PRESENTING STRATEGIES ON ROPES+ MODEL FOR CBI LESSON DESIGN

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ABSTRACT

Computer-based instruction (CBI) has strong historical roots in behavioral psychology. Recent advances in CBI have changed instructional environment for CBI design. In addition, CBI designs have been influenced by technological improvements and human factors. The purpose of the study is to examine of the effects of presenting strategies on ROPES+ Model for CBI lesson design from an integrated perspective. ROPES- Model is not a CBI model; it is a meta-model that provides requirements of instruction for CBI models. These requirements arc Retrieving, Orienting, Presenting, Encoding, Sequencing, and additionally Contextual (+) factors. The effectiveness of components is discussed with presenting phase to create effective computer screen design for CBI lessons. The processes are classified as psychological, instructional, and technological dimensions for screen design based on ROPES+ model. In addition, cognitive structure of instruction based on ROPES+ Model was developed to provide effective strategies for adaptation of instruction in CBI. As a result, directions for the next Web-based instruction (WBI) or CBI lessons by screen design research and theory findings were presented with the contributions of ROPES+ Model in this study. Thus, cognitive structure of instruction on ROPES+ Model can be used in the future classes for creating high quality interactive designs as well as creating traditional CBI lesson designs.

Keywords: Presenting lesson, screen design, visual effects in learning, computer-based instruction

ÖZET

Bilgisayarla öğretim davranış psikolojisinde çok güçlü tarihsel köklere sahiptir. Son zamanlardaki gelişmeler bilgisayarla öğretimin tasarımı için öğretim ortamını değiştirmiştir. Bunun yanında, bilgisayarla öğretim tasarımları teknolojik ilerlemeler ve insan faktörlerinden etkilenmiştir. Bu çalışmanın amacı, bilgisayarla öğretimde derslerin tasarımını birleştirilmiş yaklaşımlara göre **ROPES+** modeli olarak bilinen bir yaklaşımda ele almaktır. Bu model bir bilgisayarla öğretim modeli olmayıp, bilgisayarla öğretim için öğretimin gereklerini içeren ve bilgiler sunan bir çerçevedir. Buradaki öğretim sunusunda gereklilikler, bilgileri geriye getirme (**R**etrieve), oryantasyon (**O**rienting), sunuş (**P**resenting), bilgileri açığa çıkarma, transfer etme (**E**ncoding), sıralama (**S**equencing) ve diğer bilgiler (**C**ontextual (**+**) gibi faktörleri içerir. Bu çalışma bu faktörlerden sunu (presentasyon) stratejilerini bilgisayar ekranı tasarımı ve bilgisayarla öğretim derslerinin tasarımı bakımından sınıflandırmıştır. Ek olarak, bilişsel öğretim süreci ROPES+ modeline dayalı olarak bilgisayarla öğretimin adaptasyonunda etkili stratejiler sağlamak için geliştirilmiştir. Sonuç olarak, gelecekte WEB ile öğretim ya da ekran tasarımı araştırma ve teorisindeki bulgulara göre oluşan bilgisayarla öğretim derslerine ilişkin yönergeler ROPES+ modelinin katkıları ile çalışmada sunulmuştur. Bunun için, ROPES+ modeli üzerinde oluşan öğretimin bilişsel süreci gelecekte bilgisayarla öğretimdeki derslerin tasarımında olduğu kadar yüksek kalitede etkileşimli tasarımların yaratılmasında kullanılabilir.

Introduction

Computer-based instruction (CBI) has strong historical roots in behavioral psychology. Behavioral psychology is very effective in meeting many instructional needs. Recent advances in CBI have changed instructional environment for CBI design. Many factors effect environmental settings. First, behavioral and cognitive influences are important to develop the contributions of user and machines. Second, computer screen design, as a technical and instructional aspect of computer-based instruction (CBI), needs research for improving in instructional environment. Third, computer screen design is developed based on learning and teaching theories. At the same time, constructivism as well as behavioral and cognitive approaches affects instructional strategies for designing CBI with technological improvements (Hooper and Hannafin, 1991). Instructional design for emerging technologies is a "techno-centric" perspective. The capabilities of technology are the center of instructional design, rather than learners. This is a problem in the instruction Instructional strategies such as linear, branching and systematic activities have been developed based on research and theory in learning. Recently, a framework has been used to classify related research and theory in learning and cognition to describe instructional strategies and requirements of instruction for CBI Models (Hannafin and Phillips, 1987; Hannafin and Rieber, 1989b; Hooper and Hannafin, 1988). The model, which is called ROPES+ Model, is a framework for requirements of instruction. Recently, new learning environments were developed from CBI approach to provide e-learning tools including web-based instruction (WBI), internet-Based instruction and distance learning strategies. Researchers use interchangeable the methods in the study.

In brief, "ROPES+" model is not a CBI model; it is a meta-model that provides requirements of instruction for CBI models. These requirements are: Retrieving, Orienting, Presenting. Encoding, Sequencing, and additionally Contextual (+) factors. The model is based on psychological rather than technological research and theory (Hooper and Hannafin. 1988). The ROPES+ Model is rooted in "applied cognitivism" although traditional CBI is based on behavioral perspectives and paradigms (Hannafin and Rieber. 1989a). Based on ROPES+ Model, the presenting phase appears particularly relevant to screen design, and presentation decisions are considered in the other phases to provide deep processing of information and effective instruction with interface issues (Hannafin and Phillips, 1987; Hannafin and Rieber, 1989b; Hooper and Hannafin, 1988, 1991). In addition, computer screen design foundations are classified as psychological, instructional and technological dimensions.

In this framework, the purpose of the study is to examine of the effects of presenting strategies on ROPES+ model for CBI lesson design from an integrated perspective. Based on the purpose, computer screen design and its theoretical bases such as cognitive, behavioral and constructivist approaches are examined to integrate screen design applications for instructional strategies in CBI. Moreover, as a presenting strategy, computer screen design on ROPES+ model is examined to conduct effective CBI lessons. The significance of the paper is based on new components for CBI lesson design in any subject.

Components of ROPES+ Model

The components of ROPES+ Model have meaningful interactions in the design of instruction. As a framework, ROPES+ Model provides a bridge among foundations of screen design, such as psychological, instructional, and technological. Screen design, as a presenting strategy, provides focus-attention, lesson navigation, deep processing, interest, and engagement. At this time, presenting variables have some responsibilities with other components in ROPES+ model to conduct effective instruction.

In ROPES+ Model, psychological foundations consist of two approaches. One

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is cognitive approach. Another is behavioral approach. Cognitive constructive behaviors stay in cognitive perspective. Cognitive approaches allow learners to development retrieving, presenting, perceiving, organizing, integrating, encoding, and gaining knowledge in the instructional process. Behavioral approaches are based on motivation. S-R chains, reinforcement, generalize, and discrimination.

Retrieval involves the transfer of information from long-term memory (LTM) to short term memory (STM) (Hannafin and Rieber, 1989b). At presenting level, several factors influence the retrievability of lesson content, including depth of processing, initial encoding, the availability of retrieval cues, and the meaningful learning strategies. Orienting provides effective instructional segments, such as presenting objective, gaining attention, organizing structure of new knowledge. At this time, screen design activities provide recall and transfer. Cosmetic and information-based techniques help to control selective perception, and focus attention to identified information. Encoding involves the transfer of lesson information from working memory to long-term memory. Sequencing in lesson design is often received as the ability to vary instructional sequence to the ability and performance of individual students. Computer screen design decisions are based on learner control conventions that are prior knowledge, learner ability, and task variables in the learner environments. ContextuaI (+) factors deal with needs assessment procedures. This provides grouping strategies in the instructional process for cooperative learning (Johnson and Johnson. 1986). As a result, Presenting involves interactions with other components during the instructional process and adaptation of instruction for CBI lessons.

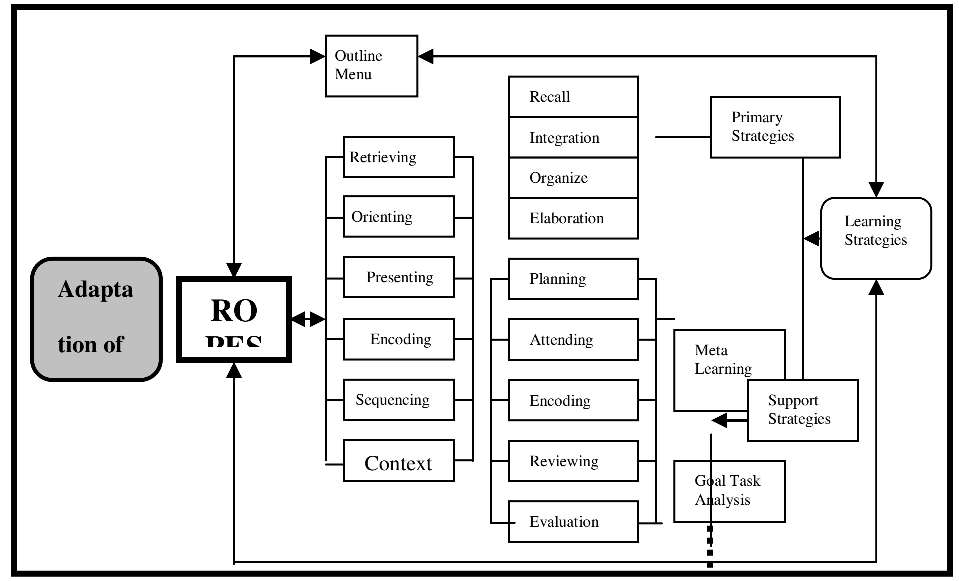
Influences for Presenting Strategies On ROPES+ Model

From the cognitive perspective, the psychological foundations focus on effects of screen organization on student's ability to perceive, organize, and integrate information. Instructional foundations influence directly the nature and activities of the instructional solution. Such foundations include information derived during front-end analysis or needs assessment. The state of learner, the learner task, and the instructional setting are considered in this process. Technological foundations deal with the limitations of instructional technologies. In emerging technologies, presentation option may include computer generated graphics display, photographic slides, typed text, video etc.

Hannafin and Rieber (1989a) indicated that "varied psychological research findings and instructional design models have important implications for the design of CBI" (p. 91). In this paper, several key concepts from CBI models, behavioral, and cognitive research and theory and their applications in computer screen design are examined to be conducted for presenting strategies in CBI design. This examination provides a framework for CBI models to consider the contributions of ROPES+ Model.

In addition, ROPES+ model is developed in "applied cognitivism". It is important to note that ROPES+ Model has more flexibility, in it logical order, when applied to instructional strategies, then other CBI models. The model provides different structures for the same content in learning. This process explains the effects of information processing on adaptation of instruction (Jonassen, 1988, 1989). Combined modes of presentation to enhance depth of processing will be possible with new technologies in visual and aural images (Dwyer, 1978), and will be effective in different

forms of media to provide effective learning (Paivio, 1979). Cognitive structure of instruction on ROPES+ Model deals with primary strategies such as recall, integration, organization, elaboration, and support strategies, which are based on meta learning and goal-task analysis strategies. The cognitive structure of instruction on ROPES+ Model is developed with hypertext techniques in a logical order by researcher (see figure 1).



It is important that ROPES+ model particularly provides interaction for presenting strategies with its levels in CBI lesson design. It is not possible to be successful with instruction without using technologies of color, image quality, realism and details of learning strategies. Each factor actually affects learning strategies at the presenting level. For example, windowing techniques encourage students to focus on the content. Each window provides a different perspective, application and function. Windows may be used to help the user explore information. The function is a combination of the navigational, organizational and metaphorical. People who have different cognitive styles view information differently. For example, field dependent people view information globally (Jonassen, 1989). Moreover. ROPES+ model has similar position on the use of visual elements of the interface to encourage learners to work with and process information in more satisfactory ways. Motivation is also influenced, in pan, by how lesson content is presented. The individual or combined selection of presentation modes can affect the learner and interaction between the student and instructional materials. The processes at an encoding level provide an organizational situation to reach a deeper understanding of the structure of the text (Keller and Suzuki, 1988).

As a result, presenting strategies on ROPES+ Model will be applied with the effects of color, image quality and multiple presentation modes for the other components of ROPES+ Model to provide new perspectives in CBI lesson design strategies. The process plans the adaptation of instruction in CBI by the means of different learning outcomes and methods in instructional technology.

Perspectives for Presenting on ROPES+ Model

Computer screen design depends on developing technology and research in instructional design systems. Tire results deal with preparing software, documents, and instructional process in CBI. Presenting strategies are defined such as color, image quality, and multiple presentation modes (Hooper and Hannafin. 1991). Presenting variables are classified as verbal and visual. Verbal variables include text and synthesized voice. Visual variables include text, graphics and animation images. In addition, emerging technologies permit a host of tactile input options, including text, spoken language, joysticks, light pen, touch screen, and variety of other devices.

Presenting strategies on ROPES+ Model are defined as designing multimodal lessons such as verbal (Gillingham, 1988; Ross, Morrison and O'Dell, 1988), and visual (Rieber and Hannafin, 1988), relevant stimuli amplified lessons (Hannafin and Peck, 1988), and lesson content organized (Glaser, 1976), frame protocol established lessons (Heines, 1984), and selecting appropriate symbol systems (Salomon, 1979). In this process, human factors in CBI design are one of the most important factors. These factors provide an interaction for the learners in learning strategies such as orientation information, student responses, error messages, and options (Hannafin and Rieber, 1989a; Heines, I984; Price, 1991), and additionally feedback (Isaacs, 1987). Orienting information deals with instructional sequences. Learners ask themselves the following questions. "How much have I done?" and "How much more do I have to do?" (Price, 1991). "How much text should be presented?" (Gillingham, 1988).

Text presentation in CBI is an important issue that includes length of text, rate of text and color of text. Consequently, length of text is related to viewing each line. Amount of text presented is sometimes linked with rate of presentation as in a technique called "leading". Leading refers to presenting text on a single line a speed time (Gillingham, 1988). Amount of text has been used to evaluate reading text speed. Screen design, in general, is based on readability of message and visual effectiveness of text or messages. Readability of messages includes type style, line length, justification, and break-points (Heines, 1984; Ipek, 2001; Isaac, 1987). Type style includes bold face, underline, blinking, flashing, text size, and various kinds of rotation. In brief, orientation information, which tells the student his or her location within the lesson, is also displayed at the bottom of the screen. So, information will be visible at all times or available at all times. In addition, orientation information tells the student what will happen or what could happen next. Directions and learner responses that tell the learner what they are expected to do, and what the learners enter in response to such prompts, are standard components in CBI display screen.

Based on psychological, instructional and technological perspectives, directions and learner responses should be created in sophisticated techniques. The components of the program should have motivational effects on learners during the lesson. Negative corrections and negative messages must be avoided during the interaction between learner and computer. Levels of error messages would be designed based on learner characteristics. Varieties of options allow students to be active at all times.

Hypertext/hypermedia systems provide students some additional considerations for the design of the CBI screen (Price, 1991). The process can provide support for a

constructivist learning strategy. There are several ways in the program to indicate what will be actively available in the next screens. The situation allows designers to combine presentations to enhance processes such as information processing and knowledge representation (Hannafin and Rieber, 1989a).

It is important to note that cognitive and constructivist theories apply to optimal system designs. New learning environments by new technologies provide high-fidelity natural presentation opportunities of visual and aural images. The situations in learning sequence for ROPES+ Model will be possible by means of presentation theories and information theories (Berry and Dwyer, 1982; Dwyer, 1978; Paivio, 1979). In addition, screen window techniques also allow students to focus on important lesson content, with different perspectives, applications, and functions for CBI lessons (Hooper and Hannafin, 1988; Jonassen, 1989). As a result, no single perspective appears adequate to create presentation design decisions on the computer screen design. Realistic visual images, color, motion, and image quality are important presentation variables but each one has varying degrees of effectiveness during the learning process. Presentation refers to the depiction of movement during the lesson. How presentation variables can be effectively used during a lesson is an important issue to integrate variables in the screen design from different perspectives (Hooper and Hannafin, 1988).

In brief, student-computer interface is extremely important because of patterns of human perception and behavior. The following four factors may be identified as fundamental principles of good screen design in CBI systems: (1) simplicity, including student computer dialogue, location of information, social amenities, split screen presentation, tabular information and reading speed. (2) spaciousness and relevance, (3) standardization, (4) changing display screen contents (Rambally and Rambally, 1987).

The effects of screen design are involved with perception. Perception deals with visual communication preparing screen design in CBI. Taylor (1960) explained that "perception is often defined as awareness of objects in the environment (p.51)". According to Taylor (1960), structure in visual perception is based on grouping in weak groups, such as proximity, similarity, and common movement, and strong units such as good continuity, closure, and separating is based on construct, figure-ground and depth cues overlap, size, perspective, aerial perspective, and light and shade. In addition, there are three dimensions to look at the factors of screen design. They are perception, reading legibility on the screen or layout, and interconnections such as linking, thinking, and technological facts. Fleming and Levie (1984) defined that perception is organized, and the more organized a message is the more readily it is perceived.

Messages may be visual or auditory, pictorial or verbal. Grabinger (1983) further defined that "simplest organization is figure and ground which influence both the visibility of the text and cueing research (p. 28)". In another study, Grabinger (1989) described the visual effects of screen design. Screen layout design refers to the arrangement of design elements on a screen. The process includes technical screen design elements and readability screen design elements. Technical screen design elements includes typographies factors, environment, and screen factors. Readability screen design elements include typographies factors, organization factors, cueing factors, and control factors. Two possible conclusions may be drawn from Grabinger's study. First, overall visual design of the screen has little effect on macro processes because of lack of learning gains. Second, research methodologies and measures employed are not sensitive enough to measure the effects. In screen design, acquisition, organization, and processing are all important components.

Dwyer (1967) studied the effectiveness of visual illustrations. His findings suggest that increasing amounts of detail in illustrations do not necessarily provide greater learning According to Dwyer's study, treatment groups, such as oral presentation, linear presentation, drawing presentation, and photographic presentation, were investigated. He found that realistic photographic presentation was no more effective for learning content than oral presentation alone. In addition, an abstract linear presentation was as effective as the detailed drawing presentation. Also, the abstract linear presentations and the detailed shaded drawings were both more effective than the oral presentation alone and the realistic photographic presentation. Another most important point is that the abstract linear presentations and detailed shaded drawing presentation were both more effective than the realistic photographic presentation.

In addition to Dwyer's (1967) study, Berry and Dwyer (1982:1091) compared the interactive effects of color realism and learner's 1Q with the effectiveness of visual instruction. They found that: (1) the use of visualization in instructional materials facilitates students' learning. (2) All types of instructional visuals are not equally effective educational tools. (3) *The use of black and while visuals reduces individual differences associated with learner's ability,* and (4) unrealistic coloring instructional visuals serve to increase learning for students with higher intelligence. Consequently, the spatial structure of the *visual cue* seems more important and color adds only secondary cues. The research findings provide support to the development of instructional materials.

Hannafin and Rieber (1989b) indicated that "presenting essentially involves the purposeful manipulation of appropriate symbol systems from available media (p.106)". In this regard presentation decisions are necessarily subordinated to instructional requirements indicated by ROPES+ Model components. Presenting variables are text design, graphics applications, screen design and layout, and computer text display variables. The multitude of display options is a focal point of CBI human factors research.

Morrison, Ross, O'Dell, Schultz and Wheat (1989) described computer screen design approaches. The first approach focuses on typographical variables that the designer can manipulate to create an effective screen design. Based on research and subjective views, several authors have recommended that display use liberal white space and double spacing (Alessi and Trollip, 1985, 2001; Hooper and Hannafin, 1986; Ipek, 2001). 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. So it seems important to consider that chunking does not change the instructional content; it changes the way the content is presented on the screen. In addition to two approaches, in their study, two variables are described. 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 variables have important relationships with spatial factors, in general, psychometric research findings

presented. Human factors are related to visual thinking processing and orientation with measurement difficulties. These differences are derived from individual factors and other variables, such as human spatial ability, environmental, generic factors, and sex differences in various aspects of perceptual-cognitive functioning.

Ross, Morrison, and O'Dell (1988) explained that low-density text presentations, which contain principally the main ideas of passage, may be an effective screen design technique for high ability students or students who are familiar with the lesson content. In addition, "low-density text provides to cue students to important information, and may be effective for learning the main points of a text. However, low-density text may not provide enough redundancy for students with little conceptual background to support encoding" (Hannafin and Hooper, 1989. p. 157).

From the view point of Isaacs (1987), color is as effective an attribute for highlighting text as it is for highlighting graphics. Very hot colors (such as pink and magenta) should be avoided since they appear to pulsate on the screen. On most color monitors red, green, and blue are the monochromatic colors, so green and blue seem to be better choices. In addition, on the grounds of luminance alone, white, yellow, cyan and green will be most legible colors on a black background (magenta, red and blue being the least legible). The most important point is that background color is best avoided in continuous text. About eight to ten words per line seem best for a computer screen (Ipek, 2001).

Research Results and Implications

Learner's attention, retention, and accuracy of response have been found as most important variables that are affected by fatigue. The variables include the effects of fatigue, density of displayed text, scrolling, uppercase versus upper-and lower case, letter size, and graphics.

For the variable the density of displayed text, Hathaway (1984) indicated the following results: (1) comparing double-spaced and single-spaced text, faster reading times with higher accuracy occurred with double-spaced text. (2) Line density defined as the number of characters per line. The result has changed between 40 and 80 characters per line. It needs further study. (3) Page density for the print condition was 40 rows of text per page, 60 characters per line, and about 400 words per page. Page density for CRT condition was 18 rows of text per page, 39 characters per line and about 120 words per page. How fast should the text be *scrolled*? As with the condition of line density, an even faster scrolling rate might result in more efficiency. There is no significant difference in performance between subjects using the two types of keys (up-down-left-right and arrows keys). Gropper (1988), on the other hand, summarized some criteria to add value to text content. These steps can be useful in learning by ROPES+ Model.

In this part, performance for presentation, learner control processing, visual and experiential modes and teaching goals have been defined as learning variables for information processing. This is available to use on the screen design based on ROPES+ Model for CBI lessons. Moreover, Morrison, Ross, and O'Dell (1988) indicated instructional dimensions of the screen design. Text density as a contextual variable should indicate length of the materials, redundancy of ideas, and depth of conceptual support for the main ideas. Less skilled readers were more likely to select high-density text, which offered more conceptual support. Better readers were likely to select low-density text, which provided adequate contextual support and reduced their reading time. This position indicates learner control and its effectiveness in teaming information.

According to Jonassen (1989: 190), "information is structured by learners when knowledge is constructed. These structures are arranged in semantic networks. These networks can be displayed using concepts hierarchies, neutral nets, pattern notes for depicting knowledge structures. The computer screen becomes a window onto a knowledge base."

Grabinger's (1983) results suggested that learners prefer a low-density screen. Morrison et al. (1989) indicated that higher-density screens in their studies were preferred. As a result, subjects prefer high-density screen when using realistic materials, in contrast to the recommendations in the literature, which suggest the use of low-density screen with adequate white space and vertical typography. In general, students focus their attention on main ideas rather than on the additional elaborations provided in the full text. The decrease in the number of words in the low-density allows the designers to make liberal use of white space and vertical typography to highlight and group ideas while maintaining an appropriate level of contextual support on individual screens.

Conclusions and Recommendations

In the future, evaluation, such as external validity of presentation format and stimulus materials, is needed to provide powerful instructional strategies on screen design for CBI.

1. Low-density text format is a viable alternative to the standard text format used in printed materials.
2. High-density screens provided full contextual support for the main ideas. When the information was divided over two, three, or four frames, the contextual support was also reduced. Subjects had to read more frames to obtain the same information.
3. Future research on CBI screen design should investigate the use of text density and varying screen density with different content areas and task with different processing demands. This is to show the effects of ROPES+ model and its applications in learning. This dimension also indicates using linear and branching programs in a variety of ways for CBI or WBI lessons.
4. Other types of learning, such as memorizing foreign language vocabulary sentences, may be impaired by lower-density contexts.
5. A critical need at this point is for educational technologist to become more versed in the wider literature in human factors and human-computer interaction. Ideal of what a program is to do and how the designer expects the user to respond, the method, which the programs operation and capabilities are depicted for the user on-screen and user's model should be conducted in the future (Kerr, 1989, p.197). The new role of graphics designer as a graphics technologist should focus on electronic based visual communication principles and visual factors research findings (Faiola and DeBloois, 1988).
6. It is a balance among the psychological, technological, and instructional foundations that is needed. The field needs better frameworks for determining how the screen design applications should be managed.

In conclusion, ROPES+ Model was developed to provide an empirical framework within instructional strategies. Computer screen design based on ROPES+ Model for CBI lessons needs to be improved in cognitive influences as well as behavioral influences in the field of instructional technology. Future research should be focus on more experimental studies in CBI and WEB lessons to create high quality screen design systems. A great deal of research is needed to further clarify design recommendations. For this reason, a useful theory of design would combine general principles with specific task requirements.

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