ELECTRONIC LEARNING DELIVERY SYSTEMS: A SELECTION MODEL

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Abstract

Selecting the most effective and appropriate delivery system for the successful implementation of a training project is often an overwhelming task. Many of the existing delivery system selection models available to the training professional are outdated, and do not represent the currently available delivery system options. Electronic technology advancements, and their application to training are bringing complex new media choices to the training professional. Distance learning delivery systems represented in this model include satellite networks, teleconferencing, Internet/intranet networks, desktop multimedia, electronic performance support systems (EPSS), transportable audio/video (i.e., systems relying primarily on physically transportable audio- and videotaped materials), collaborative technologies, and the electronically enhanced classroom.

This model narrows the choices to the system most likely to be educationally, economically, and technologically appropriate. After establishing a working taxonomy, the model recommends four stages of activity. The stages include: 1) The assessment of important overall factors; 2) Rating the importance of many learning system attributes to the training project; 3) Selecting the system that most ideally provides the attributes the model's user has rated important; and finally, 4) Validating the selection by reviewing the final choice against the first stage's overall factors.

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INTRODUCTION

Electronic technology breakthroughs and advancements, and their application to training are bringing complex new choices onto the "radar screens" of instructional technologists, instructional designers, performance improvement practitioners, knowledge officers, and managers. The dramatic rise of "distance learning," while welcome and exciting, invites misuse and overuse of distance technologies. Underuse, by contrast, may result from fear of the unfamiliar or of making mistakes. As these new distance learning choices crowd the list of delivery selection options for those in the training arena, a new method for evaluating and making a selection from among these options is needed.

Introduction to the Model

When presentation of delivery system proposals are made to higher level decision-makers, the use of the model may lend credence to recommendations. The four stages of the model enable users to narrow their choice of candidate delivery systems to the one that will most likely be instructionally, economically, and technologically appropriate to their specific situation. This will mitigate against choosing an inappropriate or ineffective system while lessening the likelihood that money is ill spent.

Model Scope

The model assists the user in making a selection from among the following electronic delivery systems: satellite networks; teleconferencing; Internet/intranet networks; desktop multimedia; electronic performance support systems (EPSS); transportable audio/video (AV), i.e., systems relying primarily on physically transportable audio- and videotaped materials; and the electronically enhanced classroom. The electronically enhanced classroom ideally provides a computer work station for the instructor and each learner and a projection device able to show the instructor's computer monitor or other electronic content on a large screen. It may also support the connection to any of the other electronic delivery systems (e.g., satellite networks, Internet/intranet, etc.).

REVIEW OF THE LITERATURE

The 1970s appeared to be the decade of media selection. Romiszowski

(1988) observed that only a few media selection models originated in the 1960s and only one or two new ones in the 1980s, but twenty or more models were developed in between. Reiser and Gagné (1983) and Romiszowski (1988) conducted analyses of existing media selection models, and both efforts found most models to be similar. While varying in form (e.g., matrix, flowchart, worksheet), most models considered the same list of factors as input to media selection: instructional setting, learner characteristics, categories of learning outcomes, physical attributes, events of instruction, and practical factors. Thousands of research studies on media effectiveness were also conducted during this period, but with little useful result. Most studies attempting to link specific media positively or negatively to certain learner characteristics (so- called aptitude-treatment interaction studies) yielded only general, common-sense prescriptions (Kearsley, 1984). Even meta-analyses (e.g., Kulik, Kulik, & Shwalb, 1986) revealed only slight advantages (probably of no practical significance) for newer technologies.

Despite the failure of researchers to find an across-the-board "better" medium or to support specific media prescriptions for classes of learners, instructional designers have continued to assert that media choices are important to the instructional design process. Romiszowski (1988) argues, for example, that essential media characteristics must be present to provide clarity of the message, while optional media characteristics are desired to improve the attractiveness and acceptability of the instruction. Dick and Carey (1996) assert that the types of learning outcomes and their required learning conditions (as well as several practical considerations) must drive media choices.

In some respects, modern delivery systems such as desktop multimedia and web-based training make traditional media selection issues and models obsolete. These newer delivery systems effectively combine most features of previously-existing media: text, sound, still pictures, full-motion video, and two-way interactive communication. Yet, when the specific conditions required by learning outcomes are considered, some modern delivery systems are found to be better for some situation. For example, synchronous satellite broadcast with limited two-way interaction is better for information dissemination than it is for building interpersonal skills in one geographic region.

Since the selection of media (now delivery systems) is important to the development of quality instruction, and no up-to-date model has been published to guide practitioners, the authors undertook the current project. The goal was to produce a model that considers all-important instructional and practical variables and relates them to currently-used electronic delivery systems.

DEFINITIONS

The Message

This term *message* refers to the content of any communication process, including learning. Messages may consist of body language, gestures, verbal sounds, verbalized speech, sign language, singing, etc.

The Medium

The term *medium* refers to that into which the message is embedded. That is, the various forms intangible thoughts may take in order to be transferred from one person to another as the message. Examples include: drawn pictures, manuscripts, books and other forms of printed text and graphics, sheet music, audiotape and videotape recordings, videodisc, CD-ROM, digital video disc, computer disks, flip charts, transparencies, realia, computer-based multimedia, virtual realia, web sites, simulators, film strips, movies, photographs, etc.

Teaching Methods

Teaching methods combine and convey message and media between and among instructor and learners with an intent to influence behavior, usually with the objective to enhance performance. Examples include: lecture, discussion, roundtable, role-play, simulation, exercises, scenarios, case studies, inquiry (Socratic dialogue), skill practice, games, assessments, review quizzes, etc.

Learning Delivery Systems

Learning delivery systems are more complex configurations designed to actually transport the mediated message between and among the instructor and learners. Electronic learning delivery systems used in developing the model are: *Desktop Multimedia* – providing individual learners with a learning experience at their PC work station using CD-ROM or similar technology*; Satellite Networks* – dedicated systems, primarily one-way, that link learning locations by satellite and typically provide both audio and video support; *Transportable Audio/Video (AV)* – learning systems relying primarily on physically transportable audio- and video-taped materials; *Teleconference Systems* – telephone land-line based two-way systems providing both audio and video support; *Electronically Enhanced Classroom* – provides a computer work station for the instructor and each learner and a projection device able to show the instructor's computer monitor or other electronic content on a large screen; *Internet/Intranet Networks* – systems that link learners at their PC's to a learning experience over the Internet (World Wide Web) or a corporate intranet; and, *Electronic Performance Support Systems (EPSS)* – software applications providing "just-in-time" learning information specifically supporting user performance while in a software program.

THE SELECTION PROCESS

Using the Electronic Learning Delivery System Selection Model requires four stages of activity.

Stage One: Assessing Overall Factors

In this stage, the user reviews various overall factors related to the circumstances surrounding the proposed training. This ensures the selected delivery system does not violate important learning, environmental, economic, or cultural conditions. This stage encourages the user to take into consideration the following four broad factors that should influence the selection process.

Overall Factor One: Domains of Learning Outcomes

Gagné's taxonomy of learning outcomes identifies five domains or categories, each of which requires special conditions for optimal learning (Gagné and Medsker, 1996). The several electronic learning systems considered in developing this selection model do not provide these conditions equally well across all domains. For example, many of the electronic systems do not provide the level of sophisticated feedback necessary for the teaching of complex motor skills.

Attitudinal outcomes are easier to teach when the delivery system can support the necessary level of teacher-student and student-student interactivity (human modeling). The model user must judge whether the training program under consideration has a preponderance of its objectives in a particular domain. If so, the narrowing process of system selection is simplified. If, however, more than one domain is substantially represented, the user may find it useful to conduct separate selection processes. For example, a sales training program may be composed of product knowledge (verbal information) and selling skills (interpersonal skills). In this case, two different delivery systems may be required. The various domains of learning outcomes include:

Verbal Information - This domain includes facts, names or labels, and organized bodies of knowledge. This type of knowledge is reproduced in essentially the same form in which it is presented to the learner. Recalling verbal information is typical of the performance made possible by this learning domain.

Motor Skills - The skills in this domain require physical movements executed in the proper sequence with accuracy, smoothness, and timing. Performing complex physical activities, such as playing tennis or driving a car, are outcomes of this learning domain.

Attitudes - Components of this domain include cognitive (beliefs), affective (emotions), and behavioral (actions). Choosing to adhere to traffic regulations or to abstain

from tobacco use are typical outcomes of this learning domain.

Intellectual Skills - This domain includes generalizeable skills that allow us to interact with our environment, and are characterized as "knowing how." Intellectual skills consist primarily of dealing with concepts and rules. Using rules to solve problems and create products are typical outcomes of this domain.

Cognitive Strategies - Skills from this domain allow individuals to manage their own thinking and learning processes, including devising ways to organize verbal knowledge, approach problems, or mentally practice motor skills.

Overall Factor Two: Economic Rules

Any training and development project requires investment and results in incremental costs and incremental benefits. Typical cost and benefit categories involved in learning technology projects include equipment, development costs, and delivery costs. Cost and benefit categories vary greatly by organization and project. The following three economic rules apply to investment in this model's learning technologies:

1. The Rule of Simplicity. Pick the simplest, most economical combination of media that will effectively fulfill the learning objectives. Remembering to apply this rule early in the project can free funds for situations that do demand a more expensive delivery system solutions.
2. The Rule of Learner Count. In general, the greater number of learners over time, the more likely it is that the benefits will be large enough, and the costs per learner will be small enough, to justify the investment in a leading-edge technology learning delivery system.
3. The Rule of Content Stability. If the learning content (e.g., company and competitor product offerings) changes faster than every 12 months, read-only media such as CD-ROM should be avoided unless the CD-ROM is programmed to access an up-to-date inter- or intranet-based database while being played.

Overall Factor Three: Synchronicity and Location

The factors of time and space help govern how we plan and design learning activities. Synchronous training takes place at the same time (or scheduled times) for all learners in the group. Asynchronous training does not. Location as a factor refers to the proximity of learners to one another and to the instructor. To the extent that the desired learning outcomes require motor skills, complex procedural tasks, interpersonal skills training, behavior modeling, or extensive practice and feedback, learners should be scheduled for training at the same time in the same location with an instructor. Synchronous co-location accommodates the social interaction and opportunity for the focused face-to-face interaction and feedback these tasks or skills require. In terms of space and time, electronic delivery systems provide the training designer, the instructor, and the learner with maximum freedom and flexibility. It should be noted that several of the systems support either synchronous or asynchronous learning.

Overall Factor Four: Acculturation and Training

The model user should not forget to consider the cultural environment of delivery system users. This includes developers, trainers, and learners. For example, instructors who work with a satellite system for the first time may have difficulty making eye contact with the camera. Learners may also need to be forewarned about the peculiarities of working with electronic learning technologies such as the Internet or electronic performance support systems. Production and service employees may lack the technical skills required for the selected learning technology. Also included in this factor are the demographics and other characteristics of the learner population, which include age, literacy, computer literacy, and language. What may initially seem to be the best fit delivery system can be ineffectual in the face of certain learner characteristics.

Stage Two: Rating System Attributes

In this stage, the model user decides how important each of seven selected learning delivery system attributes is to support their training project, and rates the level of that importance (see Table 1). After rating the attributes, the model user should rate each of the seven attributes in the level of importance to their training project. For example, if the learning content for the project is very dynamic, then "Dynamic Content" will be one of the system attributes rated among the more important. In another example, if a training outcome falls into the attitudes domain, then "Social Interactivity" may rate among the more important attributes. Finally, if the training involves verbal information or lower-level intellectual skills, "Sophisticated Practice/Feedback" may be rated as less important.

After identifying and rating the system attributes according to their importance to the training project, the model user should prepare for the next stage in the selection process.

Stage Three: Selecting the System

In this stage, the model user uses the More Important attributes rated according to their importance to the training project, to select the systems that best support each attribute. The model user reviews the attributes rated in Table 1 and identifies the top three delivery systems for each important attribute using the selection diagram (see Figure 1).

The selection diagram in Figure 1 consists of seven legs or axes, one for each of the seven system attributes. The diagram ranks each system's support of that attribute along the attribute's axis. The outside-most system on the axis provides the best support. The next system, moving towards the center, provides the second-most support for that attribute, and so on for each of the important attributes. The model user goes through this process for each of the three or four More Important attributes, recording their rankings in a blank worksheet, similar to completed example (see Table 2).

The system that consistently ranks highest in support of the More Important attributes to the training project (i.e., the system appearing most frequently on the worksheet) will be the system of choice.

In situations where no choice is clear, the model user has created a *de facto* short list of acceptable systems. A final selection from such a list can be made using economics or other factors.

Stage Four: Validating the Final Selection

This stage is necessary as a "reality check" of the model-aided selection process. Essentially, this stage consists of reviewing the overall factors in Stage One: domains of learning outcomes; economic rules pertinent to the model user's organization; synchronicity; and acculturation, against the final delivery system selected.

MODEL DEVELOPMENT AND VALIDATION PROCESS

In early 1998, the authors developed this model as a class project for a graduate course. The team's activities included researching existing models, reviewing the literature, making site visits where various electronic delivery systems were in use, and holding discussions with practitioners who were subject matter experts. During 1998-99, versions of the model were informally pilot tested with several groups of training professionals. Throughout these formative experiences, the model has been consistently described by those who used it as helpful, accurate, and easy to use. Yet several revisions have been made, based on feedback from the trial users. The order of steps has been adjusted slightly. A variety of presentation formats has been tried for displaying the delivery systems relative strengths and weaknesses. For example, the information in the diagram in Figure 1 has also been presented as a matrix, which is preferred by some users. Definitions, explanatory text, and tables have also been rewritten based on user feedback, and decision rules within the model have been slightly revised.

In early 1999, the electronic delivery system rankings on each attribute (see Figure 1) were verified using a data-based approach. A convenience sample of 29 training and performance improvement professionals familiar with electronic delivery systems ranked the delivery systems from 1 to 7 on each attribute. The averages of these rankings were compared with the original rankings by the model developers. In 37 of the total 49 comparisons, the survey respondents agreed exactly or within one degree of discrepancy with the authors. In another eight comparisons, the degree of discrepancy was two (2), which does not seem to be a great discrepancy, considering these rankings were forced choices (no ties allowed). Thus, in only four comparisons did the discrepancy exceed two degrees.

TABLE 1.
Rating Importance of Learning Delivery System Attributes to Project

Learning Delivery System Attributes	**Attribute Rating Based on Its Level of Importance to the Training Project (Circle one rating for each attribute).***		
Learner Variability – The system senses, on a real-time basis, learner responses and adapts content appropriately.	More Important	Important	Less Important
Dynamic Content – The system is easily updateable to accommodate rapidly changing content.	More Important	Important	Less Important
Social Interactivity – The system facilitates social interactivity between and among learners and the instructor.	More Important	Important	Less Important
Learner Control – The system is able to be controlled by the learner who makes choices based upon preferences and/or readiness.	More Important	Important	Less Important
Learner Progress – The system provides management detail on learner progress through the content, and degree of learner proficiency.	More Important	Important	Less Important
Sophisticated Practice/Feedback – The system provides for and enables practice and feedback.	More Important	Important	Less Important
Presentation Quality – The system presents material in an engaging and compelling manner, using color, graphics and motion.	More Important	Important	Less Important

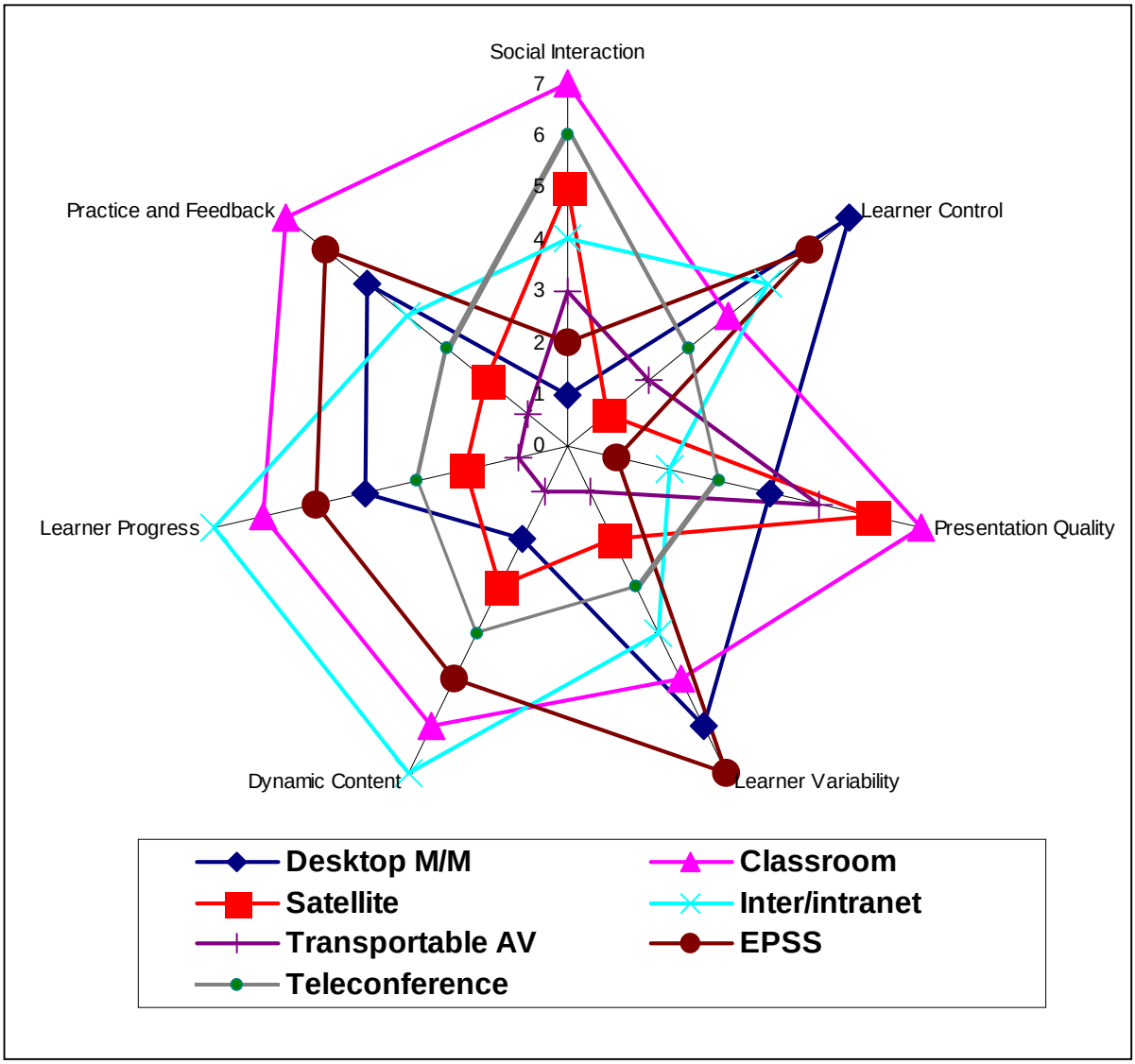
* Rating Definitions: More Important—Definitely improves learning; Important—May improve learning; Less Important—Does not improve learning.

TABLE 2.
Example Showing How to Use the Worksheet for Ranking Systems By Their Support of Important Attributes

Attributes rated as More Important to the training project	System Ranked Number One	System Ranked Number Two	System Ranked Number Three
1.Dynamic Content	Internet/Intranet	Enhanced Classroom	EPSS
2.Learner Variability	EPSS	Desktop M/M	Enhanced Classroom
3.Social Interaction	Enhanced Classroom	Teleconference	Satellite
4.Practice and Feedback	Enhanced Classroom	EPSS	Desktop M/M

* In this example, the above four More Important attributes were used to select systems that supported that attribute. The resulting matrix helps the model user to select the system of choice (In the above example, the Enhanced Classroom is the system of choice because it appears most frequently).

FIGURE 1.
The Electronic Learning Delivery System Selection Diagram



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