SELECTING MEDIA FOR SELF-PACED INSTRUCTION

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Abstract

When selecting courseware for self-paced instruction it is essential for the reviewer to have a standard for evaluation. This paper presents a criteria for evaluating courseware which is derived from the principles of instruction used for development. These principles are based on the critical conditions and events that influence learning. The principles include prerequisites for learning, modes of presentation, and feedback and reinforcement. Examples from both video and computer-based training will be used to illustrate the concepts discussed. Invalid assumptions regarding learning will be identified and "put to rest." This presentation will better equip those persons who make the decisions about end-user training by providing them with the developer's viewpoint.

INTRODUCTION

Principles of learning should be applied to any courseware designed for self-paced instruction. Although different media can be used for delivery, the methodology used should exemplify key characteristics of self-paced instruction. Self-paced instruction can be defined as a method of presentation used to instruct an individual learner who reviews and responds to material at his or her own pace. There are two distinct advantages to this type of instructional process. First, the rate of learning is determined by the learner; material is presented in a step-wise fashion so that individuals move successfully from simple to complex learning tasks. The second advantage is that the schedule is determined by the learner; an individual chooses to interact with material, within a certain time frame, at his or her convenience. This definition holds for any materials designed to achieve these results, regardless of the medium used for delivery of instruction. Due to developments within the field of instructional technology, a variety of media, such as videotape and computer-based training, are now commonly used for self-paced instruction. In this paper, the discussion is limited to these two media.

A common assumption is that one medium may be better for this purpose than another. Capabilities of media are different, but differences in the effect on learning are seldom found. When comparative studies are made on different types of media, and factors such as content, treatment, and situational factors are held constant, there is no significant difference in learning.

A second and related area of interest to researchers is whether or not the attributes of a medium enhance its potential for learning. The attributes of media such as zooming, animation, or symbols (like arrows to draw attention to details) have been examined for their effect on learning. It has been found that it is not so important what attributes are used. It is more important how attributes are used to help learners process information and develop mental strategies relevant to the learning task. This is but one aspect of the research which supports the premise that learning is influenced by the instructional design of materials.

Media can be used for instructional purposes if a number of events and specific conditions for learning are met. The purpose of this paper is to identify the critical conditions or events which influence learning and describe how these are manifested in the courseware you are evaluating. These conditions and events are defined as the evaluation criteria are addressed.

NEEDS ASSESSMENT

Another common belief is that a learner's preference for a medium is correlated with learning from that medium. Studies indicate that learning gains are more directly influenced by the degree to which material addresses the individual abilities and needs of the student as opposed to the preference. Before media or methodology is chosen, a student profile must be identified; therefore, our very first criterion for evaluation of courseware is assessment of needs.

A needs assessment for the development of a course serves to identify whether a training need does indeed exist. The assessment can be either "reactive" (in response to a deficiency in performance) or "proactive" (in anticipation of a performance problem due to the introduction of a new process or system). The level of data gathering during this stage is generally done through interviews with marketing representatives, technical support personnel, and training coordinators. Information derived from this initial research validates the need for training and targets the general audience.

This front-end analysis should also be used to determine a more detailed profile of the learner. Individuals who are representative of the target audience can be surveyed using a variety of techniques, including personal and telephone
task analysis is used when material is presented to the end-user community or the more sophisticated individual for self-paced instruction. A content approach can be defined as "learning relating to a particular body of knowledge or subject matter." Analysis which focuses on content results in material presented as a survey, a kind of smorgasbord of facts, concepts and processes. Usually this encompasses a wide scope of material, which contributes to the belief that more content is better content. While the curriculum may be well-defined, the knowledge to be acquired may not be predictable. A problem with this approach is that learning may be incidental rather than intentional.

In contrast to this, a task approach requires that the intent of learning is well-defined and limits the content to only that which is needed. A task approach, favored by industry, can be thought of as "learning related to the present job of the individual." It is important to recognize the present level of performance for that individual and the skills which must be gained to improve performance. A task analysis identifies what is essential to job performance and what must be learned during training to ensure success on the job. How universal is this task? How frequently is the task performed? How critical is the task to successful performance? The primary principle is the "need to know" versus what is "nice to know."

A second distinction between a content and a task approach is the assessment of learning progress. When you evaluate a learner engaged in a self-instructional process, you examine test scores referenced to a criteria for performance, rather than a norm. In fact, a normal distribution of scores, some very low, most average, and some very high, would be a disappointment to the training effort. Ideally, the curve, representing a group of learners, should be positively skewed. When you consider the individual learner, you should see a great difference between a pre and post test on the task learned. You can think of it as a different learning curve for each learner, representing increased competency from zero at the outset to maximum performance upon completion of the training. The rate of learning will be different for each learner following a self-paced course. Remember, however, that courseware should be designed for a targeted audience. Although courseware defines where learners begin as well as end, different paths can be taken to arrive at the same stated outcomes.

Self-paced instruction should be designed to obtain these results. When evaluating courseware please remember the distinction between mastery of content versus mastery of identified tasks. A task approach places emphasis on the sequence for what is to be learned, the critical features of the task, and the context of that performance. This second type of analysis is based on the need of the learners. A task approach results in savings of time spent on training, decreases in variability and increases in performance.

DESIGN

A task analysis helps you make better decisions about what to teach. Once you have identified what must be learned to improve performance on the job, you then must focus on the design of courseware, the architecture or framework used as a basis for the development of instruction. How is this made visible to you as an evaluator of courseware? You can begin by reviewing the objectives for each module and segment. Too often a global statement of purpose, course outline, or overview will be substituted for objectives. Objectives should accentuate the learning, rather than the teaching process.

What is meant by objectives? These may be referred to as performance objectives, behavioral objectives or learning outcomes. Regardless of what they are called, objectives should indicate performance, what the student will be able to do.
upon completion of the instruction. Objectives should specify the conditions for the performance as well as the criteria. When you are reviewing objectives, take a close look at the way they are written. You cannot know what goes on inside a student's head. Words like "understands," "knows," and "comprehends" should raise a red flag, for these provide you with little insight into whether or not a student has mastered a particular task. The emphasis should be on behavior—something that you can observe and measure. The student will be able to "state," to "recognize," to "apply," or to "follow" a particular procedure. The verbs used in objectives provide you, the reviewer, with critical information about the type of learning addressed in courseware.

What is meant by types of learning? In the broadest context, domains of learning include cognitive, affective, and motor areas which describe what you think, feel, and do. In this discussion the focus will be on types of learning representative of the cognitive domain. As each type is described, note the conditions for learning particular to each type. This will help you in your evaluation of courseware.

The first type of learning is information—facts, figures, and terminology that must be remembered. Recall is enhanced when this information is presented in a meaningful context, when mnemonic devices are used and when there is repetition or over-learning. A second type of learning is concepts—objects, symbols, or events which share common characteristics. Concepts are best taught when critical features are illustrated through a series of examples and nonexamples. A third type of learning is rules—a set of operations which can be applied to a class of events. Rules are best taught by providing learners with a formula, by illustrating how the rule applies to a variety of situations, while pinpointing common errors. A fourth type of learning is procedural—a series of steps followed to complete a particular task. The sequence of events relevant to a procedure should be demonstrated in one way, and one way only. A fifth type of learning is problem solving—the generation of original strategies used to solve a novel problem. Reminders of relevant rules and principles improve performance. Repetition has little effect on learning of this type. Once discovered, a strategy used to solve a novel problem is not easily forgotten.

Each type of learning builds one upon another. Material must be developed in a stepwise fashion so that facts, concepts, rules, procedures, and problem solving form a hierarchy. As you evaluate courseware, carefully review objectives to see that each type of learning is addressed. The conditions for each type of learning are different and will influence the development of instruction, the next criteria for evaluation.

DEVELOPMENT

Development involves the incorporation of a specific series of instructional events and activities to facilitate the learning process. As an evaluator of training materials, you will want to check to see that these events are present. This series of events can be ordered so that three phases of instruction are addressed: readiness, presentation, and feedback.
Readiness: Orientation

The first event in the readiness phase is an orientation to the technology used for delivery of the training for the student. This orientation should familiarize the learner with the technology and hardware pertinent to the medium. Auxiliary print materials, a simple job aid, or preliminary instruction eliminates the need for intervention by a training coordinator. It should never be assumed that a trainee knows how to handle a videotape machine or how to access on-line training.

Another aspect is an orientation to the course itself. This process should acquaint the student with the sequence of instruction and the logical progression through course materials. A recommended study route should be presented to suggest how students might get the most from the instruction.

With video it is important that learners follow the recommended sequence for instruction. Generally, a student's initial exposure to material is through video, while an accompanying workbook with text and computer exercises is used to supplement instruction, reinforce concepts, and attain mastery. How to proceed through a course should be discussed and illustrated in a course administration guide and at the beginning of a student workbook.

In a CBT course, a lesson on the mechanics of the instruction can be accessed at any point. This "how to" session affords students the opportunity to practice response procedures to unique test items without penalty.

The orientation activity as implemented in both media reduces the stress level associated with learning a new task. Thus, the trainee is free to concentrate his or her energies on the task and skill acquisition.

Readiness: Review of Prerequisite Skills

A second event to be included in the readiness phase is the review of prerequisite skills and remediation as needed. Necessary skills for beginning the main instruction should also be identified for the trainee, the training coordinator, and the department manager. Research suggests that the learner's entry skills have a significant impact on learning.

Video instruction relies heavily on the components of needs assessment and task analysis to target an audience and direct training efforts appropriately. Ancillary materials are used to review the entry level requirements. If a student requires assistance before beginning the instruction, sources of help should be identified. Once routed to the appropriate level of courseware, a student may use a workbook to refresh prerequisites. This may include a glossary of terms, an index to direct learners to summaries of key concepts, syntax of programming statements, and usage rules. A student can access supportive materials or review a portion of a videotape as the need arises.

CBT is a powerful medium for assessing the abilities of each student and providing remediation as needed for skill deficiencies. Ideally, students enter instruction with all the necessary prerequisite knowledge and skills to proceed directly through the instruction. More often than not, students enter at varying levels of accomplishment. CBT should take advantage of the ability to remediate a student based on an answer to a question. This branching technique means that several students should be able to take the same course and progress at very different rates along very different paths.

Readiness: Inform the Learners of Objectives

A third activity in the readiness phase is to inform the learners of objectives. It sounds simple enough, but how often are students blinded put through the paces--overwhelmed with new information and not quite sure what it is they are supposed to do. A statement of objectives also provides a set of expectations for the department manager or training coordinator.

Regardless of the medium, the objectives should be stated in the text of a lesson or easily accessed in the supplementary materials.

With all parties adequately informed, no learner should start the instruction lacking the required entry level skills.

Presentation: Directing Attention

In the next phase of course development, presentation, emphasis is placed upon the delivery of the instruction. This is not to say the medium itself becomes important, rather, it is the instructional strategies and the utilization of the attributes of a given medium that are important.

For instance, one of the instructional events which makes up presentation is the use of stimuli to gain and direct the learner's attention. Verbal and visual directions should be used to cue the learner to the most relevant aspects of the task and to keep the student on track. Visualization should enhance verbalization; highlighting, directional symbols, the use of color, and graphics should serve to focus a learner's attention on the essential features of a stimulus. Verbal cues--whether spoken or written, such as "notice that," "take a look at," and "find," alert the learner to specific points.

Video is the outstanding medium for capturing the "real thing" while compressing time and space. When video is used, camera angles are selected so that a trainee has the best vantage
point for a demonstration. Pictorial or representational graphics can be equally, if not more, effective. Animation and elaborate graphic design can illustrate processes and make the abstract seem very concrete. Another feature of video is the ability to use pitch and tone for emphasis. The audible message must reinforce the visible one and not confuse the issue.

Screen design is as important for CBT as it is for video. Too often the screens become cluttered with text and the training is nothing more than a book on the screen—a computerized page-turner. Often unnecessary and irrelevant graphics grab the eye and miss the point. The use of highlighting, underscores, reverse video, blinking, or other attributes may be excessive. It is not necessarily desirable to employ all the capabilities of an authoring system. Attributes and graphics should be used for purposes of instruction rather than entertainment.

Again the idea is to focus the student's attention on the most relevant aspects of the task to be learned.

**Presentation: Learning Guidance**

Another key event in the presentation phase of courseware is learning guidance. This idea of “guidance” is to help the student place content in perspective, to provide a meaningful and relevant context for the material to be learned. The process is facilitated by what is known as an advance organizer. The characteristics of an advance organizer include outlining the information to be covered or comparing the new material or task to something that the student already knows. This technique gives the student an organizational structure into which this new material will fit. Learning is accomplished with less difficulty and retention is more likely when the task can be placed in perspective for the student.

The use of an advance organizer in any medium should provide a framework for the introduction of new content. In both video and CBT, graphics may be used to depict the relationships between concepts and processes.

**Presentation: Use of Prompts**

The third event associated with the presentation of instruction is the use of prompts. Hints or suggestions to students are not “giveaways,” but carefully employed tools. To an uninformed reviewer, prompting may appear repetitive. However, critical prompts speed up the learning process. The learner does not waste time attending to irrelevant details or establishing erroneous patterns which must later be unlearned. Prompting decreases errors in performance. Prompts are used in various ways. A prompt in the text reminds the trainee of a relevant formula, a sequence of steps, or strategies for problem-solving. When behavior is first elicited, prompting is crucial. As learners progress toward mastery, prompts should be gradually removed. This technique reinforces the content and offers a device to “code,” remember, and recall what has been learned.

Both video and CBT can be designed so that this prompting seems natural and conversational in nature. In video, scenarios provide a means for dialogue between two characters or a character and a host. Through a series of interchanges, the host can be used to clarify concepts, to remind the learner of associated principles, and to structure the sequence of task performance.

Because of the interactive nature of CBT, learning also occurs during a “dialogue.” Although not as obvious to the learner, the computer acts as a host to guide and direct the training activities. Verbal reminders in the text and visual cues for responses contribute to the efficiency of the learning process.

If this series of events—directing attention, learning guidance, prompts and cues—are present, the instructional presentation is sound. This does not, however, guarantee performance. The next phase of instructional development is equally important.

**Performance: Modeling Performance**

This third phase of the instructional process, performance and feedback, is crucial to the success of courseware. The first event in this phase, providing a model for performance, is similar to the readiness phase. But instead of providing expectations for what is to be learned, expectations are provided for what is to be performed. This model may be realistic, pictorial, representational or symbolic. Graphics are frequently used to identify key elements of the performance. No matter what medium is used, it is important that the learner know what the present conditions are and what the desired outcome is. Regardless of the mode, it is important that standards for performance are identified and, if appropriate, illustrated so that learners can compare their results with a model. This model for performance may be provided for in a number of ways depending on the capabilities of the media used.

In video, characters can be used to motivate learners to gain new skills and competencies. Context can be provided by using realistic models. It is important that models are easily identified with and that they are perceived as being rewarded for their efforts. It is not uncommon for courseware to employ an “expert” or content specialist as a model. However, a highly skilled model may be perceived as intimidating and may not always be the best model. If content is new to learners, it may be
more appropriate to portray a character who struggles but always succeeds.

In CBT, case studies can be used for the same purpose. A situation is described and learners are asked to solve the problem. If directions are not clearly stated and guidelines are not provided at each step of an exercise, learners can be easily frustrated. Courseware should be designed to anticipate likely errors and allow for checkpoints along the way to assure learners that they are on the right path to completion of the task. Learners need frequent models for performance so that they can match their response to the desired outcome, whether this be a group of program statements or a copy of the output screen.

**Performance: Practice and Application**

The next instructional event, practice and application, is a critical feature of self-paced instruction. You will recall that each type of learning imposes different requirements on practice. The learning of information, commonly referred to as rote, requires frequent drill and practice. The learning of concepts requires recognition of critical characteristics; opportunities for discrimination and generalization should be present. The learning of rules requires application and use in a variety of situations. Problem solving by definition, requires that learners discover new strategies for solving totally novel problems rather than practice.

Courseware should be designed in short segments so that there is a short lapse of time between presentation of new material and student response. Each instructional unit, in video referred to as a “segment,” in CBT as a “lesson,” should address a group of closely related tasks. Related workbook activities or computer exercises should reinforce the type of learning that takes place in each instructional unit. When evaluating courseware, whether CBT or video, look for spaced reviews and activities which require trainees to respond and recall what they have learned. Look for exercises or problem solving tasks where trainees apply rules or principles to new situations.

**Performance: Feedback and Positive Reinforcement**

A third instructional event which should be present to ensure learning is feedback and positive reinforcement. These principles are well-recognized in stimulus-response theory and should be apparent when evaluating courseware. Courseware designed for self-paced instruction should promote self-assessment. Is feedback provided to the learner on how a task has been performed? Correct responses should be rewarded; inaccurate responses should be remediated. Frequent reinforcers can be used to gradually shape the student’s behavior as he or she proceeds through the course and gains new competencies.

Because realistic situations can be portrayed, video provides an opportunity for vicarious reinforcement when characters receive recognition from superiors and peers for their accomplishments. With computer-based or video courseware, the successful completion of a computer exercise is an intrinsic reinforcer. Courseware should make every attempt possible to minimize the likelihood of error and maximize successful performance.

**IMPLEMENTATION**

During the evaluation of software training, some attention should be directed to how the training is to be implemented.

The effectiveness of training is diminished if the support variables are not accounted for. Information regarding the hardware and software, as well as installation instructions and recommendations, should be made available to the training coordinator. Students should have copies of materials and should receive guidance as to how to begin and where to go for assistance.

Video training packages should accommodate implementation by providing auxiliary materials. Course coordinator’s guides should provide
checklists and instructions. Student workbooks should supplement the video instruction and provide practice exercises. Computer-based case studies should give students an opportunity to apply acquired skills. Documentation should accompany the course materials to provide a reference for clarification and elaboration.

CBT courses should follow much the same format of informing the training coordinator about special site installation requirements. Ancillary print materials and job aids should be used to enhance on-line instruction. After all, it is computer-based instruction—not computer only. Reference materials and documentation should also accompany the training package.

Research indicates that supplemental materials almost always have a pronounced effect on the quality of instruction. If the courseware does not take the implementation component into consideration, the learning process is handicapped, and training may be ineffectual.

EVALUATION AND SUMMATION

You have seen how conditions for learning and instructional events are applied to the assessment, the analysis, and the design and development of instruction, now evaluation will be discussed. As courseware is developed, a field test of the product is on-going. Student response is used to shape and refine the methods of presentation. In video, typical users are exposed to scripts and storyboards so that changes can be made at the earliest stages of development. In CBT, screens and exercises are reviewed and revised based on the feedback from these learners. In addition to the formative evaluation, a summative evaluation is provided by an alpha test to assess the validity of the product. Learning gains are measured by pre and post testing. Unfortunately, evaluation by developers may not be referenced in the materials you receive describing the courseware.

There are, however, key features you can look for in the courseware you evaluate: a learner profile or description of the intended audience to help you determine the appropriateness of the material for your identified learners and clearly stated behavioral objectives to assist with your measurement of a student’s performance. To assess the instructional quality, it may be helpful to review the criteria we have discussed, including the critical events and conditions which influence learning.

As a summary, we have provided you with an informal checklist so that you can better determine the instructional value of any product you review.

1. Are the needs of the audience and prerequisites for learning identified?

2. Is the analysis of content based on task and performance of job-related skills?

3. Is an instructional sequence designed so that learning tasks are ordered from simple to complex?

4. Are instructional events developed to promote readiness, presentation values, feedback and reinforcement?

5. Are support variables present to facilitate implementation of courseware for both administrators and learners alike?

When these features are present in courseware, there is a high probability that learning outcomes will be achieved and training will be successful.
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