DOCUMENT RESUME

ED 308 829 IR 013 889

| | |
|---|---|
| AUTHOR | Morrison, Gary R.; And Others |
| TITLE | Reconsidering the Research on CBI Screen Design. |
| PUB DATE | Feb 89 |
| NOTE | 20p.; In: Proceedings of Selected Research Papers presented at the Annual Meeting of the Association for Educational Communications and Technology (Dallas, TX, February 1-5, 1989). For the complete proceedings, see IR 013 865. |
| PUB TYPE | Reports - Research/Technical (143) -- Speeches/Conference Papers (150) |
| EDRS PRICE | MF01/PC01 Plus Postage. |
| DESCRIPTORS | Comparative Analysis; *Computer Assisted Instruction; Higher Education; *Instructional Design; *Intermode Differences; *Media Research; *Screens (Displays); Student Attitudes; *Text Structure |
| IDENTIFIERS | *Learner Control; *Screen Format |

ABSTRACT

Two variables that designers should consider when developing computer-based instruction (CBI) text screens are text density, which manipulates the context of the information presented, and screen density, which is a measurement of the amount of information presented at one time on the screen. A study on text density was designed to identify alternative methods for displaying computer text; it focused on the level of richness or detail presented in text displays, i.e., density level. A second study on text density was designed to extend the first study in several ways, e.g., use of larger samples; use of both immediate and delayed achievement posttests; and an extended examination of learner control. The first study was designed to determine how individual density levels were judged relative to one another by examining student preference for two different screen designs, while the primary interest in the second study was to determine replicability of the results of the first one when only the first screen of each density level was presented. In general, findings revealed that low-density format is a viable alternative to the standard text format used in printed materials; subjects indicated a strong preference for learning from high-density screens as opposed to low-density screens; and future research on CBI screen designs should investigate the use of text density and varying screen density in different content areas, and for tasks with different processing demands. (46 references) (CGD)

# Title:

# Reconsidering the Research on CBI Screen Design

## Authors:

Gary R. Morrison
Jacqueline K. O'Dell
Steven M. Ross
Charles W. Schultz
Nancy L. Wheat

# Reconsidering the Research on CBI Screen Design

Gary R. Morrison Steven M. Ross

Jacqueline K. O'Dell Charles W. Schultz Nancy L. Wheat

Memphis State University
College of Education
Memphis, TN 38018

Reconsidering the Research on CBI Screen Design

The continuing expansion of the microcomputer into schools, businesses, hospitals, and homes has created a market for instructional software ranging from beginning mathematics programs to sophisticated simulations of hospital emergency room events. A review of these instructional packages indicates both effective and poor applications of instructional design. One aspect that is often overlooked, however, is the design of screen displays (Bork 1987; Burke, 1981; Keller, 1987) Computer displays (a) are limited to one page at a time, (b) have restricted backward paging and review, (c) are limited to layouts of 40 or 80 columns by 24 rows, (d) provide limited cues as to lesson length, (e) are typically limited to one typeface and one or two typesizes, and (f) offer relatively poor resolution. In contrast to the printed page, however, the computer has the capability to generate dynamic "pages" (e.g., windows, screen building, and animation), which can be increased in number with a relatively smaller effect on distribution costs.

Computer Screen Design

The literature on computer screen design tends to follow one of two approaches. The first approach focuses on typographical variables that the designer can manipulate to cree e an effective screen design. Based on research and subjective views, several authors have recommended that displays use liberal white space, double spacing, a standard ASCII typeface, and left-justified text (Allessi & Trollip, 1985; Bork, 1987; Grabinger, 1983; Heines, 1984; Hooper & Hannafin, 1986). A second approach to computer screen design is the manipulation of the content. One such method is chunking the material into meaningful thought units which are then presented with blank (white) spaces bordering each. Although Failo and DeBlois (1988) suggest chunking as an effective means of designing displays, research on chunking and similar methods have failed to show clear advantages under either print or CBI (cf. Basset, 1985; Carver, 1970; Fiebel, 1984; Gerrel & Mason, 1983; O'Shea & Sinclair, 1983). It seems important to consider that chunking does not change the instructional content; rather, it changes the way the content is presented on the screen.

This paper will describe two additional variables designers need to consider when designing CBI text screens.

The first variable, text density, manipulates the context of the information presented The second variable, screen density, is a measurement of the amount of information presented at one time on the screen. The following sections of this paper will summarize two studies on text density and two studies on screen density, and the final section will provide guidelines for designing CBI screen based on these four studies.

## Text Density

The research described in this section was designed to identify alternative methods for displaying computer text. Its specific focus was on the level of richness or detail presented in text displays, a variable that we have labeled "density level." In related research with print material, Reder and Anderson (1980; 1982) compared complete chapters from college textbooks to summaries of the main points on both direct and indirect learning. The summaries were found to be comparable or superior in the 10 studies reported. They concluded that the summaries may help the learner focus on the main ideas without the distraction of additional elaborations.

Similar to Reder and Anderson's (1980; 1982) construct, the present text density variable includes such attributes as length of material (number of words), redundancy of ideas, and depth of conceptual support for the main ideas. Reading researchers have referred to such text attributes as "microstructure" (Davidson & Kantor, 1982) or "texture" (Amiron & Jones, 1982). Following Reder and Anderson's (1980) procedure, we generated low-density material from conventional text by: (a) defining a set of rules for shortening the text, (b) having different individuals apply the rules to the rewriting of the text, and (c) requiring those individuals to arrive at a consensus on the final content.

Application of these rules to a textbook unit consisting of 2,123 words on 18 pages yielded a low-density version of 1,189 words (a 56% savings) on 15 pages (a 17% savings). The print pages and computer frames were designed using what were subjectively determined to be the most appropriate layouts for the content. Final versions of the CBI lessons resulted in 49 frames in the low-density lesson and 66 frames in the high-density lesson. Figure 1 shows a sample frame from the two density levels. Although both frames present the same main ideas, the high-density version includes additional elaborations and supporting context.

Insert Figure 1 about here

Our main research interest was evaluating the effectiveness of the low-density material for learning. We hypothesized that, when used in CBI, low-density narrative would promote better learning and more favorable attitudes by reducing reading and cognitive processing demands of the screen displays. A second area of interest was the effect of allowing learners to select preferred density levels in the print and CBI modes. Prior research on learner control (LC) has shown positive results in some studies (Judd, Bunderson, & Bessent, 1970), while more recent findings have been negative (Carrier, Davidson, & Williams, 1985; Fisher, Blackwell, Garcia, & Greene, 1975; Ross & Rakow, 1981; Tennyson, 1980). In contrast to the task variables typically varied through learner control (e.g., lesson length, difficulty, or organization) the text density variable represents a "contextual" lesson property that primarily influences how lesson material appears without changing its basic informational content. Making effective LC choices (i.e., ones that accommodate learning preferences and styles) was therefore assumed to be less dependent relative to these other variables on prior knowledge or skill in the subject area. To investigate these questions concerning density variations and learner control, we conducted the text density studies (Morrison, Ross, & O'Dell, 1988; Ross, Morrison, & O'Dell, 1988), summarized below.

Text Density: Study I

Subjects were 48 undergraduate teacher education majors in six treatment groups arranged by crossing two presentation modes (computer vs. print) by three text density conditions (high, low, and learner control). Main dependent variables were different types of learning achievement (knowledge, calculation, and transfer), and lesson completion time.

Results. The major finding from Study I were

1. No differences in learning occurred between low- and high-density groups.

2. The high-density group, took 34 percent more time to complete the lesson.

3. Within the print mode, low-density text was selected an average of 3.75 (out of 5) times; however, while within the CBI mode, it was selected an average of only 1.25 times, the exact opposite pattern.

4. CBI subjects judged the high-density material as slower moving and low-density material as more sufficient than did the print subjects.

5. Low-performers in the learner control treatment did not seem to favor the "low-support" option (i.e., low-density text) over high support.

Text Density: Study II

Study II (Ross, Morrison, O'Dell, 1988) was designed to extend Study I in several ways. First, comparisons between density and presentation modes were repeated using much larger samples, an immediate achievement posttest, and a delayed achievement posttest. Second, the examination of LC was extended to include selections of both text density ("partial-LC") and presentation mode ("full-LC"). As in Study I, the partial-LC treatment allowed subjects to select either a high-density or low-density text display for each print or CBI lesson. Subjects in the full-LC treatment, however, were allowed to first select either the print or CBI mode, and to then select high-density and low-density text within the selected mode.

Results. The major findings from Study I were

1. Comparisons of the full- vs. partial-LC conditions indicated no significant differences on achievement, attitudes, or density selections.

2. Under CBI, the full-LC group (18.9 min.) took significantly less time than the partial-LC group (29.0 min.), indicating that those who selected CBI completed the lesson more quickly than those who were prescribed CBI

3. In the full-LC treatment, subjects' choice of presentation mode was almost equally divided between print and CBI.

4. Reading rate was found to be the only significant predictor of these preferences: subjects selecting CBI were faster readers than those who selected print.

5. LC subjects in both groups showed a general tendency to select low-density text (70 vs. 30 percent) more frequently than high-density text regardless of presentation mode.

Discussion

Similar to Study I, the highest achievement scores were obtained by the LC group, but this time the effect was consistent across CBI and print, and statistically significant on three of the four measures (calculation, transfer, and delayed retention). The CBI group (25.8 min.) took significantly more time than the print group (21.5 min.), and the high-density group (26.5 min) took significantly more time than the low-density group (21.0 min).

The significant time savings but comparable achievement using low-density as compared to high-density materials was consistent with the results of Study I. The LC comparisons further suggested that learners are capable of making adaptive decisions when selecting contextual lesson attributes such as presentation mode or text density level. This finding is in contrast to the negative results from LC applications which required learners to select the sequence, difficulty, or amount of instructional support needed to achieve objectives (Hannafin, 1984).

## Screen Density as a Design Variable

Prior research on typographical variables and content manipulation have provided useful guidelines for screen design; however, they have not addressed the issue of how much information the expository frame should contain. We call this variable "screen density" as differentiated from text density (Morrison, Ross, & O'Dell, 1988; Ross, Morrison, &O'Dell, 1988) For example, the International Reading Association Computer and Technology Reading Committee (1984) recommends using "clear and legible" displays with "appropriate margins and interline spacing", but provides no operational guidelines or specifications to define these qualities. To provide designers with clearer recommendations for optimum density levels, the screen density construct must be operationalized and precisely defined.

One method of evaluating screen designs is to calculate the density of the total screen by determining how many of the screen spaces are contain a character or are adjacent to a character (Tullis, 1983). Human factors research suggests that performance error rates increase as the density of a display increases (Burns, 1979, Coffey, 1961; Mackworth, 1976; Ringel and Hammer, 1964). Research, however, on the upper limit of screen density has yielded disparate recommendations ranging from 15% (Danchak, 1976) to 31.2% (Smith, 1980, 1981, 1982) all the way to 60% (NASA, 1980).

Another research focus was the possible influence of the type of material presented on how different screen designs were viewed. For example, Grabinger's (1983) evidence for supporting low density screens was obtained using a typographical notation developed by Twyman (1981) to create a content-free screen representation of a CBI screen. In contrast, judgments of realistic materials would appear to demand greater awareness of and reliance on contextual properties (e.g., proximal supporting text) that helps to increase the meaning of the information being read. Thus, it is not clear that preferences for low-density screens similarly apply to realistic lesson materials, especially since the low-density designs present the material in smaller thought units and consequently also necessitate an increased number of lesson frames. We expected that with fixed content and realistic displays, preferences for lower-density screens would not be as high as some of the previous research in the instructional design literature would suggest. A third research interest was the preferences of users differing in degree of CBI experience, namely graduate instructional design students versus undergraduate education students (Ross, Morrison, O'Dell, & Schultz, 1988).

Screen Density: Study I

Subjects were 23 graduate and 23 undergraduate education majors who volunteered to participate in the study. A paired-comparison design (Nunnally, 1967) was employed involving a total of six unique pairings of four density levels presented on an Apple IIe monochrome screen. For each of the six comparisons, subjects were presented with two different screen designs and asked to indicate their preference. The six comparisons and the two density levels within each were presented in a random order.

Results. Table 1 shows the proportion of subjects who selected each density level when paired with each of the alternative levels. These proportions reflect a curvilinear pattern, with preferences tending to favor the two middle density levels (especially the 31% level) over the lowest (22%) and highest (53%) levels. Specifically, the 31% level was favored by the majority of subjects (from 52 to 74 percent) over each of the other three levels, the 26% level was favored by the majority (54 to 56 percent) over each of the two extreme levels.

Insert Table 1 about here

The above results provide information on how the individual density levels were judged relative to one another. A somewhat different question concerns whether or not overall preferences tended to favor, as the literature suggests, lower-density over higher-density designs. However, tabulations across subjects on the six paired-comparison trials indicated the opposite pattern: 156 (57 percent) selections favored the higher density design whereas only 120 (43%) favored the lower density design.

Summary. In contrast to recommendations in the literature (Allessi & Trollip, 1985; Bork, 1984, 1987; Grabinger, 1983; Heines, 1984; Hooper & Hannafin, 1986) for designing lower density screens, these results showed that subjects tended to prefer higher-density screens. The relatively stronger preferences for the 31% (intermediate) density level may suggest that subjects were attempting to balance aesthetic properties (i.e., perceived readability and appeal of the screen) with either both (a) the degree of contextual support and (b) the number of screens in the lesson. If the latter were the key factor, then preferences for the lower density (more spacious) designs would seem likely to increase if judgments were to be based on only the first screen of each screen density level as in Grabinger's (1983) study. Study II was conducted to test this interpretation.

Screen Density: Study II

The primary interest in Study II was to determine replicability of the Study I results when only the first screen of each density level was presented. It was predicted that in this case, stronger preference for the lower density screens would be indicated than in Study I, since reductions in density level would not require having to review a greater number of frames.

Subjects were 27 graduate and 12 undergraduate education majors who volunteered to participate in the study and had not participated in Study I. The same paired-comparison design as in Study I was employed. The stimulus materials were the same as used in Study I with one change. Only the first screen for each density comparison was presented.

Results The proportion of subjects who selected each density level in the separate comparisons is shown in Table II. Here, in comparison to the curvilinear trend of Study 1, the pattern is directly linear, with the higher-density design consistently preferred over the lower-density design. Across all comparisons, subjects chose the higher-density design 145 (62 percent) times and the lower-density design only 89 (38 percent). Thus, compared to Study I, while no particular density level emerged as significantly more or less desirable than others, there was an even stronger tendency to select higher-density designs in the paired comparisons.

## Discussion

Our studies on text density and screen density suggest two additional variables to consider when designing CBI text screens. First, low-density format is a viable alternative to the standard text format used in printed materials. A frame designed with low-density text can incorporate white space, double-spacing, and headings adequately in a single frame. This leaner text format provides the designer with the space needed to organize text which increases its visual appeal (Grabinger, 1985) while minimizing the total number of screens required to present the same content. Ample use of white space, and vertical and horizontal typography with low-density text will typically produce a unit of instruction that is comparable in frame length to high-density text, but with approximately 50% fewer words. The resultant low-density material in our research was read faster, perceived as more sufficient, and selected more frequently under LC than the same text presented in a high-density format.

Second, in contrast to previous studies and recommendations in the instructional design literature (Allessi & Trollip, 1985; Bork, 1984, 1987; Grabinger, 1983; Heines, 1984; Hooper & Hannafin, 1986), subjects indicated a strong preference for learning from high density screens as opposed to low-density screens. These results suggest that the use of realistic stimulus materials may produce different results than obtained with nonrealistic stimulus materials (Grabinger's, 1983) or with informational (e.g., machine status) displays (e.g., Danchak, 1976; Smith, 1980, 1981, 1982). The combined results of the text density studies and and the two screen density studies suggest the use of lean (low-density) text with a medium (31%) screen density. Low-density text provides the designer with a means of reducing the total amount of text in the lesson. The medium density level provides a balance between aesthetic appeal and an appropriate amount of context.

Future research on CBI screen designs should investigate the use of text density and varying screen density with different content areas and tasks with different processing demands. Other research should investigate the application of both low-density text and varying screen densities to online help screens where the purpose is more for review of the ideas as opposed to instruction.

References

Amiron, M.R. & Jones, B.F. (182). Toward a new definition of readability. Educational Psychologist, 17, 13-30.

Allessi, S.M. & Trollip, S.R. (1985). Computer-based instruction: Methods and development. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Basset, J.H. (1985). A comparison of the comprehension of chunked and unchunked text presented in two modes: Computer and printed page. Unpublished doctoral dissertation, Memphis State University.

Bork, A. (1984). Personal Computers for Education. Cambridge, MA: Harper & Row.

Bork, A. (1987). Learning with personal computers. New York: Harper & Row, Publishers, Inc.

Burke, R.L. (1981). CAI sourcebook. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Burns, D. (1979). A dual-task analysis of detection accuracy for the case of high target-distractor similarity: Further evidence for independent processing. Perception and Psychophysics, 25, 185-196.

Carrier, C.A., Davidson, G., & Williams, M. (1985). The selection of instructional options in a computer-based coordinate concept lesson. Educational Communications and Technology Journal, [illegible]. 199-212.

Carver, R.P. (1970). Effect of "chunked" typography on reading rate and comprehension. Journal of Applied Psychology, 54, 288-296.

Coffey, J.L. (1961). A comparison of vertical and horizontal arrangements of alpha-numeric material--Experiement 1. Human Factors, 3, 93-98.

Danchak, M.M. (1976). CRT displays for power plants. Instrumentation Technology, 23, 29-36.

Davidson, A., & Kantor, R. (1982). On the failure of readability formulas to define readable texts: A case study from adaptations. Reading Research Quarterly, 17(2), 187-209.

Feibel, W. (1984). Natural phrasing in the delivery of text on computer screens: Discussion of results and research approaches. In D. T. Bonnett (Ed.), Proceedings of the Sixth Annual National Computing Conference. Dayton, OH.

Fisher, M.D., Blackwell, L.R., Garcia, A.B., & Greene, J.C. (1975). Effects of student control and choice on engagement in a CAI arithmetic task in low-income school. Journal of Educational Psychology, 67, 776-783.

Gerrel, H. R., & Mason, G. E. (1983). Computer-chunked and traditional text. Reading World, 22, 241-246.

Grabinger, R.S. (1983). CRT text design: Psychological attributes underlying the evaluation of models of CRT text displays. Unpublished doctoral dissertation, Indiana University.

Grabinger, R.S. (1985). Relationships among text format variables in computer-generated text. Paper presented at the Annual Conference, AECT, Las Vegas, NV, 1985.

Hannafin, M.J. (1984). Guidelines for using locus of instructional control in the design of computer-assisted instruction. Journal of Instructional Development, 7, 6-10.

Hartley, J. (1987). Designing electronic text: The role of print-based research. Educational Communication and Technology Journal, 35, 3-17.

Hays, W.L. (1981). Statistics (3rd Edition). New York: Holt, Rinehart, & Winston.

Heines, J.M. (1984). Screen design strategies for computer-assisted instruction. Bedford, MA: Digital Press.

Hooper, S., & Hannafin, M.J. (1986). Variables affecting the legibility of computer generated text. Journal of Instructional Development, 9, 22-29.

Falio T. & DeBloois, M.L. (1988). Designing a visual factors-based screen display interface: The new role of the graphic technologist. Educational Technology, 28, 12-21.

International Reading Association Computer Technology and Reading Committee (1984). Guidelines for educators on using computers in schools. Reading Research Quarterly, 20, 120-122.

Judd, W.A., Bunderson, C.V., & Bessent, E.W. (1970). Effects of computer-based instruction on prerequisite mathematics. (MATHS Tech. Rep. 5) Austin, TX: University of Texas. (ERIC Document Reproduction Service No. ED 05 532).

Keller, A. (1987). When machines teach. New York: Harper & Row, Publishers, Inc.

Mackworth, N.H. (1976). Stimulus density limits the useful field of view. In R. A. Monty and J.W. Senders (Eds.) Eye movements and psychological processes. Hillsdale, NJ: Erlbaum.

Morrison, G.R., Ross, S.M., & O'Dell, J.K. (1988). Text density level as a design variable in instructional displays. Educational Communication and Technology Journal 36, 103-115.

NASA. (1980). Spacelab display design and command usage guidelines. (Report MSFC-PROC-711A). Huntsville, Al: George Marshall Space Flight Center.

Nunnally, J.C. (1967). Psychometric theory. New York: McGraw-Hill.

O'Shea, L.T., & Sindelar, P.T. (1983). The effects of segmenting written discourse on the reading comprehension of low-and high-performance readers. Reading Research Quarterly, 18, 458-465.

Reder, L.M., & Anderson, J.R. (1980). A comparison of texts and their summaries: Memorial Consequences. Journal of Verbal Learning and Verbal Behavior, 19, 121-134.

Reder, L.M., & Anderson, J.R. (1982). Effects of spacing and embellishments on memory for the main points of a text. Memory and Cognition, 14, 64-78.

Ringel, S. & Hammer, C. (1964). Information assimiliation from alphanumeric displays: Amount and density of information presented (Tech. Report TRN141). Washington, D.C. U.S. Army Personnel Research Office (NTIS No. AD 6021 973).

Ross, S.M. (1983). Increasing the meaningfulness of quantitative material by adapting context to student background. Journal of Educational Psychology, 75, 519-529.

Ross, S.M., Morrison, G.R., & O'Dell, J.K. (1988). Obtaining more out of less text in CBI: Effects of varied text density levels as a function of learner characteristics and control strategy. Educational Communication and Technology Journal, 36, 131-142.

Ross, S.M., Morrison, G.R., O'Dell, J.K., & Schultz, C.W. (1988). An investigation of varying screen densities on learner preference. Manuscript submitted for publication.

Ross, S.M., & Rakow, E.A. (1981). Learner control versus program control as adaptive strategies for selection of instructional support on math rules. Journal of Educational Psychology, 73, 745-753.

Ross, S.M., & Rakow, E.A. (1982). Adaptive instructional strategies for teaching rules in mathematics. Educational Communications and Technology Journal, 30, 67-74.

Smith, S.L. (1980). Requirements definition and design for the man-machine interface in C³ system acquisition. (Technical Report ESD-TR-80-122). Bedford, MA: USAF Electronic Systems Division. (NTIS no. AD A087 528).

Smith, S.L. (1981). Man-machine interface (MMI) requirements definition and guidelines: A progress report. (Technical Report ESD-TR-81-113). Bedford, MA: USAF Electronic Systems Division. (NTIS no AD A096 705).

Smith, S.L. (1982). User-system interface design for computer-based information systems. (Technical Report

ESD-TR-82-132). Bedford, MA: USAF Electronic Systems Division. (NTIS no. AD A115 353).

Tennyson, R.D. (1980). Instructional control strategies and content structures as design variables in concept acquisition using computer-based instruction. Journal of Computer-Based Instruction, 3, 84-90.

Tullis, T.S. (1981). An evaluation of alphanumeric, graphic, and color information displays. Human Factors, 23, 541-550.

Tullis, T.S. (1983). The formatting of alphanumeric displays: A review and analysis. Human Factors, 25, 657-682.

Twyman, M. (1981). Typography without words. Visible Language, 15, 5-12.

Table 1

Proportion of Times Density Levels Within Each Paired Comparison Were Selected in Study 1

Paired Comparison

| 22% | 26% | 22% | 31% | 22% | 50% | 26% | 31% | 26% | 50% | 31% | 50% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| .46 | .54 | .26 | .74 | .46 | .54 | .35 | .65 | .56 | 44 | .52 | .48 |

Table 2

Proportion of Times Density Levels Within Each Paired Comparison Were Selected in Study 2

| Paired Comparison | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 22% | 26% | 22% | 31% | 22% | 50% | 26% | 31% | 26% | 50% | 31% | 50% |
| .28 | .72 | .41 | .59 | .44 | 56 | .36 | .64 | .41 | .59 | .39 | .62 |

The median corresponds to the middle frequency score in a ranked set of data

Half the scores will be higher
Half will be lower

| | X | f |
|---|---|---|
| | Hi | 50% |
| Median------------------------------------ | | |
| | Lo | 50% |

If N=40 (40 scores), median = 20th score
If N=17, median = 8.5 highest score

Median corresponds to the 50th percentile

Higher than half the scores
Lower than half

The median, another measure of central tendency, is the number that corresponds to the middle frequency (that is, the middle score) in a ranked set of data. The median is the value that divides your distribution in half; half of the scores will be higher than the median, and half will be lower than the median.

| | X | f |
|---|---|---|
| | Hi | 50% |
| Median------------------------------------ | | |
| | Lo | 50% |

It is important to remember that the median is the halfway point in the distribution--in terms of frequencies. For example, if N=40 (meaning that you have 40 scores), the median will be your 20th score (in terms of rank); if N=17, the median will be your 8.5 highest score, etc.

Another way of defining the median is to say that it corresponds to the 50th percentile.

In any distribution, the median will always be the score that corresponds to a percentile rank of 50; it is higher than half the scores, and lower than half the scores.