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ABSTRACT

Screen designers for computer-mediated instruction (CMI) products must consider the motivational appeal of their designs. Although learners may be motivated to use CMI programs initially because of their novelty, this effect wears off and the instruction must stand on its own. Instructional screens must provide effective and efficient instruction, appropriate navigational tools, and aesthetics. This paper represents a compilation of screen design guidelines from over 90 sources. Guidelines were proposed in whole or in part on the basis of their contribution to motivational appeal. Two primary types of guidelines were discovered--those aimed at enhancing motivation, "expansive," and those aimed at preventing loss of motivation, "restrictive." The paper assesses typography, graphical images, color, animation, and audio, and proposes a framework that CMI designers can use to apply the two types of guidelines and arrive at more effective, efficient, and appealing screen design. (Contains 91 references.) (Author/SWC)

Title:

Motivational Screen Design Guidelines for Effective Computer-Mediated Instruction

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Abstract

Screen designers for computer-mediated instruction (CMI) products must consider the motivational appeal of their designs. Although learners may be motivated to use CMI programs initially because of their novelty, this effect wears off and the instruction must stand on its own. We surveyed approximately 92 articles and books to compile screen design guidelines that were proposed by their authors in whole or in part on the basis of their contribution to motivational appeal. Two primary types of guidelines were discovered-those aimed at enhancing motivation and those aimed at preventing loss of motivation. The authors call the first type of guideline "expansive," and the second "restrictive." The authors propose a framework that designers can use to apply the two types of guidelines and arrive at effective screen design.

INTRODUCTION

Computer-mediated instruction (CMI) systems are increasingly used for learning and training in school as well as in corporate settings. Designers of CMI aim to design presentations that will encourage and facilitate learning. Screen design, as the communication vehicle for most of the human-computer interface, refers to "the purposeful organization of presentation stimuli in order to influence how students process information"(Hannafin & Hooper, 1989, p. 156). Studies on human memory and message design consistently show that well organized material causes learners to develop and maintain interest in lesson content, promotes the learner engagement with the material, and facilitates deep processing of important information better than does unorganized material (Cook & Kazlauskas, 1993; Faiola & DeBloois, 1988; Grabinger & Albers, 1989; Hannafin & Hooper, 1989). Well organized material also improves reading speed and comprehension, and effectiveness and efficiency of learning from CMI (Galitz, 1989; Hannafin & Hooper, 1989; Hathaway, 1984; Strickland & Poe, 1989).

CMI delivers information in a variety of ways including text, graphical images, color, animation and audio, and other components of screen. Well designed CMI screens combine these elements into a whole, cohesive and balanced display (Moore & Dwyer, 1994). Skillfully designed CMI screens should not only provide the content and functionality to satisfy learner's needs in a manner that draws learners' attention, motivates interaction, and helps them accomplish learning goals without confusion and fatigue (Faiola, 1990; Galitz, 1989; Jacques, Preece, & Carey, 1995; Shneiderman, 1992), but also contribute to quality and usability (Tufte, 1992).

Motivation is a frequently used word in the literature of education and computers, however, the study of motivation has long been a neglected area in instructional technology (Rezabeck, 1994). To be effective, instruction must be appealing to learners. Many learners do find CMI programs novel and appealing, at least initially. Most CMI programs often contain interactive communication, automatic feedback, animated graphics, sound effects, and freedom to make mistakes without fear of censure. If CMI screens are not well designed, or lack motivational appeal beyond the novelty level, then learner involvement wanes, and the program is abandoned (Keller & Suzuki, 1988). Consequently, it is critical for designers of CMI to make screens that are appealing at a level beyond the novelty effect in addition to making the screens instructionally efficient and effective.

Keller (1983) suggests that motivation attracts learners to the instruction and increases their effort in relation to the subject . Bohlin and Milheim (1994) concur, stating that motivation provides appeal or interest for the learner and stimulate learner effort. With reasonable limits, the greater the motivation, the greater will be the learning (Butler, 1972). According to Keller's ARCS model (Keller, 1987), instructional motivation has four main components: it should gain and sustain attention of learners (attention), pertain to the needs and familiarity of learners (relevance), foster confidence in accomplishing the learning task (confidence), and satisfy learners by meeting their expectation (satisfaction).

Screen design for effective CMI is not complete without considering its motivational appeal. Most designers would agree with these assertions, however, many would think of motivation for CMI as a consideration to be brought up late in the design process (Keller & Burkman, 1993). Motivation should be considered throughout the design and development process (Okey & Santiago, 1991; Keller & Kopp, 1987). Many designers believe that effective use of motivational elements for CMI screens can contribute to increasing motivation to learn. Keller and Burkman (1993) go so far as to suggest that the motivation to learn is, in large part, a CMI designer's responsibility, not learner's responsibility.

Motivational screen design should be related to orienting learners toward the instruction, encouraging deep processing, focusing attention, engaging learners on task, and resulting in better performance (Grabowski & Curtis, 1991; Mukherjee & Edmonds, 1994). CMI texts with a high legibility enable the readers to devote their attention to understanding whatever information the text conveys. Inherently rewarding interactions increase learner's intrinsic

motivation to continue, which can lead to a state of flow: a condition in which "people are so involved in an activity that noting else seems to matter" (Csikszentmihalyi, 1992, p. 4).

The purpose of this article is to identify the available guidelines for effective, user-friendly designed CMI software to maximize learners' performance of the content material and their motivation to learn, and place these guidelines in a useful framework for making CMI system more effective, efficient, and appealing.

GUIDELINES FOR MOTIVATIONAL SCREEN DESIGN

The authors discovered two primary types of guidelines in the books and articles surveyed. The first type is aimed at supporting intrinsic motivation or enhancing extrinsic motivation. The second type is aimed at preventing the loss or degradation of either intrinsic or extrinsic motivation. We call the first type of guideline "expansive," and the second type "restrictive."

There are many components of screen design which may affect the motivational value of CMI screens, however, this present study will be focused on five screen design elements: typography, graphical images, color, animation and audio. Guidelines for each category are listed based on the expansive and restrictive classifications.

Typography

First of all, typography is the key element in text materials and in almost any well-designed table, chart, map, or diagram (Marcus, 1992). Generally, text on screens has been found to be less legible than text on paper. Text display on computer screen can be difficult to read or easy to read, depending upon the font, the screen layout, and the contrast provided (Moore & Dwyer, 1994).

Signals are writing devices that emphasize aspects of a text's content or structure without adding to the content of the text and help readers identify specific points in a text (Golding & Fowler, 1992; Lorch, 1989). These include titles, headings, pre- and post- instructional strategies, such as preview, overview and summary, and typographical cues (Golding & Fowler, 1992; Lorch, 1989). Although there are many typographical motivation elements for CMI system, they are all share the goal of directing the learner's attention during learning. Signals including typographical cueing may lead to enhanced memory performance as the result of a von Restorff effect[12]. The result is that the isolated events have a higher probability of being recalled at a later time (Glynn, 1978). Signaling is information in text that does not add new content on a topic, but that gives emphasis to certain aspects of the semantic content or points out aspects of the structure of the content (Meyer, 1985). Signaling should serve to clarify content.

Typographical cueing system, defined as the attachment of a specific meaning to a part of a text by displaying it in a way which is different from the rest of the text, controls mathemagenic behaviors. Typographic coding in CMI screen is mainly used for accentuating; the accentuation can relate to single words, phrases or whole paragraphs (van Nes, 1986). The cueing systems guide the construction and implementation of learner's prose-processing decision criteria (Glynn & Di Vesta, 1979). However, we should try to establish a hierarchy of importance using the techniques above and then employ it consistently throughout the CMI system.

Expansive Guidelines

- Use graphic character fonts for attention-catching because of their size and unusual shape, even if less legible than normal fonts (van Nes, 1986).

Restrictive Guidelines

- Be consistent in assigning textual cues and messages to the learner (Faiola, 1990). Consistency in typographic attributes can establish and convey a very clear visual message to the viewer that (s)he is now reading a certain subject or section of instructional content.
- Use both upper and lower case letters (Apple Computer Inc., 1989; Faiola & DeBloois, 1988). The legibility of text with letters in mixed case, i.e. with capitals only used for indicating the first letter of a sentence, a name etc., is higher than in upper case only (van Nes, 1986). All upper case characters should be used only occasionally, and for the purposes of emphasis (Strauss, 1991).

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[12] von Restorff effect refers to "signaled information is remembered better because it is perceptually salient or isolated from the rest of the text." (Golding & Fowler, 1992, p. 100)

- Use high contrast between letters and background to improve legibility and readability (Isaacs, 1987; Pastoor, 1990; Reynolds, 1979; Revlin, Lewis, & Davies-Cooper, 1990).
- Left-justify text, but do not right-justify it (Garner, 1990). Limit text to approximately 65 character per line, or a maximum of 8-10 words per line (Galitz, 1989; Garner, 1990). Increase the spacing between lines for long lines of text (Garner, 1990; Hartley, 1990).
- Use highlighting techniques conservatively and carefully, since they are likely to attract the reader's attention (Apple Computer Inc., 1989; Galitz, 1989; Hartley, 1987; Heines, 1984; Isaacs, 1987; Rivlin, Lewis, & Davies-Copper, 1990). Underlining and blinking should only be used if they do not interfere with the legibility of the text (Heines, 1984; Merrill, 1988; Rivlin, Lewis, & Davies-Cooper, 1990; Tullis, 1988). Flashing should be reserved for items that must convey an urgent need for attention. Reverse video can be an effective method in attracting the reader's attention, but it should be used judiciously to avoid the "crossword-puzzle effects" (Galitz, 1989, p. 61).
- Select a typeface with a simple, clean style and use a few typefaces in any one screen or CMI program (Apple Computer, Inc., 1989; Hartley, 1994). Most screens look best with no more than two different fonts, using different sizes and weights of each (Strauss, 1991).

Graphical Images

With the advent of the first widely used graphical user interface(GUI) computer by Apple Computer in 1984, it became possible to do more sophisticated things with the CMI screen design (Jones, 1995). Graphical images including pictures, graphics and illustrations throughout CMI system can function to attract and maintain attention, and facilitate learning from text materials (Duchastel, 1978; Levie & Lentz, 1982; Rieber, 1994). Graphical images can also provide functional guidance, aesthetics charm, and corporate or product identity (Marcus, 1992).

Even though using graphical images to arouse general curiosity and interest in CMI system seems as a very superficial way, they offer the potential to increase the challenge and curiosity of the task, as well as encouraging students to be creative and use their imaginations (Rieber, 1994). Learning certainly demands effort and hard work, but instruction does not need to be boring and dull. So we need deeper ways to maintain attention and interest beyond the simple provision of interesting graphical images. Screen designers attempt to achieve visual solutions using graphical elements that are functional, elegant, appropriate, simple and economical, and consistent (Hartley, 1987). The use of graphical images may enrich presentations and make them more attractive to the learners.

Expansive Guidelines

- Consider the overall standard of imagery that meet learner expectations for style (Rivlin, Lewis, Davies-Cooper, 1990).

Restrictive Guidelines

- Use simple and clear images to make CMI more effective (Levie & Lentz, 1982; Marcus, 1992; Rivlin, Lewis, & Davies-Cooper, 1990; Tompson, 1994). Don't use images with too much detail at a small scale as this can be lost on screen. Simple image are more effective for instruction than complex images.
- Use graphical images for instructional, motivational, or attention-focusing effects, and not simply for the sake of including them on the screen (Duchastel, 1978, 1983; Levie & Lentz, 1982; Pettersson, 1993; Rieber, 1994; Surber & Leeder, 1988).
- Make sure all the key components of the graphical images are labeled (Rivlin, Lewis, & Davies-Cooper, 1990). Use captions or title for labeling the key elements of graphical images.
- Consider the prior knowledge and cultural conventions of the learner in choosing graphical image components (Apple Computer Inc., 1989; Boling, Johnson, & Kirkley, 1994, Easterby, 1970). Avoid sexist, culturally-sensitive, and other potentially offensive imagery. However, include pictures of people, plants, and animal with relatively large and detail for especially appealing to girls, while include vehicles or machines in action for only appealing to boys (Jakobsdóttir, Krey, & Sales, 1994).
- Obey any existing conventions, such as the standard symbols in a circuit diagram or the top to bottom or left to right order for a low chart (Rivlin, Lewis, Davies-Cooper, 1990).

Color

Color can also be used effectively within CMI system for aesthetic and motivational reasons (Galitz, 1989; Hartley, 1987, 1994; Heines, 1984), however, it is the most sophisticated and complex of the visible language components for screen design. Color may promote deep processing of important information, aid in organizing lesson content, allow reasonable learner-control options, promote interaction between the learner and lesson content, and facilitate lesson navigation (Hannafin & Hooper, 1989). Most researchers seem to agree that colored images are desirable from a motivational point of view, although the research suggests that the motivation effect of graphical images varies greatly with the age, the intelligence and the education of the reader (Hartley, 1994). While claims are often made for the motivational value of color in instructional materials, the research findings on motivation are by themselves not strong enough arguments for using color (Brockmann, 1991; Misanchuk & Schwier, 1995).

However, misuse and misunderstanding of the use of color is common. The differently colored part will involuntarily attract fixation of the eye when it scans the page. A part of a text may rapidly found by giving it a specific color, provided the learner knows which color to look for. Color differences, therefore, can deliberately be used as efficient search aids (van Nes, 1986).

Expansive Guidelines

- Make color coding aesthetically pleasing and logically toward lesson objective (Chapman, 1993). Use a bright color to cue the learner for new information, while presenting the reminder of the information in standard colors consistent with the rest of the screen (Knupfer, 1995).

Restrictive Guidelines

- Use color in the conservative way: limit the number and amount of colors used (Brockmann, 1991; Davidoff, 1987; Garner, 1990; Shneiderman, 1992; Strauss, 1991). Use a maximum of five plus or minus two colors per screen (Faiola, 1990; Marcus, 1992; van Nes, 1986).
- Use colors selectively to manipulate attention. Color can be used to highlight text or graphics to make them conspicuous (Durrett & Trezona, 1992; Garner, 1990; van Nes, 1986).
- Keep consistency in color coding (Faiola, 1990; Galitz, 1989; Marcus, 1992). Consistency is crucial for CMI screen design. Carefully select colors for all visual devices such as touch screens, buttons, menus, and titles, and never change the coding scheme during the presentation (Brockmann, 1991; Chapman, 1993; Faiola, 1990; Faiola & DeBloois, 1988; Galitz, 1989; Heines, 1984; Marcus, 1992; Milheim & Lavix, 1992; Shneiderman, 1992; Rivlin, Lewis, & Davies-Copper, 1990; Strauss, 1991).
- Use cool, dark, low-saturation colors (e.g. olive green, gray, blue, brown, dark purple, black, etc.) for background that recede and do not vie for the user's attention, while foreground colors can be hotter, lighter, and more highly-saturated colors (lemon yellow, pink, orange, red, etc.) that tend to come forward on the screen and attract the user's eye (Faiola, 1990; Faiola & DeBloois, 1988; Milheim & Lavix, 1992; Strauss, 1991; Tufte, 1992; van Nes, 1986).
- Avoid the use of complementary colors (e.g. blue/orange, red/green, violet/yellow) (Heines, 1984).
- Use commonly accepted colors for particular actions, remembering that such color may be appropriate only for specific culture or social systems (Shneiderman, 1992). Colors should match conventional meaning and symbolic associations (Chapman, 1993; Loosmore, 1994).
- Use higher levels of brightness for distinguishing colors according to learners age (Misanchuk & Schwier, 1995).

Animation/Audio

Animation can be an effective way of arousing and maintaining a learner's attention during CMI system. The purpose of the animation sometimes is not to teach something, but only to attract and focus the learner's attention onto the CMI screen (Rieber, 1990, 1994). Animation should be incorporated only when its attributes are congruent to the learning task (Rieber, 1990). Screen designers should not be over-ambitious with animation. Moving a small component on the screen is often more effective and generally easier to achieve (Rivlin, Lewis, & Davies-Cooper, 1990).

Although animation can be a very dramatic visual effect, the efficacy of animated presentations on cognition is quite subtle (Rieber, 1990). Animation, like any graphical images, would also be expected to help learners to visualize a dynamic process that is difficult or impossible for them to visualize on their own, and would facilitate learning tasks

(Rieber, 1990). The mental processes of selection and organization are particularly important considerations in designing animated displays because of the temporal nature of these displays.

Audio in CMI program is not a new phenomenon, however, little research has been done. In language and speech training audio was also a common feature (Aarntzen, 1993). Audio can draw and hold learners' attention to the most important parts of the CMI screen, complement the visual information on the screen, support the learner reading the text on the screen (Aarntzen, 1993). Generally, there are three kinds of audio sources: (a) voice or speech, (b) music, and (c) sound or natural effects (Brewer, 1986).

The function of sound is temporal when spoken instructions and directions are provided about a future event, or feedback about the past, creating a synergistic relationship with the visual presentation (Mann, 1995). Temporal sound may help to focus learner's attention on critical information from the CMI program, particularly when they can listen to the highlights as well as read the details, however, Barron and Kysilka (1993) report that digital audio did not have a significant effect on overall comprehension of the tutorial content.

Expansive Guidelines

- Use graphical animation to explicitly represent highly abstract and dynamic concepts in science, including time-dependent processes (Park, 1994; Park & Hopkins, 1993; Reiber, 1990, 1994).
- Use animation as a substitute or aid for verbal communication (Park, 1994; Park & Hopkins, 1993).

Restrictive Guidelines

- Use animation sparingly and only when required to enhance CMI program (Rieber, 1990; Venezky & Osin, 1991). Small and simple animation may be more effective than large ones (Rivlin, Lewis, & Davies-Cooper, 1990).
- Use congruent animation to the learning task (Reiber, 1990, 1994). Use animation as a visual analogy or cognitive anchor for the instruction of problem solving (Park, 1994; Park & Hopkins, 1993). Use animation to simulate functional behaviors of mechanical or electronic systems and to demonstrate troubleshooting procedures (Park, 1994; Park & Hopkins, 1993).
- Avoid unnecessary or gratuitous animation on the screen not to distract (Strauss, 1991). Do not harm using unnecessary animation. The simpler animation, the better result.
- Use voices or speech for providing information. When speech is used as the mainstream provider of information, same text should appear on the screen. According to redundancy theories (Aarntzen, 1993), this will enhance learning.
- Use calm music to create a relaxing atmosphere; Use loud sound for alarm and warning messages (Aarntzen, 1993).

INTEGRATIVE GUIDELINES FOR MOTIVATIONAL SCREEN

Based upon the results of exploring the motivational screen design guidelines, the issues in CMI screen design are not which fonts are inherently best, whether to double space routinely, or whether to employ color or sound, but how to best to utilize those elements to promote appropriate learning processing (Hannafin & Hooper, 1989). Each of motivational screen elements is not effective definite roles to play in instructional media. The instructional roles of each element and the instructional conditions appropriate for their use are an attempt to move us closer to a realization of the effects on integrated design factors.

The task of the instructional designer who wants to make instruction both effective and appealing is to link the ideas of motivational design to an instructional design theory (Main, 1993; Okey & Santiago, 1991). Motivational screen design supports instructional strategy. Instructional strategy should be sound in view of content selection and sequencing appropriate for audience and learning goals (Reigeluth, 1983). If these conditions are not met, motivational screen design can't fix the problems such as engaging learners in irrelevant instruction or demotivating learners further than usual. Instructional design and motivational design are complementary, not conflicting ideas.

Integration of Motivational Elements

According to dual-coding model on perception and cognition (Paivio, 1978, 1983; Bleasdale, 1983), coding an item in two ways will enhance memory more than coding an item in one way only. Researches on cueing (Grabinger, 1989; Grabinger & Albers, 1989) have shown that learners learn best when they are cued to specific information in an application. The cue summation theory has also been the focus of much research into multichannel communication.

This principle of learning theory predicts that learning increases as the number of available cues or stimuli is increased (Barron & Kysilka, 1993). Designers of CMI should consider the question of how the combination of visual and auditive screen design elements should be for motivating learners (Aarntzen, 1993).

Some of the more substantial guidelines for the CMI screen emerge from the tradition of print-based materials (Hartley, 1994; Tinker, 1964, 1965). Guidelines generalized from researches related to screen design offer specific recommendations as to individual elements of the CMI screen design such as typography, graphical images, color, animation/audio, and so forth. Although single element research, as a necessary first step in understanding how to combine elements into overall screen, is extremely important in identifying the strengths, weaknesses, and potential problems of using specific attributes on CMI screen, they often do not address the overall visual dimension of the CMI screen (Grabinger, 1989; Haag & Snetsigner, 1994).

Motivational screen design elements should be integrative and holistic perspective as the effect of multimedia is more than just the sum of its individual elements (McKerlie & Preece, 1993). The combination of these elements to create an overall design, look, or aesthetic is one not typically addressed in the current literature (Hagg & Snetsigner, 1994). Multi-elements research, as "visual gestalt of a screen" (Grabinger, 1989, p. 179), tends to be more complex than single-element research on motivational screen design for effective CMI program.

Motivation and achievement interact in ways that warrant a "holistic" examination of strategies incorporated into CMI program. It should serve to captivate the learner's attention, promote feelings and expectations of success, improve perception of control, increase positive attributions to effort and ability, and enhance self-efficacy and foster achievement and positive affect through social interaction (Relan, 1992). Motivating students to learn and become life-long learners is an especially important and difficult task for a teacher (Bohlin, Milheim, & Viechnicki, 1993). CMI is often very motivating to students, especially when the lessons involve animated characters, voice capabilities, and full-color graphics (Blickhan, 1992). The use of both visual and audio to arouse the learners' attention is more likely to increase interest than the use of visual or sound alone (Frence & Vockell, 1994). Motivation is a key factor in all types of learning.

Overall Motivational Guidelines

- *Use* the motivational elements of CMI screen as *economically* as possible (parsimony principle). The economic use of motivational CMI screen elements should be made of screen display elements to get the designer's message across as simply and clearly as possible (Galitz, 1989; Garner, 1990; Heines, 1984; Rivlin, Lewis, & Davies-Copper, 1990, Schwier & Misanchuk, 1993; Shneiderman, 1992). A well design screen should "...exhibit no annoying or distracting features" (Strickland & Poe, 1989, p. 89). The implication is that screen elements over and above the minimum required will be experienced as annoying or distracting.
- *Keep* the CMI screen *consistent* in using the motivational elements of CMI screen (consistency principle). Consistency in cueing should be applied to all usages of fonts, sizes, spacing, color, and any other attribute. Visually pleasing arrangements focus the perception of structure (Faiola, 1990; Garner, 1990). Consistency is critical for CMI screen design. Consistency states that the appearance, location, and behavior of motivational elements should remain constant, and that screen elements with similar function should share similar appearance, location, and behavior (Faiola, 1990; Galitz, 1989; Lucas, 1991; Marcus, 1992; Shneiderman, 1992). Consistency also makes a CMI program easy to learn, use, and remember (Shires & Olszak, 1992), and reduces the effort required to learn new programs (Apple Computer Inc., 1992, Galitz, 1989).
- *Make* the CMI screen *aesthetically* (aesthetics principle). It states that general rules of visual composition (balance, symmetry, unity, and harmony) should be regarded in CMI screen design (Galitz, 1989; Garner, 1990; Misanchuk, 1992; Reilly & Roach, 1986; Strauss, 1991; Thompson, 1994). Aesthetically pleasing CMI can attract and hold the learner's attention more successfully, and will promote cognitive learning better than, CMI screens constructed without regard for aesthetics (Hagg & Snetsigner, 1994; Lucas, 1991; Misanchuk, 1992; Pett, 1989; Reilly & Roach, 1986; Schwier & Misanchuk, 1993; Thompson, 1994). Well-designed CMI screen can be creative and aesthetically pleasing (Misanchuk & Schwier, 1995).

Based upon the literature review, it can be proposed a framework that can use to apply the two types of guidelines and arrive at effective screen design. Following is the summary of the framework. (Table 1)

Table 1
Framework for Motivation in the Screen Design Process

Type of design in the development process	Learner activities requiring motivation	Screen design issues most relevant to learner activities	Engagement goals (Jacques, Preece & Carey, 1995)
instructional design	apply judge consider reflect	look and feel metaphor production value	encourage
function design	explore attend comply	interaction sequencing art direction	facilitate
form design	navigate click/type see and hear	layout text graphical images audio	don't distract

In considering motivation as it relates to screen design for CMI, it may be useful to note that the learners' motivation in the experience is not only important at the highest level, which is in relation to the learning. The learner needs motivation for different types of activities within the CMI experience: to click a "Forward" button, to explore more then one path in a hypertext environment, or to compare two video sequences at the content level in order to draw a conclusion about some subject. Only one of these activities represents what might be called a "learning activity," although the others must be recognized as contributors, and perhaps prerequisites, for learning to occur. Column 2 of Table 1 shows examples of the types of activities learners may carry out during the CMI experience, and it breaks those activities into three groups according to the relative complexity of carrying them out.

For the sake of this discussion, instructional design is presumed to mean the selection of strategies and tactics for delivering the CMI experience. Functional design is the description of the capabilities that a CMI program will have, and the capabilities it will place under control of the program user, or learner. Forms design is the creation or selection of specific representations of function. By way of a simplistic example, the instructional design might specify that content will be delivered in an exploratory environment. The corresponding functional design might specify that "learners will be able to collect items of information and compare them as they move through the environment." These functions would be operationalized as forms - perhaps an illustrated knapsack into which the learner might drag items using a cursor in the shape of a tiny hand.

Screen design issues exist within the instructional design, function design, and forms design processes, although most guidelines and discussions purporting to relate to screen design are typically restricted to the forms design level. For any given element in the overall screen design, Column 3 of Table 1 lists examples of the types of issues for which a screen designer is responsible, and divides them into categories corresponding to the learners' activities.

The authors feel that once the distinctions we have drawn between levels of screen design issues are clear, it may be possible to characterize the overarching principle guiding each level of design activity according to the three primary goals of engagement laid out by Jacques, Preece, and Carey (1995) in their recent discussion of engagement as a design concept for multimedia. Although the design of an individual on-screen navigation button might aim to encourage learners by using animation to attract their attention and audio to entice them into choosing the button, it is our opinion that any "encouraging" features of a navigation button should be subordinated to the "don't distract" principle. At the top of the chart, however, a screen designer may wish to be cautious regarding the possible distractions inherent in a chosen metaphor, but that designer should err on the side of "encouragement" when looking for guidance at this level of the design.

Our survey of design guidelines reveals that most guidelines fall into what we have called the "restrictive" category, and further that most of them address only the bottom two rows shown in Table 1, with the majority addressing the lowest level only. We speculate that this may account for an overall "restrictive" view of screen design in the field, and that this

view may keep instructional designers from discovering the strategies used by graphic designers, multimedia designers, and others in related disciplines to enhance the motivational aspects of screen design.

CONCLUDING REMARKS

Based upon the increasing use of CMI program for both education and corporate training, screen design is becoming an issue of great importance for instructional designers and developers in many different content areas. Instructional screen must provide effective and efficient instruction, appropriate navigation tools, and aesthetics. This article has sought to provide an integrated list of motivational screen design guidelines for effective CMI systems. It is hoped that these guidelines will provide a useful framework for making CMI system more effective, efficient, and appealing. Implications for motivational screen design will also help instructional developers for practical use. Without better understanding of motivational screen design guidelines, efforts for designing CMI system will continue largely by trial-and-error. In short, CMI designer should focus on motivational screen design that make the learning more appealing and the learner more confident.

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