Learner Assessment and Text Design Strategies for Distance Education

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Abstract: In this article three learner assessment strategies are described, as well as approaches that can be used by the designers of distance education instructional materials. These are: prior knowledge; reading/readability; and learning style. In addition, suggestions are made for designing learning environments and providing learners with the tools to enhance their own learning experience.

Resume: Get article decrit trois strategies devaluation de l'apprenant, de meme que plusieurs demarches pouvant etre suivies par les concepteurs de materiel didactique de tele-enseignement, a savoir selon les acquis, la lecture et la lisibilite, et le style d'apprentissage. On y suggere en outre des moyens de concevoir des cadres d'apprentissage et de fournir aux apprenants des outils qui leur permettront de tirer le plus grand profit possible de leur situation d'apprentissage.

- **The writer has to produce a book or text about some subject with certain features. What strategies can be incorporated into the materials to improve the learner's likelihood of comprehension and successful learning?**
- **The learner has to comprehend and ultimately learn from textual materials that have been given certain features. What best strategies can learners use to improve their desired level of achievement?**

These problems relate to any designer-learner combination, but they are more critical in the distance education environment. Study guides, tutorial support, teleconferencing, study groups and computer networking all can play a greater or lesser role in helping translate the designer's intentions into the students' achievement of learning goals. But unfortunately, distance education systems frequently do not provide many of these extra learning resources. This suggests that text materials slated for distance consumption should include as much strategic design as possible.

With additional information, the designer can make the text better reflect the needs of the learner. Three characteristics can be assessed relatively easily and translated into design decisions:

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- prior knowledge
- reading ability and text readability
- learning style

The purpose of this article is to describe some of the techniques that are available for assessing these learner characteristics and suggest strategies that can improve the design of distance education text materials.

Prior Knowledge

Prior knowledge refers here to the specific vocabulary and concept knowledge that a student possesses about a subject prior to beginning a course of instruction or a textbook. Prior knowledge can affect almost all aspects of study behavior (e.g., reading speed and time on task) and how the designer approaches the planning of text materials.

Measuring Prior Knowledge

The designer can get a sense of students' prior knowledge from a variety of sources, especially from members of the learner population. Many of these sources are described in more detail in the next section on reading level and readability. Global methods, like casual talks with teachers, can help define the general style and scope of text materials. However, more objective and systematic procedures are needed for the designer to judge exactly what content should be included or excluded.

One method that can be used with any of a variety of knowledgeable individuals, including students, is concept rating. A sample of relevant concepts is given to raters along with a scale (e.g., ranging from do not know to definitely know). This scale and the resulting data can be quantified, depending on the precision needed for design judgments. As with most methods, it is best to obtain information from more than one source and more than one representative of that source.

Other quantifiable student assessment procedures are: formal tests (standardized or unstandardized); unstructured free recall (specifically or globally graded); structured interviews; and structured recall tests (fill-in-the blank or short answer). If multiple choice and true-false tests are to be used, respondees should be asked not to guess because, as in achievement testing, guessing results in ambiguity of measurement.

Students can also be asked to provide outlines or concept maps of the content being assessed, but these methods may require some instruction in technique in order to achieve reasonable uniformity in the data. Also, these techniques are very time-consuming but may yield useful qualitative data.

With any pre-structured or testing approach, adequate coverage of the content is paramount. There are two approaches that seem reasonable here: a) drawing from preliminary content under the assumption that if beginning materials are not known, then more advanced content will not be known either; b) drawing a reasonable sample from all of the content that is available. The

second approach provides more certainty of what students know and do not know, while the first method requires less time and preparation.

As you will become aware in the next section on measuring readability, fill-in-the blank tests and the cloze procedure can be similar; both requiring content blanks. The cloze test, explained in more detail in the next section, has the advantage of testing connected discourse, but this can also be a disadvantage, because less variety in concepts can be tested.

Text designers can use any of the above techniques, but before choosing one, they should decide:

- the purpose of the testing;
- what kind of information will best facilitate the development of materials.

DESIGNING FOR PRIOR KNOWLEDGE

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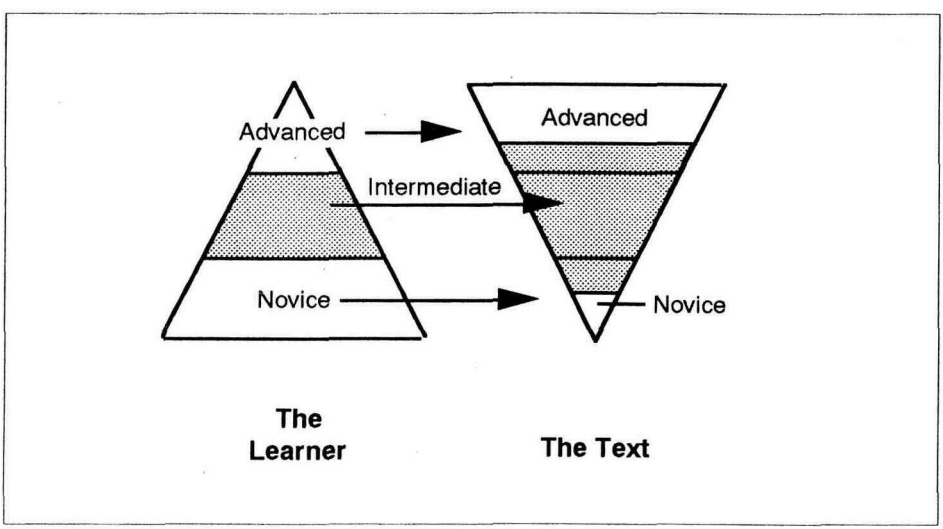
In texts designed for the general consumer, it is difficult to design for the actual prior knowledge of the learner. The typical approach is to grade texts as introductory, intermediate or advanced along with age, and gear the language and the concepts being taught to this assumption. For truly advanced or truly introductory texts this is by far the best approach. It is unreasonable to expect that novice learners should be exposed to materials that is too advanced, or that truly advanced learners should be expected to wade through all too familiar content — you really cannot produce a text for both.

Figure 1.
The Relationship Between Learner Knowledge and Text Design.



However, in the mid-range of difficulty, a strategy which balances familiar and unfamiliar can be the best approach. And it is entirely possible to design a textbook which caters to both the confident and the uncertain student. Naturally, this approach takes more space and considerably more time and thought on the part of the designer, but in the end the success rate of less knowledgeable students, in particular, will be worth the effort. Figure 1 shows this approach for designing text for intermediate students that contains both remedial content and moderately advanced content.

Providing definitions of basic terms, as well as advanced terms, is one way of solving the dilemma of variability in prior knowledge. Definitions can be set off in boxes, with special notes in text indicating their presence. Illustrations, charts and diagrams can be of great use to readers who need to see as well as read about the content. In general, it is best to provide several ways of understanding content, but there should be a clear connection between text and illustration.

Advance Organizers

When prior knowledge of a subject is low, advance organizers can be used to aid student learning. An advance organizer (Ausubel, 1968) is a short prose passage or graphical adjunct that appears before the content to be learned. The organizer provides information at a higher conceptual level than the text. In Ausubel's words, this gives the learner "ideational scaffolding" on which the new learning can be built.

It is a "top down" approach to learning based on the notion that specific detailed learning can only be remembered if it is connected to a pre-existing schema. An advance organizer can be designed as an expository organizer, for new information, or a comparative description of previously known content.

Expository organizers provide the conceptual framework that undergirds the up-and-coming material. A comparative organizer is constructed to provide a known parallel to the new information. For instance, if the learner has prior content knowledge, that schema can be used as a basis for comparison to unknown content (Jonassen, 1982).

According to Ausubel, advance organizers are not the same things as other kinds of introductory materials, such as summaries or objectives, that are often placed at the beginning of chapters. These are at the same conceptual level as the content and do not provide the higher-order conceptual organization as an advance organizer.

One of the problems of advance organizers is that they do not work for all students in all learning situations (Stone, 1983). If the student already possesses the prerequisite knowledge, the organizer is redundant. As well, certain curricular patterns such as spiral curriculum that, through design, pre-condition the learner to incoming new information, may also inhibit the effectiveness of an organizer. However, it is arguable that advance organizers cannot hurt the reader, and it is possible that they might help.

Figure 2.
Differences in Organizer Type by Instructional Group.

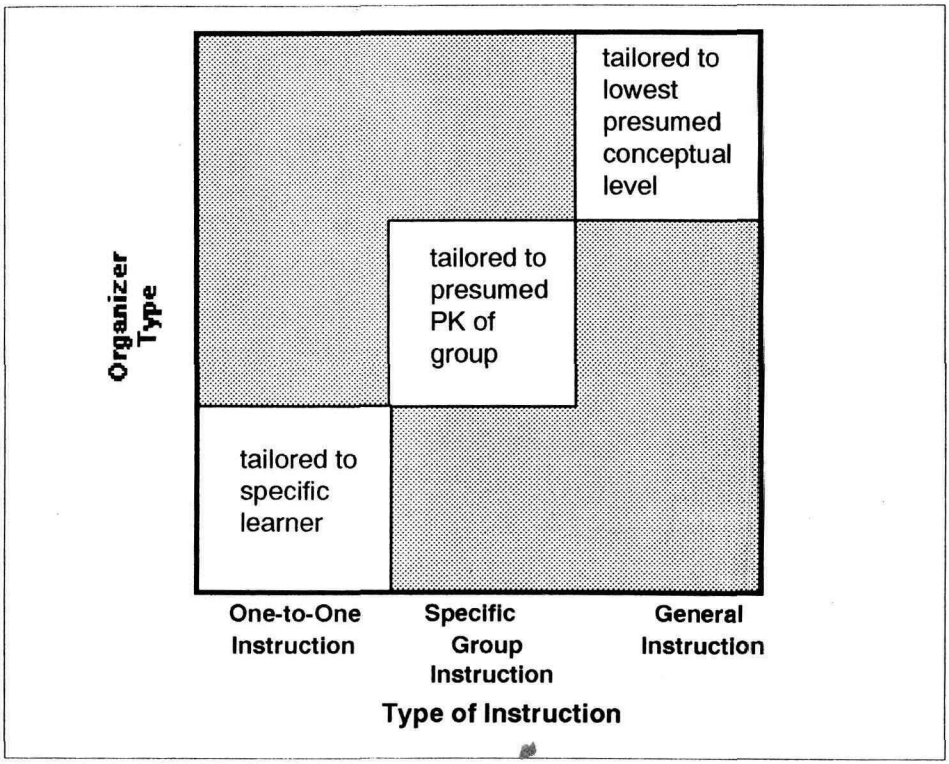


Figure 2 shows three hypothetical learning situations—one-to-one instruction, specific group instruction, and general instruction — and suggests the kind of organizer that might be appropriate. Each organizer is more specific than the next, moving from lower left to upper right, and a fewer number might be expected. In addition, expected benefits would decrease as a more general and more variable audience is addressed. The student's prior knowledge and possible non-use of the organizer are two of the aspects of general instruction that make organizers questionable.

Graphic Organizers

The concept of graph ic organizers was developed by Barren (1969) around the same theoretical notions upon which advance organizers are based. The main difference is that the content is presented in graphical, rather than verbal, form.

Graphic organizers can be illustrative or pictorial if their form effectively communicates an organizing aspect of the content to be addressed. However, they should be labeled as organizers to improve their effectiveness (Bernard, 1990b). As with most aspects of text, graphic organizers should be pilot tested on the target audience.

READING ABILITY / READABILITY

Reading ability and readability can be viewed as two sides of the same coin. But according to Rye (1982), there are many aspects of each that impinge on both text (e.g., non-verbal elements) and the learner (e.g., motivation) which cannot be assessed by either readability or reading ability measure.

Measuring Reading Ability

The theoretical and practical literature on measuring reading ability is quite extensive, and there are a large number of instruments available. Reading tests for children are often non-verbal and bound into multi-dimensional skills packages.

Reading tests for young adult and adult groups, such as the *Nelson-Denny Test*, typically measure three aspects of reading ability: comprehension, vocabulary and speed, which can either be interpreted individually or as a composite based on national or locally produced norms. These norms help determine where the reader stands in relationship to the larger norming sample.

The *Nelson-Denny Test*, and instruments similar to it, can provide useful information to teachers and students. Having a measure of reading ability is an important piece of information to the designer, as well. Scores can be obtained through actual testing or from school records. However, a reading score by itself does not help much in specifying how text should be written and structured. Readability estimates can help with this determination.

Measuring Readability

This section includes *a* discussion of traditional approaches to readability measurement, followed by a discussion of the cloze procedure. An interpretation example of the cloze procedure used in conjunction with a traditional reading measure is provided.

All of the following approaches require the use of a sample of the content material to be tested.

Qualitative techniques. Content experts, instructional designers, colleagues, librarians, editors and instructors can all provide invaluable input into the assessment of draft manuscripts or selections. Each will approach the task from his/her own perspective, and this must be considered in interpretation. In the absence of a systematic way of collecting data from them, however, their opinions should be considered anecdotal and supplementary.

Talkaloud or thinkaloud approaches (Flagg, 1990) can be used with small numbers of students, preferably a selection of high and low ability readers. Talkaloud refers to the students' behavior during a testing session, where an examiner sits with students while they read aloud. The students are given the instruction that, when they encounter problems in understanding or difficulty with any aspect of the text, they are to mention it. Explanation of the difficulty is also desirable. This technique gives an enormous amount of formative information, including suggestions for structuring text, word choice and exam-

pies. This method usually requires extensive notetaking or tape recording.

Open-ended questions can be used to gather data on readability from experts or from students in the target population. Either procedure could involve using a structured questionnaire or interview protocol that reflects the kinds of information desired. Sometimes a small follow-up sample of questionnaire respondees is interviewed to obtain more information. Designers requiring information from distance education students, especially through the mail, should be aware of the possibility of a small return rate. Special consideration, such as the length of the text, should be given to questionnaires that will be sent by mail.

Students can also be asked direct questions about the text. This could be accomplished in a one-to-one testing format or in larger groups. Students could be questioned after reading with a pre-set group of questions. If test-like questions are used, they should assess factual information, and be thought of as an equivalent to the prior knowledge test from the previous section.

Single grade level formulas. The traditional way of assessing readability is to judge the text, according to a formula, without asking student or expert opinion. Klare (1969) lists 31 such readability formulas. These tests differ in the way they operationalize terms like comprehension and vocabulary, but are similar in that they all produce a grade-level equivalent readability estimate.

Three of the most important and commonly used are the Fry Readability Formula (1968), the Flesch Test (Flesch, 1948) and the Dale-Chall formula (Dale & Chall, 1948). The Flesch Test is the easiest to use and the shortest test to conduct. The Dale-Chall formula is the most accurate, however, having undergone the most research and having produced the highest correlations with other tests and teacher ratings of text.

The Dale-Chall formula will be used as an exampl^af a single grade-level equivalent procedure (Gilliland, 1972).

- Select 100-word samples throughout the material to be rated.
- Compute the average sentence length in words (x^2).
- Compute the percentage of words outside the Dale list of 3000 (x^1). This list can be procured from Dale's Work or from specialized books on the subject.
- Use the formula: $X50 = .1579x' + .0496x^2 + 3.6365$ — where X50 is the grade level of a student who could answer 50% of the questions on the McCall-Crabbs Test (1925).

Since this way of expressing grade-level equivalent provides a single reading measure, it does not easily match reading ability test scores, unless the reading test itself is expressed in grade-level equivalents. When the target audience possesses high prior knowledge of the content, a higher number does not necessarily mean that the reading level is difficult for that group.

The cloze procedure. The cloze procedure is particularly adaptable for use in formative assessment, because it measures readability in terms of an individual student's understanding of an actual passage from the text. In a sense, it is the sum of a variety of linguistic variables estimated independently by other techniques.

The cloze procedure is appropriate for distance education, since an instrument can be formed from samples of the material to be taught and administered, untimed, in settings similar to those where students usually study. A negative feature of the cloze procedure is that it produces arbitrary scores, which can be expressed in percentages, but which will require interpretation.

Since the cloze procedure is not a test, per se, or a formula, a set of guidelines has been established for producing individual testing instruments. The following list includes these guidelines (Rye, 1982) plus some comments from personal experience:

- The selected passage should be devoid of standard instructional design features, such as illustrations or inserted questions. It should also be representative of important, rather than "quirky" content. It should include instructions to students.
- Selections should be at least 250 words in length with at least 50 deletions. However, since the test is not timed, students should not become frustrated by excessive passage lengths. It must be remembered that finding the correct word for the blank is much harder than reading the passage without the blanks. It is imperative to take time constraints and the motivation of the student to complete the test into consideration, in judging the length of the test. Generally speaking, the older and more mature the reader, the longer the test can be.
- Cloze tests can be made progressively more difficult by shortening the span of words before the next deletion. This technique allows the testee to become progressively more comfortable with the testing procedure, which is surprisingly difficult even for simple passages.
- Prior knowledge of the content is not a desirable aspect of using the cloze procedure. For this reason, it is better to select as many non-specific terms and words for deletion as possible. If content items are used, the test takes on the character of a fill-in-the-blank test, and would be better used to test prior knowledge.
- It is generally better to use selective deletion when testing for readability, rather than using a semi-random procedure or a strategy with picks every-nth noun or verb. Detailed schemes for assigning values to different types of deletions (i.e., nouns versus adjectives) and their position in text are available (Rye, 1982).
- Research on scoring is conflicting; if comprehension testing is the desired outcome of cloze testing, it is better to score with synonyms, as well as exact matches. However, this is the harder procedure, since someone must construct a list of acceptable synonyms, and scoring is

Figure 3.
Sample from a Cloze Test.

In recent years hundreds of behavioral specialists have pondered, (1) _____ and measured people for evidence of the possible impact (2) _____ being the oldest, middle, last — or only — child. I (3) examined about 6O of these studies and made a modest (4) _____ myself. No exact conclusion can be drawn about (5)_____ particular child, and on certain points the investigators disagree (6) _____ themselves.

complicated by the need for multiple scorers and inter-rater reliability estimates.

- If a more exact, and less subjective, interpretation of the test is necessary, only exact matches should be considered.
- Pilot test the instrument for time and difficulty on a few readers first, so as to avoid multiple administrations with a larger group.

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A sample from a cloze test, taken from a *Reader's Digest* article, is shown in Figure 3.

It is easy to confuse reading ability with readability, when the cloze procedure is used. What makes this application a test of readability and not of reading ability is that a content sample is being evaluated. An independent reading test makes interpretation much easier, because of the tendency to view the readers as having the problem, not the passage.

Interpretation of Reading Ability and Readability Data

Figure 4 (Gilliland, 1972. p. 97) shows the theoretical relationship between text difficulty, in grade level equivalents, and the development of reading ability. Notice that the relationship is linear, meaning that reading level progresses at a relatively stable rate over different text difficulties. The second line is curvilinear. At the early stages of reading a small increase in text difficulty produces greater difficulty for students. As reading skills develop, difficult text is more easily dealt with because of the history of reading skills that have been acquired by the student.

Early readers need careful planning in terms of readability in text design, whereas older, more mature readers, need less consideration concerning readability. Age, however, is not always the determining factor on scale to the left in Figure 4. A young precocious reader may be able to handle very sophisticated text, whereas an older, but poorer reader, may require considerably more development time and effort on the part of the designer.

Good readability-reading ability should fall within the gray area that marks the variability that surrounds these joint concepts. Consider the graphing

Figure 4.
Text Difficulty (Readability) and Reading Ability Graphed Together.

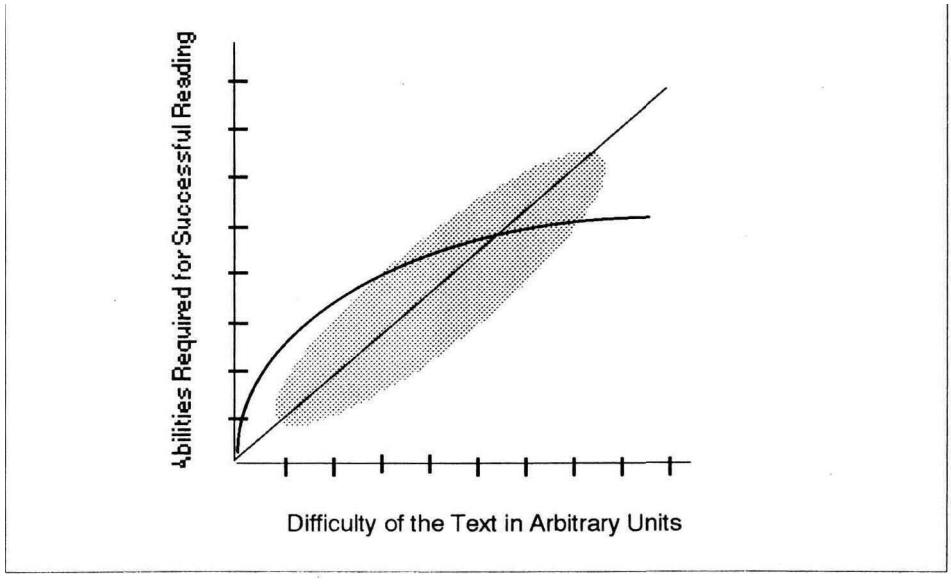
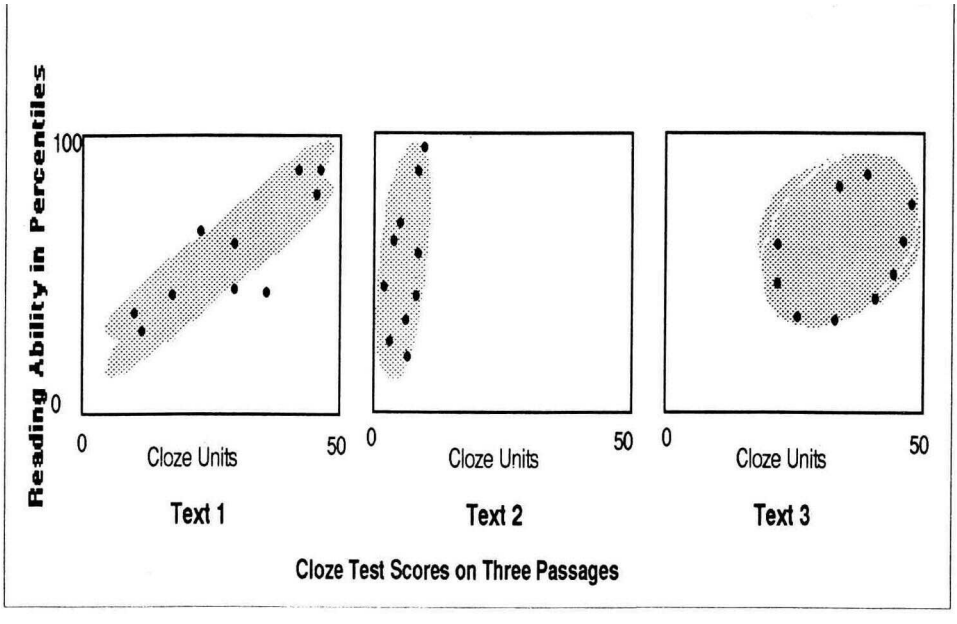


Figure 5.
Graphs of Fictional Data.



approach with some fictional data. Afterwards we will deal with the statistical interpretation.

This fictional example (the raw data are not included) describes one sample of 10 readers of differing reading ability, expressed in percentile form, and three different text selections measured in cloze units. Figure 5 shows scattergrams of the three sets of data,

Notice that the first test approximates the previous illustration. This is not a requirement, but the reading test by cloze distribution has the marks of a good match. Tests 2 and 3 are too hard and too easy, respectively.

Now look at these same data statistically.

TABLE 1
Interpretation of Fictional Data

Statistical Variables	Text!	Text2	Text3
Mean	27.1	6.1	34,7
SD	16.26	2.28,	8.03
M -to-SD Ratio	1.67	2.67	4.32
M-to-Max. Ratio (50 items) x 100	54%	12%	69%
Correlation	.81	.50	.56

The means tell what we expected; the texts are different on the cloze tests. The standard deviations show us how variable the test scores are. Test one and two are moderately variable while Test 3 is very variable.

The *mean-to-standard deviation ratio M to SD.* The mean-to-standard deviation ratio helps us understand these univariate descriptive data more thoroughly. Technically, the M-to-SD should not be less than 1.00 (there can be no negative values), because means should always be larger than their standard deviations. Distributions with means smaller than their standard deviations are very flat and variable. M-to-SD Ratios of about 2.0 are a much better spread of scores around the mean. M-to-SD Ratios of greater than 2.0 (particularly as high as 4.0) indicate narrow distribution where the majority of scores are close to the mean (opposite of a large SD itself).

The Mean-to-Max Percentage. This statistic is simply the percentage of correct responses of the average student. For Text 1 the average student received about half of the items or 50% correct. This number is about right for this sample. However, it can be too low (30% or less in the case of our example), or too high (70% or greater).

Pearson Product Moment Correlation. The correlation coefficient tells us how much grade level and test scores match in the sample. The .83 is a high correlation and the 0.50 and 0.56 are moderate. We would guess that the high correlation

coefficient indicates that Test 1 is the best, since there is a good match between reading ability and readability.

Correlation coefficients produce a useful complement to the graphic representation (Figure 5). However, the number itself can be misleading. Several peculiarities of correlation coefficients can make their interpretation misleading (e. g., variability could be limited on the grade side as well). It is recommended you examine both the coefficient and its accompanying scattergram.

Standard interpretation. Looking at all of the graphical and statistical information together suggests that Test 1 is preferable. It has a good graphic shape, and the M-to-SD Ratio as well as the Mean-to-Max Percentage are reasonable. Its correlation coefficient in combination with the scattergram (Figure 5) indicates that the match between grade level and readability is high. This suggests that students of different reading abilities scored about the way they should have on the readability measure.

DESIGNING FOR READING ABILITY/READABILITY

There is no substitute for clear, concise writing, and this above all is what makes text readable. But good learners do not just read; they display a set of behaviors that turn readability into learnability. Some of these are: organization, reiteration, rehearsal and exercise. The strategies discussed below are intended to implant, in poor readers and hence poor learners, some of the traits of good readers/learners.

Headings and Sub-headings

Headings and sub-headings are organizers, of sorts, but they are "running organizers;" the organization revealing itself as the material progresses. While they are critical, their over-use creates the impression of an outline.

Establishing and maintaining consistency is important (Hartley, 1988). A student should be able to count on the scheme that the designer has devised. As important too is how consistency accounts for itself in the placement and characteristics imbued in the scheme. Hartley has amply demonstrated the importance of proportional spacing regarding headings.

An outline of headings and sub-headings may also appear at the beginning of a section or chapter. This amounts to a "table of contents" for the chapter. A chapter outline is a summary and organizer rolled into one, but since the organization will eventually reveal itself in the text, a more descriptive summary may be preferred. The one exception to this is in scientific texts, where invariant order of topics provides advance organization.

Overviews

Overviews are descriptive passages which are intended to introduce a section or topic by summarizing it. However, overviews are often far too literal. Instead of reading, "In the following chapter you will find...", overviews could easily begin

with, 'In the last chapter you saw that...", and go on to say, 'In this chapter we'll see how..."

We'll call this a "continuity overview" for want of a better term. Summaries of this type lead knowledge to knowledge in a way that simple reiterative summaries cannot. This may sound like an advance organizer, but there is a very big difference, from Ausubel's point of view. "Continuity overviews" summarize previous and future learning rather than organize.

Student Objectives

Student objectives, usually placed at the beginning of a section or chapter, are seldom used, or even read. When forced to, research shows that students will use them, and even then they are only modestly effective (Klauer, 1984).

If the content objectives are concrete (e.g., the student will be able to insert the bulb into the socket) then behaviorally based objectives make perfect sense. But if the content deals with information that is richer in meaning, a behavioral objective such as "the student will be able to recall the steps leading to knighthood", is little more than an instructional strategy f^r memorization, or at best an overview of the bottom level content.

Instructional objectives, on the other hand, provide a variety of possibilities. Instructional objectives can, but do not always, convey information that is valuable from a strategy point of view. An experimental study by Bernard (1990a) pointed out how important related procedural statements can be used to create an overall strategy for improving achievement. Through a series of statements that can be put into objective form, the student can be given a "pathway" through the material. Instructional objectives can be more interesting, linguistically, and more helpful, instructionally.

Take the following example:

- Learn the variance formula — it is critical to everything that follows.
- Remember the symbology: a^2 = variance; 2 = summation; X = a score on a variable; M = mean of the distribution of scores; n = number of subjects in the distribution.
- Learn the form of the formula variance: "the sum of the squared deviations of scores from the mean, divided by number of subjects". You will see this form in many different disguises in future chapters.
- Explain how the variance can be converted into standard deviation units. Remember that variance, by definition, is in squared units, and SD is in unsquared units.

These objectives, admittedly are not conventional, but they express critical relationships among concepts and tie into prior knowledge. This is just one idea that could improve the practice of using objectives.

Inserted Questions in Text

Inserted questions have a long and honored research tradition. Rothkopf (1965) coined the term *mathemagenics*, which became equated with questioning, and this led to a spate of studies of every variant on inserted questions imaginable.

There is little question, that, if assiduously used, inserted questions can improve scores on future achievement measures (Hamaker, 1986). However, the level of the question is a determining factor. Simple rote recall questions will, invariably, cue students to simply memorizing. More complex, comprehension level questions will lead to better understanding of the content, and may serve less well as models for presumed future questioning.

Application and/or problem solving questions provide the best opportunity for real growth and the use of previous knowledge. Application questions require much more than simple comprehension, they require generalization, adaptation, analogy and articulation.

Problem solving questions go one step further. They demand information from various places (presumably from within the target source) and the engineering of the information for some purpose.

Exercises and Problems

The data are mixed on the usefu Iness of exercises and problems placed at end of text selections (Paschal, Weinstein & Walberg, 1984). If left ungraded, or without feedback, exercises and problems are only modestly effective. If graded, with real feedback on better performance, they can be very effective. But unfortunately, the provision of appropriate feedback is outside the realm of the instructional text designer.

Good "end of chapter" exercises need not all be at the same instructional level. If memory is required (i.e., "memorize the variance formula"), then a number of memory questions are desirable. If they are to be used, it is most important for the text designer to know why particular questions are included and the presumed content and instructional veracity of each.

LEARNING STYLE

In addition to the consideration regarding prior knowledge and reading ability/readability, there are other measurable learner characteristics that can provide information to the designer of instructional text.

The past 20 years of research in the area of learning styles (e.g., Pask & Scott, 1972; Marton & Saljo, 1976; Entwistle & Ramsden, 1983; Biggs, 1985; Schmeck, 1988) have found that certain types of characteristics are more favorable to successful learning than others. Several approaches to measure these differences in style have been based on observations and interviews (Pask & Scott, 1972; Marton & Saljo, 1976) resulting in paper-and-pencil questionnaire or inventories. The results of learning styles research suggest that students employing a deep-level approach driven by intrinsic motivation matched with good reading habits

seem also to perform better on common university tests.

One inventory was devised by Entwistle and Ramsden (1983), and validated by a variety of researchers in many settings including distance education (Kember, 1989). This measure, and others like it, may help the designer determine whether the learner is operating at the level of surface (e.g., rote memorization, etc.) or deep (e.g., meaning and understanding) approaches to learning, and whether other factors, such as *improvidence* (i.e., search for details), *operations learning* (i.e., proceduralized learning), and *intrinsic* versus *extrinsic* motivation are also operating. This list of factors has been identified as either contributing to or impeding learning success (e.g., Hattie & Watkins, 1988).

Findings from these studies suggest three explicit strategies for text-designers:

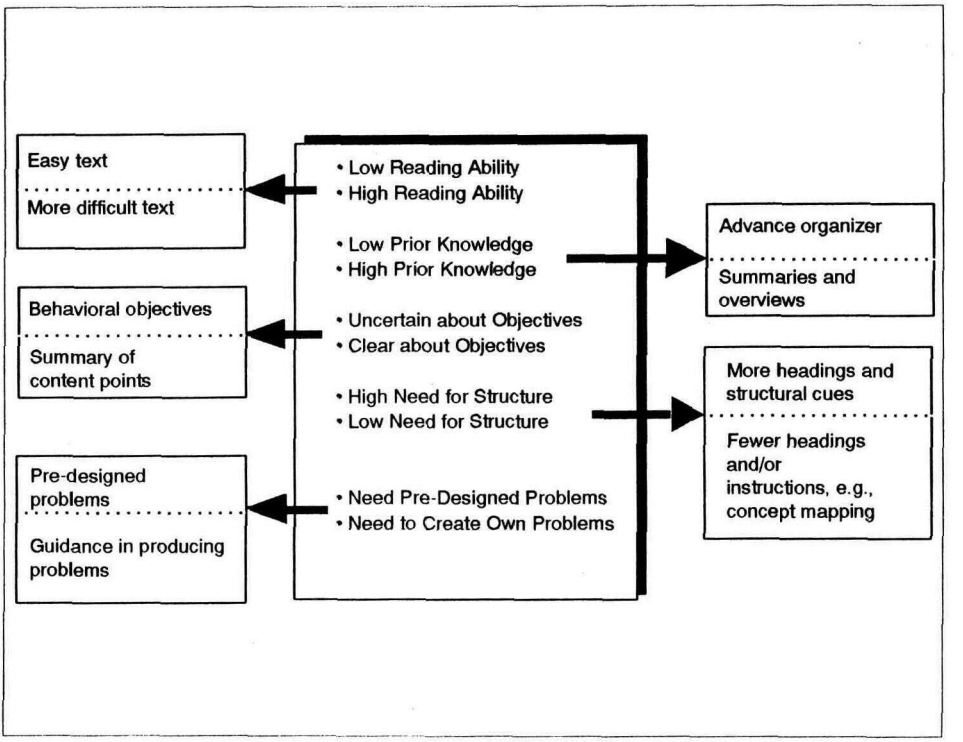
- to include a learning style inventory as a self-diagnostic test to allow students to determine how they might improve their study habits.
- to incorporate built-in text design suggestions that prompt the students to take responsibility for their own learning, such as the use of meta-cognitive learning strategies.
- to suggest alternative ways of viewing and representing the information in other ways by constructing graphical representations and designing their own learning exercises.

Then, exactly how do you design instructional text for individual differences. The best answer is to do everything: perform careful readability assessment, provide structures that aid in comprehension and memory and provide some form of training for some organizational instructional strategies such as concept mapping. However, knowing something about the kind of environment in which a text will be used, as well as the objectives, the time that students will be able to invest and learning style information can contribute to the designers' decisions regarding the amount of structure to provide and how much help should be provided in the form of suggestions for study.

DESIGNING FOR SUCCESSFUL LEARNING AT A DISTANCE: A QUESTION OF STRUCTURE

Figure 6 shows the various strategies that can be used for specific learner difficulties. Most of the suggestions are designer-based, in that they are adjuncts that can be designed into the material. However, successful learning involves more than simply responding to pre-designed elements. For real learning success to occur a gradual change from designer structured texts to the inclusion of self-directed learning activities has been found to encourage independent deep-level learning (Beaudoin, 1990). Independent learning, by the nature of distance education, is one of the essential requirements for success.

Figure 6.
Learner Characteristics and Potential Instructional Strategies.



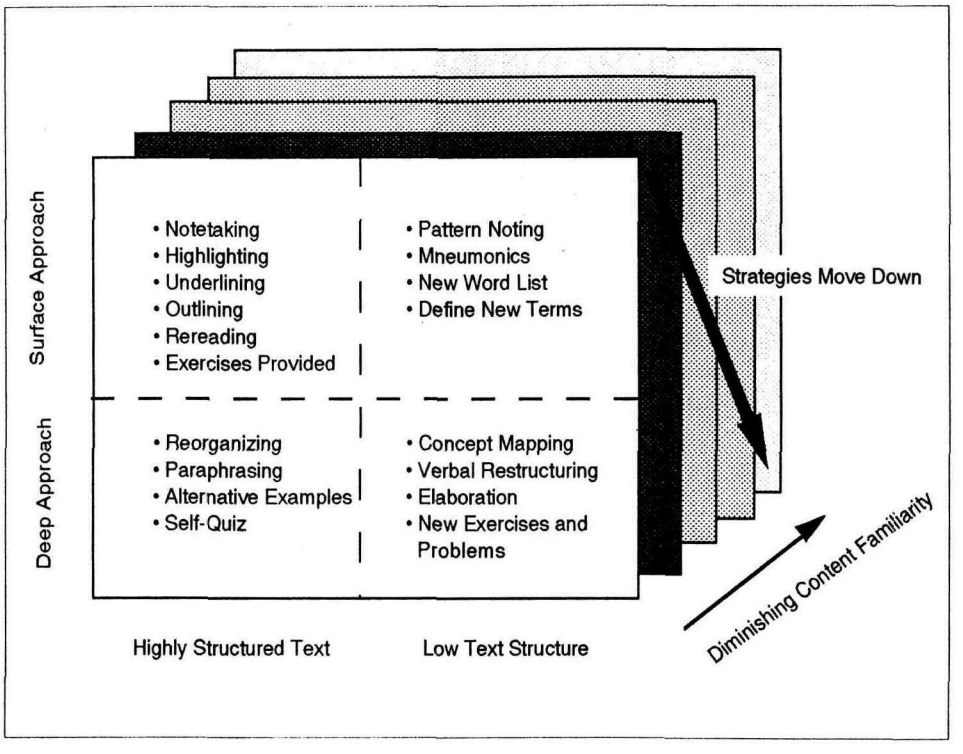
The problem of providing less structured approaches to the learner is greater than the reverse. Some readers prefer to take their own notes, in one form or another, but these notes can simply duplicate the text structure in a highly structured text. However, some learners, probably the truly deep learners on the deep and surface scale, prefer to create their own organization, independent of the organization of the text. These are advanced learners in content as well as style, but this is not always the case. Most learners need to create their own organization in order for content to become meaningfully "theirs".

The question regarding how much structure and which instructional strategies to include in text is a difficult one (Grow, 1991). Figure 6 may help suggest which types of strategies are possible for different kinds of learners. But in adopting one strategy, some learners may be excluded. The real trick is knowing the learners and the nature of the structure they require. A training manual, for example, for a very homogeneous group will require a different design than a general text, intended for a heterogeneous audience.

The complexity involved in the designer's task is shown in Figure 7. Here, three variables - learning style (deep-surface), textual structure and prior knowledge (high and low) are displayed in relationship to one another. Learning

Style is shown on the vertical axis, varying text structure is on the horizontal axis and diminishing subject matter familiarity (prior knowledge) is on the depth dimension.

Figure 7.
Relationship of Learning Styles to Learning Strategies.



At one time or another, most learners cross categories, so this graph is not intended to characterize the behaviors of these learners as much as to suggest a progressive strategy to both student and designer.

The depth dimension in Figure 7 — diminishing content familiarity — suggests that as learner's prior knowledge or readiness for the content decreases, surface-oriented strategies are likely to help even normally deep learners. Encountering new terminology, relating unfamiliar concepts, having to form a new knowledge structure based on content frameworks or hierarchies demand many of the behaviors that characterize the surface learner. Fragile knowledge in learners demands rehearsal and gradual cognitive restructuring, before even deep comprehension, much less creativity, can occur.

One current line of thinking and research suggests that a solution to the question of structure lies in guiding learners towards creating their own structure (e.g., Novak& Gowan, 1990; Patten, Chao& Reigeluth, 1986), thus allowing them

to link concepts to their own personal schemata. This means that the designer needs to provide the learner with strategies rather than structures. A wide variety of such strategies have been proposed, including concept mapping, cognitive mapping, idea mapping, patterned note-taking, webbing, flow charting and networking. All of these strategies fall within the general theoretical perspective known as elaboration theory (Reigeluth & Stein, 1983).

Procedures for encouraging cognitive elaboration include planning, attending, encoding, reviewing and evaluating (Weinstein & Underwood, 1985), all of which can be activated in textual materials to improve learning achievement. A study of concept mapping (Bernard & Naidu, 1992) in distance education demonstrates this point.

One-hundred forty-one female distance education subjects participated in one of four treatments: a control group (standard materials for the course); an inserted questions group (linked to course materials); a concept mapping instructions group and a combined group. The concept mapping group was further divided according to the number of concept maps they turned in and received feedback on. Achievement scores at the end of the 12-week course for high persistent mappers were better than both the control condition and the inserted questions group. They were close to significantly better than low persistence mappers. This suggests that, even for a general audience, concept mapping, built into course materials, can provide genuine benefits in terms of achievement and learning self-sufficiency.

SUMMARY AND CONCLUSIONS

This article has attempted to sketch a perspective on text design that emphasizes assessment of learner characteristics from three perspectives. These are prior knowledge, reading ability/ readability and learning style. It is argued here that for distance education, in particular, it is important that designers possess some understanding of these characteristics in their intended audience. This is because distance education materials form the basis for distance learning, especially when other kinds of learning support are lacking.

Designing materials is often not enough, however. In addition to modifying text to make it more learnable, it is often desirable for the designer to provide tools and strategies that can facilitate independent learning. Concept mapping was cited as an approach that can be designed into distance education texts, to increase learner control.

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