eDUSS
Education Software Solutions

Research Paper

The EDUSS™ Framework for Effective Learning System Design: Requirements and Applications

Linda Lohr, Ed.D.
James Gall, Ph.D.
University of Northern Colorado,
School of Educational Technology, Leadership, and Research

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The EDUSS™ Framework for Effective Learning System Design

Executive Summary

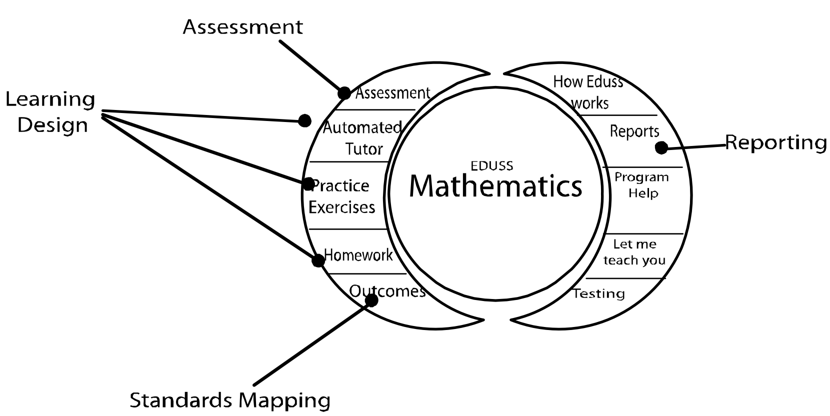
A critical component of modern schooling is the desire to increase accountability. Schools are increasingly being asked to be accountable to their communities, and both teacher and student are under pressure to be accountable to standards-based curricula. In the United States, this has most recently been expressed in the No Child Left Behind (NCLB) Act of 2001. In addition, teachers and schools are being asked to verify that the techniques and methods they employ are current and consistent with scientifically-based research (SBR).

The application of technology in the classroom and school is not only seen as necessary to prepare students for an increasingly information-based economy, but can also serve as a way to deliver and assess standardized curricula. Computer-assisted instruction) can be an effective way to develop skills on an individualized basis within a set curriculum. An Integrated Multimedia Teaching Assistant (IMTA) can readily identify individual deficiencies and deliver just-in-time education.

EDUSS ™ is an IMTA used worldwide to make schools more effective and accountable in the subjects of K-8 Math and Language Arts. EDUSS™ has been designed with a learner-centered focus. Individual student progress is tracked and assessed in order to deliver the correct level of instruction as it is needed. In addition, EDUSS™ provides teachers, administrators, and parents the information they need to make good educational decisions.

More important than the provision of the information, however, is the provision of accessible and highly usable information, especially for the teacher. It is in this capacity that EDUSS ™ may be considered a leader in the IMTA market. The figure below shows the interface of the EDUSS product, highlighting the assessment, learning design, reporting and standards mapping features.

Interface of an IMTA
(Integrated Multimedia Teaching Assistant)



Throughout the research literature teacher buy-in has been shown time and again to be the critical variable in the success of any new technology. When a technology helps the teacher do their jobs with greater ease, the technology has significant chances of success.

EDUSS ™ may be the only system available that addresses the importance of not only learner-friendly intervention, but teacher-friendly support. Where other systems may identify where intervention is needed, the materials necessary are not immediately available to the student. The teacher's ability to respond in a timely manner is jeopardized by the time-consuming task of locating prescriptive materials when class size is prohibitive. Because the EDUSS ™ system not only identifies where student remediation is needed, but immediately provides the instructional interventions needed, teacher's are able then to focus on what they do best, teaching.

The EDUSS ™ system provides individually calibrated instructional interventions, timely feedback, and important highly usable reporting tools: all tasks often compromised by the heavy demands and lack of resources many teachers face. Just-in-time strategic sourcing provides teachers with the tools needed to do their jobs effectively, efficiently and satisfactorily. In short, EDUSS ™ meets the requirement of strong usability in learning design, assessment and reporting, three variables that interact to produce quality learning environments.

This research-based white paper finds the following core strengths of the EDUSS ™ system.

- the design of the **learner-computer interaction** is consistent with current SBR in the cognitive and learning sciences
- **highly-calibrated assessment delivered just-in-time** helps teachers and schools address the overarching goals of NCLB

- **highly effective information design** that makes reports and their interpretation accessible
- critical **just-in-time performance support** for teachers, who in turn are able to provide the highest quality of instruction possible.

The EDUSS™ Framework for Effective Learning System Design: Requirements and Applications

Introduction

Although there is considerable disagreement regarding the topic of school reform, the mandate for accountability in student learning is one in which learners, parents, teachers, and administrators share a common interest (Hoover & Shook, 2003). The No Child Left Behind (NCLB) Act of 2001 requires not only that K12 Schools across the nation improve instruction in math, science, reading, history and other subjects, but also that this improvement be documented using reports of annual assessment measures. Schools are required to identify clear, measurable goals against which to evaluate student progress. In turn, this progress must be communicated through systematic reporting to parents, teachers, and relevant agencies for maintain accountability at the individual and group level.

The NCLB Act requires that assessment measures be based on achievement benchmarks or standards, traditionally set at the national or state level, which are then implemented locally. Schools systems now have the additional (and in many cases welcome) task of operationally defining standards of learning they believe important for student success.

In order to facilitate this process, the NCLB Act encourages the use of technology, such integrated multimedia teaching assistants (IMTA). An IMTA is a type of

CMI, defined as "either the use of computers by school staff to organize student data and make instructional decisions or to activities in which the computer evaluates students' test performance, guides them to appropriate instructional resources, and keeps records of their progress" (Cotton, 1991, p. 1). Although there are many ways to track and manage student data with technology, a system designed to measure against established standards goes beyond the mere electronic record-keeping aspect of technology. An IMTA is most valuable when it allows the monitoring of progress on both the micro (the individual student) and macro (all students, or any relevant subset) levels.

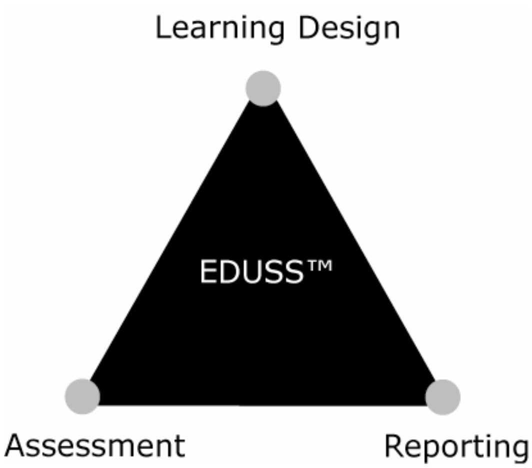
Implementing a technology solution, without the consideration of the specific learning context, will have little, if any, influence on learning (Earle, 2002). Once a need has been identified, (by assessing student progress against pertinent goals), an effective educational intervention must take place. This is more than the mere presentation of information. The quality of the learner's engagement with subject matter must be guided by established principles of learning.

An IMTA Design Framework

EDUSS™ is a privately-owned IMTA system used in schools worldwide to assess, deliver, monitor, and report on student progress in key content areas that are clearly defined and applicable to a broad base of potential learners. Three important design functions of EDUSS™ are: the presentation of learning materials (i.e. learning design), the integration of assessment tools (i.e. assessment), and the production of assessment reports (i.e. reporting). The interaction of these components allows the delivery of instruction to be individualized, accountable, and easily communicated to both learners and the various stakeholders of a quality educational experience (see Figure 1).

Figure 1

EDUSS™ Design Functions



Political, societal, and technological pressures (to name a few) can often have a dramatic impact on an educational system (Datnow, 2000). A learning system must be flexible enough to allow for a variety of reporting demands and changes both internal and external to the system. The EDUSS™ structure provides a useful and flexible framework from which to consider the interacting nature of learning, assessing, and evaluating. However, this framework would merely be an empty shell if it were not host to a solid curriculum of IMTA materials. The IMTA aspect of EDUSS™ does allow choice in particular methods for delivering relevant content, both in approach and medium. Materials may be delivered online, both at home and school. Materials may be printed into student workbooks or as supplements to group-based instruction. Regardless of the choice made by individual schools or teachers, the materials have been developed in support of scientifically-based research (SBR). The remainder of this paper addresses in detail the core theories underlying this approach.

Key Terms

The following are terms used throughout the paper. The definitions here describe the term's specific and unique connotation in this paper.

Assessment

A process by which educators use students' responses in order to make inferences about students' knowledge, skills or affective status. Assessment also involves the proper use of test results as indicators of educational effectiveness, and the ways in which the results can improve the caliber of classroom instruction (Popham, 200).

Design

Design is the deliberate process of analysis and synthesis that begins with a problem and concludes with a plan for an operational solution (Fleming & Levie, 1978).

Heuristics

Heuristics are "rules of thumb" that suggest possible solutions (Leahey & Harris, 1989). They can be thought of in comparison to algorithms which are strategies that guarantee a specific solution (such as how to add two one-digit numbers).

Information design

Information design is a term describing an emerging field of study that focuses on how information is selected and presented to individuals in order to achieve a particular goal (Jacobson, 1999). In terms of specific documents, good information design results in high usability: it is clear, accurate, easily accessible, and relevant.

Learning/ instructional design

Learning design is a term that describes how information is structured and presented to encourage meaningful and memorable student interaction with instructional content (Mayer, 2002).

Reporting

Reporting addresses the usability (effectiveness, efficiency and appeal) of information presentation from the perspective of learning system stakeholders (Cibulka & Berlin, 1995). These stakeholders include state departments of education, school districts, principals, contributing businesses, teachers, and students.

System

System is a term used to describe a structure, either tangible or intangible, that operates according to the interaction of more than one element (Modell, 1988).

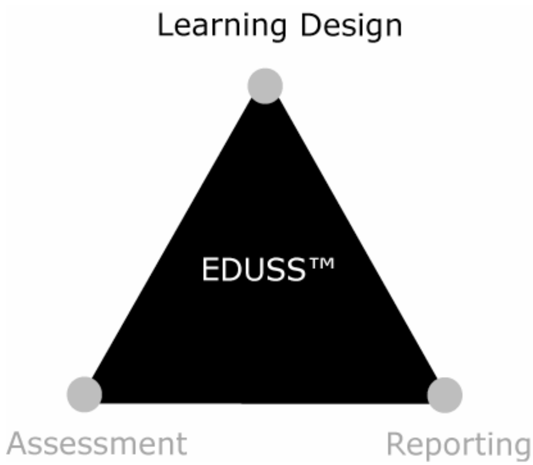
Scientifically-based research

Scientifically-based research is a systematic attempt to provide answers to questions. By definition, it is systematic, logical, empirical, reductive, replicable and transmittable (Tuckman, 1999).

Usable / Usability

Usable (also usability) is a term that describes design that is effective, efficient, and appealing (Lohr, 2003). Effectiveness is gauged by how closely a design serves its intended propose. Efficiency is gauged by how easy or accessible the design is for people to use. Appeal addressed the emotional experience: did the user feel comfortable, confident, and satisfied with the experience.

Learning Design



Although at one level, the classroom of today bears a striking resemblance to classrooms of ten, fifty, or even one hundred years ago, our understanding of the learning process and cognitive functioning is very different (Watras, 2004). This section describes current learning theories and their relevance to EDUSS™.

A cognitive-psychology theory base

Theories of learning based on cognitive psychology underlie the design of EDUSS™. Cognitive psychology seeks to understand human behavior by examining mental functioning at the conceptual level (Anderson, 1985). Two recent learning theories relevant to the EDUSS™ framework are Baddeley's model of memory (2000) and cognitive load theory (Paas, Renkle and Swellers, 2003). From the perspective of cognitive psychology, understanding the structure and limitations of human memory can aid in the design of information and interactions that promote meaningful learning.

Baddeley's model of memory

Baddeley's model of memory is an extension of previous information-processing models of human memory (Atkinson & Shiffrin, 1968; Broadbent, 1984; Lockhart & Craik, 1994; Norman & Bobrow, 1975; Waugh & Norman, 1965). Analagous to the operation of a computer, an information-processing model is one in which mental structures are characterized by their ability (or inability) to retain and process particular types of information. Atkinson and Shiffrin (1968) proposed a model based on two types of memory, short-term memory (including sensory and working memory) and long-term memory. In this model, short-term memory is very limited in duration (lasting only seconds) and capacity (a relatively small amount comprising our conscious attention at any particular point in time). A component of short-term memory is working memory, where information is actively managed and manipulated. In contrast, long-term memory has a seemingly infinite duration and capacity. Meaningful learning is the result of the interaction of short-term and long-term components. Our acquisition of new information must overcome the bottleneck of short-term memory. The process of learning is not complete when information is in long-term memory. Learners must be able to identify and retrieve relevant information when performance is demanded. Because working memory is a potential bottleneck for both the encoding and retrieving of relevant information, it is of particular importance to researchers studying learning.

In Baddely's model (2000), the functioning of working memory is described by an additional level of detail. He describes working memory in terms of a central executive function involved in focusing attention, switching attention, and dividing attention. This executive functions monitors a visual sketchpad (consisting of visual and spatial memory), a phonological loop (auditory memory), and an episodic buffer. The episodic buffer assists in the integration of the visual and auditory information.

To fully appreciate the complexity of this function, imagine being in the midst of a large group of people carrying on a conversation with a smaller group. There is an overwhelming amount of visual and spatial information, both novel and familiar (such as faces in the crowd). There is also a conflicting stream of auditory signals in the form of conversations, music, and background noise. However, most people are able to make sense of the situation, choosing to focus on a specific conversation, dealing with interruptions, and also managing to encode additional information (such as the identities and locations of others present). However, this balancing act comes at a cost. In such an environment, it would be difficult to concentrate on a task or perform a mental calculation or other skill. With too much stimulation, one would even find it difficult to recall specific conversations or events that had occurred. Designing effective learning seeks to take advantage of the various and flexible capabilities of the mind while avoiding the trap of overwhelming the learner.

One implication of the episodic buffer is that unfamiliar or non-integrated information requires additional processing by the learner to create an initial level of understanding. Relating prior learning to new information and structuring understanding are also cognitive processes. If the learner is overwhelmed with the amount or structure of new information, it is unlikely that this higher level integration will occur. Higher-level problem-solving and creativity may be explained by the unique juxtaposition of new and old information in the episodic buffer.

Sweller's cognitive load theory

The conceptual capacity of mental activity in terms of attention and processing limitations is addressed by cognitive load theory. Although there is no direct measure or scale regarding cognitive load, it is conceptually useful particularly in terms of relative comparisons. An optimal cognitive load is a function of both the individual learner and the instructional material and/or task being addressed. Cognitive overload impairs learning; too little cognitive load is characterized by a lack of interest or attention, often leading to distraction. Experts are able to attend to and make adjustments based on their own self-evaluations of cognitive load. Novices often have difficulty managing cognitive load particularly with novel tasks or situations marked by past failures.

Theorists have suggested three categories or distinctions of cognitive load: intrinsic load, extraneous load, and germane load (Paas, Renkle & Sweller, 2003). Intrinsic load refers to the nature of the content and its inherent level of complexity. Extraneous load can be thought of as the noise, or superfluous elements of communication, that act as barriers to learning due to the increased load they place on memory. Germane load can be thought of as those things that a designer can do to facilitate optimal load, such as chunking content, sequencing it, or providing analogies that can help people understand new information more quickly. A designer can work to reduce a high intrinsic load by both reducing extraneous load and increasing germane load.

Relevance of cognitive theories to EDUSS™ design

The EDUSS™ learning system organizes instructional content into learner-appropriate chunks, or categories. The adaptive presentation strategy (the calibration of new information presentation based on past learner responses) allows the learner to interact with material that is neither too hard nor too easy in terms of intrinsic load. Because the complexity of the information adjusts to a level appropriate to the student, germane load is increased, and learning is facilitated. To the learner, the adaptation is relatively seam-less and transparent. As the learner attempts to master a new skill, the software will drill down as far as necessary to ensure understanding and confirm mastering of underlying skills.

The EDUSS™ learning system also employs multiple modalities in the presentation of content. Relevant information is presented via text, graphic examples, and an auditory narration. The technology allows the presentation of complementary information in an integrated fashion. Although there has been much written about visual and verbal learning styles (or what some may call simply preferences), learners are inherently receptive to various stimuli and will attempt to consolidate meaning from them.

Multimedia learning theory design guidelines

Although it is important to consider individual modes of presentation, researchers have also been concerned with how individuals perform, or fail to perform, when multiple modes are utilized. After conducting numerous studies, Mayer (2001) has created a number of multimedia principles to guide the design of instructional materials. Multimedia is defined by Mayer as the combination of words, sounds, and images. Mayer focuses on optimizing the flow of information through visual and auditory (phonological) memory channels. Because working memory is composed of separate visual and phonological memory stores, utilizing both in a complementary fashion can theoretically increase the learner's capacity. Each of Mayer's principles (see Table 1) is derived from scientific, experimental studies meant to specifically address the issue of learner performance.

Table 1

Multimedia design principles

Name		Principle
1.	The Multimedia Principle	Use images in conjunction with words. The combination is more powerful than words alone.
2	The Temporal Contiguity Effect	Show words and images at the same time. Showing an image after showing a word is not as effective as showing the image and the word together.
3	The Coherence Principle	Avoid the use of extraneous materials since they compete for the limited attention of the learner.
4	The Modality Principle	When possible, combine animations with narrations (spoken words) rather than printed text.
5	The Redundancy Principle	Avoid combining printed words with animation and narration. Printed words will place an extra load on memory and compete with attention being paid to the graphic animation.
6	Individual Differences Principle	Learners who have high spatial ability and/or low knowledge will benefit most from multimedia presentations.

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Relevance of multimedia theory to EDUSS™ design

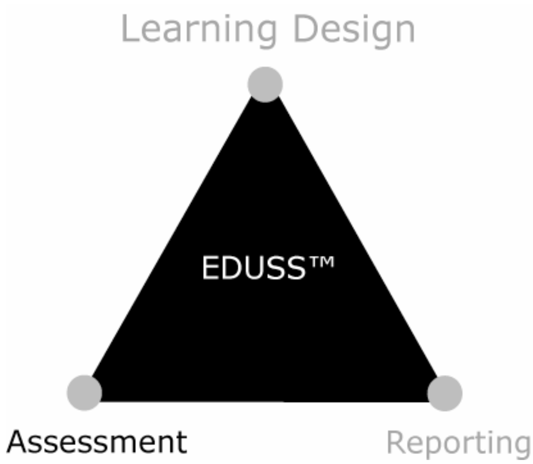
The design of educational content in EDUSS™ is consistent with Mayer's multimedia principles (see Table 2).

Table 2

Multimedia design principles

Name		EDUSS™ application
1.	The Multimedia Principle	Words and images are consistently used together. Images are used to support the instruction and illustrate the instruction.
2	The Temporal Contiguity Effect	EDUSS™ consistently presents words and images simultaneously rather than successively. Narrations are used effectively to describe onscreen images.
3	The Coherence Principle	Learners are presented with concisely organized information approriate to their level of skill, thereby reducing extraneous load. The screen design is clean and avoids unnecessary imagery.
4	The Modality Principle	Narrations support onscreen content and animations so as not to divert attention.
5	The Redundancy Principle	The amount of onscreen content is carefully limited so as to avoid extraneous load. When the learner has difficulty with content, a lower-level presentation is seamlessly presented rather than requiring the learner to self-diagnosis and access remedial content.
6	Individual Differences Principle	EDUSS™ uses adaptive presentation to accommodate different learner skill levels. Although the content is appropriate for all skill levels, those learners that have had difficulty in the past are the most likely to benefit from the individualized multi-modal approach.

Assessment



Assessment focuses on two complimentary levels: 1) assessment of the individual learner's progress, and 2) assessment of the organization in meeting the needs of all the learners. Theoretically, there is a synergistic relationship between these levels. Improving the quality and quantity of feedback to each individual learner also improves the ability of the organization to address the needs of all learners.

Assessment of the individual learner

At the individual level, many learning systems use diagnostic and adaptive assessment "... a solution [that] provides an information function that more closely approximates the information needed to meet all requirements of NCLB" (Kingsbury and Hauser, 2004). Adaptive assessment changes the difficulty of test items based on individual student performance. The efficiency of instruction is directly related to frequent and accurate assessment of individual performance.

Underestimating a learner's ability leads to presentation of redundant information and a decrease in learner interest. Overestimating a learner's ability results in information that cannot be comprehended and a decrease in learner confidence. The range of information and skills that represent what a learner can accomplish with a minimum of support has been called the "zone of proximal development" (Vygotsky, 1978).

In an adaptive testing setting, items presented to the student are based on the learner's previous test responses. As the learner gains understanding, more difficult questions are presented. When a learner's responses indicate poor performance, the test adapts by presenting less difficult information. A growing calibration between student performance and subsequent presentation occurs, moving the learner to a level where achievement is realistically challenged.

A critical component of adaptive testing is the feedback to the student. When standards for performance are clearly defined, the research is clear on how to improve that performance. Wong (2001) found that under such conditions computerized drill-and-practice homework, as compared to computer games and computer-aided-discovery, was the most effective format for student achievement. Wong attributed the success of this format to the immediacy of feedback and access to relevant content.

Assessment of the learning organization

The effectiveness of an overall learning organization is in part determined by how well students achieve on pre-determined specific learning. Although standards are commonly determined at the state or national level, there is considerable flexibility in how those standards are to be addressed at the school or classroom level (Fuhrman & Elmore, 1990). There is still a strong belief that individual teachers and schools have the pedagogical expertise and knowledge of their students necessary to determine the most effective educational interventions. Although there is a definite benefit to this approach, it does offer a challenge in tracking individual student progress and ensuring all appropriate standards are being addressed as learners move from classroom to classroom and progress from grade to grade.

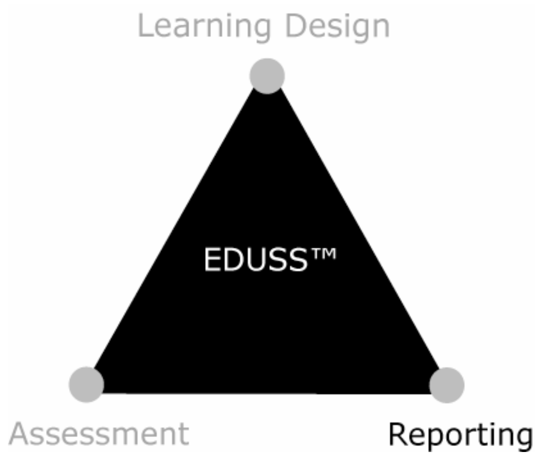
This variation in interpretation makes it difficult to assess learning across learning contexts (Chatterji, 2003). Systems of learning that are open to individual interpretation yet provide wide ranges of easily accessible and consistently designed learning materials are a potential solution or perhaps middle-road approach to the problem. Access to a pool of a wide range of well-constructed learning materials, especially those focusing on practice, allows each teacher to maintain teaching strategies they value, but to supplement those strategies with a number of different, but accountable, systems-delivered practice activities that support the overall learning standards.

Assessment relevance to EDUSS™

EDUSS™ assessment allows for evaluation of both individual learners and groups of learners. Special features of EDUSS™ allow evaluation to be directed by individual teachers. Teachers are able to tailor instruction and its assessment to their unique teaching styles while maintaining alignment between that style and system-wide assessments.

Students have access to adaptive testing and feedback that continually adjusts instructional presentation to the level of each student. This adaptive feedback and assessment process facilitates a student's progress towards increasing levels of understanding.

Reporting



The importance of the reporting function is often overlooked. Although the need for reporting on performance is often mandated by an external agency, the intent is not mere data collection. Rather, this information is meant to establish communication with various constituencies and guide future decisions (Cibulka & Berlin, 1995). Reporting is most effective when it is subject to the same information design practices that underlie content presentation. A clear, accurate, easily accessible, and relevant presentation allows the learners and stakeholders quickly understand the status of both micro- and macro-level assessment outcomes. Improved communication between stakeholders, teachers and their students is a critical element of a continuous improvement process. Teachers and parents are able to easily track and understand student progress. In turn, systems design is modified to improve and precisely target learning opportunities.

Effective information design has an additional, and perhaps most important, influence on the learning process itself. When instructional content is presented in ways that display information quickly and efficiently, a student's learning is facilitated (Lohr, 2003). Careful attention to how information is presented can encourage the mental processes of selection, organization, and integration (Mayer, 2002). Lohr (2003) suggests three strategies important to visual design: 1) optimal figure/ground distinctions, 2) clearly established levels of information hierarchy, and 3) attention to the gestalt of an instructional message.

Figure/Ground optimization

Figure/ground is the interaction of visual information that creates separate focal areas. The "figure" in an image is the dominant or most quickly perceived information, the information that immediately stands out. The "ground" is the background information, or the information that surrounds and takes on a secondary level of importance. A designer's job is to identify within an information presentation the elements that should be either figure or ground in order to improve a learner's cognitive processes of selection. Creating emphasis and contrast using type weight and color, space, shape, and dimension are methods used by the designer.

Hierarchical optimization

Hierarchy in a visual image is established when the relationships between image elements are easily perceived. A designer's job is to make coordinate, subordinate, and super-ordinate relationships within the instructional materials visible in order to improve a learner's cognitive processes of organization. Using contrast in type, color, shape, and spatial arrangement can emphasize the organization. For example, items that are placed higher in a visual space by a Western culture are generally considered more important (or super ordinate) than items placed lower (subordinate) or side-by-side (coordinate) in an image. Use of arrows, lines, flowcharts, tables, and charts are methods used by designers to show hierarchy.

Integration optimization

Integration refers to the visual gestalt of an image, the perception that parts belong to a whole. Gestalt is a German term that psychologists have used to describe processes in which the mind attempts to assemble a collection of independent objects into a cohesive whole with a unified meaning. Visual gestalt helps a learner see "the big picture" and understand relationships within image elements and how they influence an overall understanding. A designer's job is to help the learner perceive the underlying meaning of an information presentation, without losing the important details. Photographs, interface/menu designs, color coordination, and any methods used to bring information together to create a whole whose meaning is greater than the sum of its parts are tools used to influence gestalt and influence the learner's cognitive processes of integration.

The visual designer often does not clearly separate figure/ground, hierarchy, and gestalt into distinct categories or steps in creating a presentation. Rather, they use these principles in an integrated manner. Figure/ground and hierarchy are in fact considered elements of gestalt. Their use depends on the unique needs of a message. For example, understanding a visual might create a need for improved figure/ground. Or, it could be that hierarchical methods are needed. The visual designer of information juggles the tools and methods of design to influence optimal display of figure/ground, hierarchy, and gestalt.

Relevance of reporting and information design to EDUSS™

EDUSS information design quality is highly usable throughout the system. Report formats are easy for teachers, parents, and other school administrators to understand because:

1) the audience for a message or comment is clearly identified. Reports include wording such as:
    - "note to parents"
    - "overall comments for (student name) assessment"
    - "level your child has achieved"
    - "this assessment demonstrates Sam has (very little/ some/ very good) understanding of the topic "
    - "Eduss says: your child ..."
2) The design of reporting information and instructional display effectively employ **figure/ground** (important information stands out) and facilitate cognitive processes of **selection** through:
    - Bolding (labels and important information are displayed in bold typeface)

- White space (units of related information are spatially separated from less related information)
- Contrast of color, shape, type, and space to separate information

3) The design of reporting information and instructional display effectively employ **hierarchy** (information relationships are easy to interpret) and facilitate cognitive processes of **organization** through:
   - Use of tables and charts to organize information in ways that are easily understood
   - Variation of contrast in shapes, colors, and space to show relative importance of content
4) The design of reporting information and instructional display effectively employ **gestalt** (information relationships are easy to interpret) facilitating cognitive processes of **integration** through:
   - Menu and table of contents design that show parts to whole
   - Instructional cues in the context of content
   - Use of summaries and overviews to help the user see the big picture

Overall, these examples show a sensitivity to information design and the importance of reducing information overload for any of the EDUSS™ users (students, teachers, parents, administrators, and so on). These examples show a few, but not all, of the EDUSS™ applications of effective information design. Reporting by the system does not merely present data, but rather attempts to explain the meaning and impact.

Guidelines (The EDUSS™ Framework)

Figure 1 depicts the EDUSS framework by integrating design heuristics important to learning, assessment and reporting. While not all-inclusive, these heuristics provide an overall design that employs scientifically, based research in a technology solution focused on systemic improvement.

Learning Design

- Design is based on principles of cognitive learning theory, focusing on cognitive load theory (reduce extraneous and intrinsic load to increase germane load)
- Multimedia learning theory principles are used throughout the content (use words and images, show words and images at the same time, place images close to the text they represent, when possible use narration in place of text, avoid the combination of narration and text when images are used, use images when students are unfamiliar with content).

Assessment

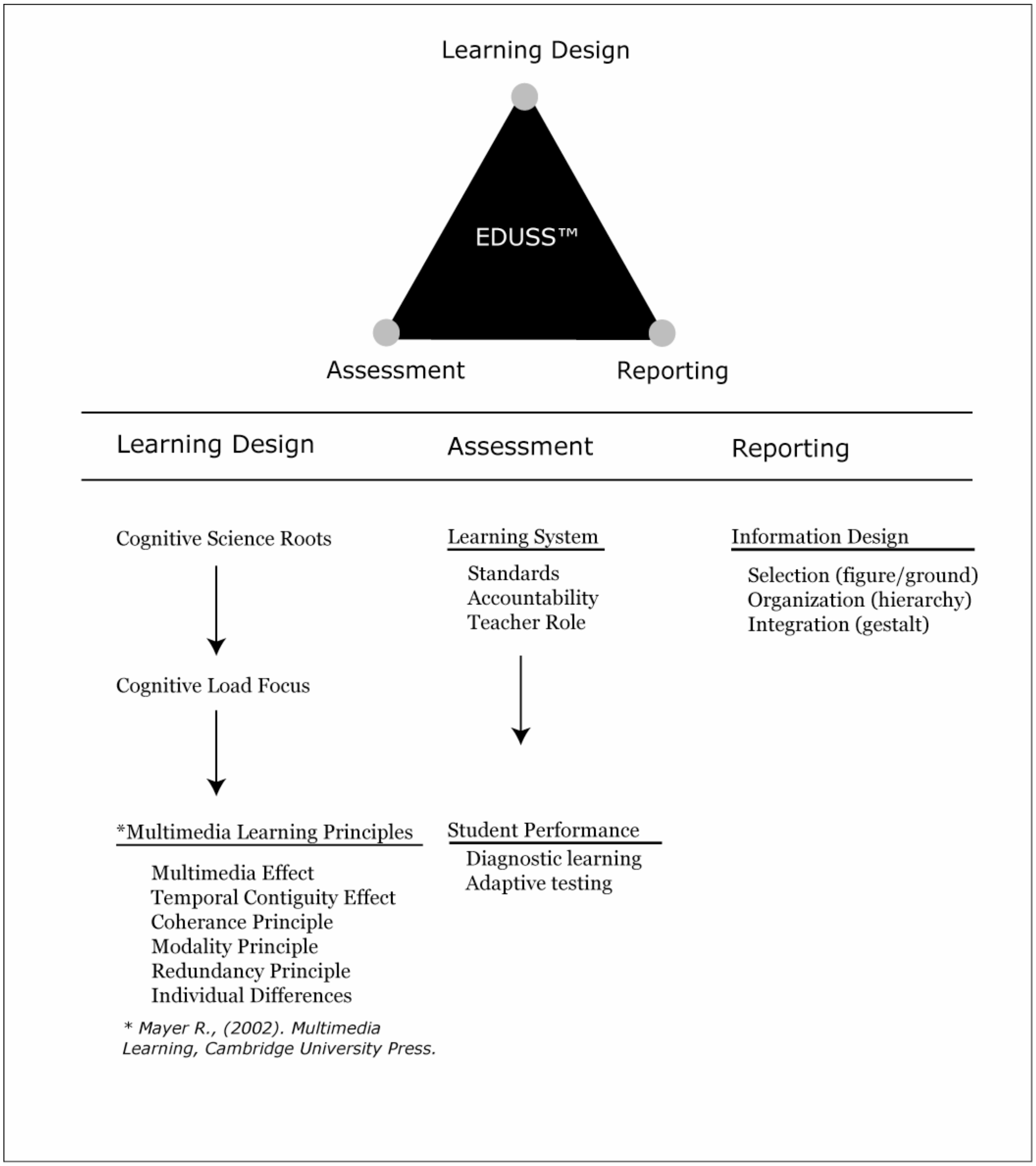
- The alignment of state standards with assessment creates accountability of learning at both the individual learner and organizational levels in an effective way
- The use of adaptive testing formats (information changes based on prior student responses) is used throughout for efficient learning

Reporting

- Design is rooted in cognitive load theory and based on principles of effective information design
- Effective design incorporates strategies to facilitate the cognitive processes of selection, organization, and integration

Figure 2

The EDUSS™ Framework



Summary

This paper documents a learning systems design based on current research in cognitive psychology. Learning design, assessment, and reporting heuristics are presented within a cognitive learning paradigm, with a particular focus on cognitive load theory. Rules of thumb are applied to the learning design, assessment, and reporting functions of the learning system. Learning design heuristics focus on reducing cognitive load by presenting information in ways that decrease demands on learner memory in order to increase learner capacity to interact with germane content. Assessment focuses on the need to align testing with standards in a way that allows teachers to maintain their teaching style while still achieving reporting and accountability concerns. Particularly important at the learner level is the need for adaptive testing and feedback to allow for a constant monitoring of a student's zone of proximal development. Communication of assessment measures is facilitated by effective information design. As with learning design, cognitive learning theories guide the process of developing usable information formats. Attention to the figure/ground, hierarchy, and gestalt elements of information increases the probability that the user will select, organize, and integrate the information easily.

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About the Authors

Linda Lohr is an Associate professor of Instructional Design and Technology in the Educational Technology department of the University of Northern Colorado. She is the author of two textbooks: Creating Graphics for Learning and Performance: Lessons in Visual Literacy, and An Introduction To Instructional Design, release date of 2008. She has authored over 30 research articles as well as book chapters. In addition to teaching and research, Linda has consulted for organizations and businesses in the areas of needs assessment, interface design, and usability testing. Currently Linda is the book reviews editor of Educational Technology Research and Development.

Jim Gall is an Associate Professor of Instructional Design and Technology in the Educational Technology department of the University of Northern Colorado. His published research is in the areas of multimedia, information design, knowledge management, and emerging technologies. He has a broad base of practical experience in applying educational technology in a variety of settings, including working with the military, corporate training, the K-12 environment, non-profit organizations, and higher education. Currently, he is involved with implementing the use of online digital portfolios in all pre-service teaching programs at UNC.