempt to understand why five out of nine significant characteristics were found to be significant predictors of readability, we analyzed the relationships between the characteristics.

Visual load, hanging mode, and spacing between letters

Visual-load is composed of many characteristics, including *background, hanging mode*, and *spacing between letters*, which were found to be significant predictors of readability when examined individually. However, when examined as part of a comprehensive prediction equation, only *visual-load* and *background* maintained their predictive feature. It appears that the *mode of hanging* and *spacing between letters* does not contribute to readability, beyond the visual-load that is associated with the *background* of the letter.

Visual load and font type

The presence of *visual load* and the absence of *font type* from the prediction equation can be explained by the significant statistical relationship between these two characteristics. This means that an illegible font is related to the visual load, and vice versa. Wagner and Noy (2012), who explain that a decorative or curly font may create visual overload and make it difficult to read, reinforce this finding.

Letter thickness and font type

The statistical relationship between letter thickness and font type may explain the absence of *font type* from the prediction equation of readability. In most cases, thicker letters have a greater presence (regardless of their font), thereby making them more readable from a distance.

Size and thickness

Letter size and *thickness* are dominant readability characteristics. When letters are too small or too slim, all other aspects (such as *color, background*, or *typography*) become relatively negligible. On the other hand, letter size enables the reading of a text from a distance and appropriate thickness creates a presence that helps create a clear contrast between the letter and its background.

Contrast, Letter and Background Color

Letter and background color are significant parameters in predicting readability with all elements combined. This color combination, of letter and background, defines the degree of contrast between the two. Our findings show that the *contrast* parameter, which was significant when examined as a single parameter, does not contribution to the readability evaluation prediction beyond the letter's color and background.

Practical Recommendations and Applications

This chapter of recommendations based on the findings of the study are important, and contains an applicable list of *dos and don'ts* for designing an alphabet-board. Complying with these guidelines may ensure sufficient readability and effective pedagogical use.

The list begins with recommendations regarding parameters that were found to be significant in relation to readability, both individually and combined: (a) letter size; (b) letter thickness; (c) visual-load; (d) letter background; and (e) letter color. Next, the list presents parameters that were found to be significant when each characteristic appeared separately: (a) degree of contrast between letters and background; (b) typography and font; (c) hanging mode; and (d) spacing between letters. Finally, additional parameters are presented in the list of recommendations, some of which are a breakdown of the parameters presented at the beginning of the list.

Letter Size – Letters with a height of 12cm (approximately 450 points on the computer) will be readable from anywhere in the classroom. All letters should be printed in the same size.

Letter Thickness – As it is the font type that affects letter thickness, in most cases, a bold letter will have more presence. If the letters are not printed from the computer but are prepared manually (e.g., drawn or cut out), letter thickness should be approximately 2cm.

Visual-Load – Try to avoid adding unnecessary visual-load behind the letters and choose a uniformed background color. The letters of the alphabet-board should be hung in a clean manner, without additional stimuli or visual disturbances. In other words, try to be uniform and consistent in letter font, type, size, thickness, spacing between letters, and hanging shape and mode.

Color of Letters and Background – Choose black or dark-blue letters on a white or bright background.

Contrast between Letters and Background – Maintain a clear and high contrast between the letters and their background.

Typography and Fonts – Choose fonts that with clear differences between similarly-looking letters to make it easier for learners to identify and differentiate between them. Make sure the font displays each letter in a clear and legible manner, without excessive decoration.

Hanging the Letters – Place the letters in a sequential straight line and with fixed intervals that will allow for "breathing space" and create a logical rhythm between them.

Spacing between Letters – Keep a fixed space of at least 6cm (including background) between letters. Leave clean, empty background on all sides of the letter, rather than decorating or filling them.

Background – Avoid a camouflaged, transitional, or patterned background that can interfere with and reduce the contrast.

Letter Contour – Use full letters rather than hollow ones with only a contour.

Visual-Representation – If using a visual-representation to accompany the letters (such as a painting or drawing), choose the same type of representation for all letters. Make sure it is a clear representation with balanced colors and of proportional size in relation to the letters and additional visual-representations. Place the representation near the letters, but not behind them.

Frames for Differentiating between Letters – When each letter is printed separately, framing can create a border and help differentiate between letters.

Composition – Choose a uniform color, size, and spacing between letters to create a balanced composition.

Hanging Location – Try to hang the alphabet-board *on the blackboard wall*, as it is easily accessible to the teacher and convenient for the students to look at. It is recommended to hang it *above the blackboard*, with a small space between the two.

Lamination – Avoiding plastic covering is recommended, that prevent distracting reflections, or use a matte covering, not a glossy one.

Combining Printed and Hand-Written Letters – If choosing to display a board with both types of letters, make a clear distinction between them. For example, the printed letters should be in one row and the hand-written ones in another. Also choose different fonts and colors to differentiate between them and try to enclose each type in separate frame.

Summary

Using an alphabet-board for teaching children requires an understanding of the learners and of what they need to learn. At early ages, when children undergo numerous cognitive, physical, and motor changes, care should be taken when designing alphabet-boards. To reduce the cognitive load, the design of the board should be simple and coherent, and

suited to the age of the students and to their cognitive abilities.

Choose letters of about 12cm with clear typography that enhances differences between similar letters. The background should be white, with a high contrast between the letters and the background. Use a thick, full (non-hollow) letter in a dark uniform color of black or dark-blue, and maintain spacing of approximately six centimeters between letters. A frame can be used to outline the margins of the board. Hang the letters in one or more straight lines. It is best to place the alphabet-board slightly above the classroom blackboard (or whiteboard).

When using visual-representations such as photographs or drawings, a clear representation should be chosen and placed at the bottom of the board, below the letters (not behind them), to avoid decreasing readability. Finally, to help decrease visual-load, maintain uniformity and consistency in letter type, size, thickness, spacing, and hanging. Our goal as teachers is to impart the basic symbolic system in an accessible, readable, and clear manner – to reduce unnecessary and interfering visual stimuli in the alphabet-board environment.

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