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EFFECTIVE WRITING FOR A COMPUTERIZED TRAINING SYSTEM

OFFICE OF THE PRODUCT MANAGER
COMPUTERIZED TRAINING SYSTEMS PROJECT
FORT MONMOUTH, NEW JERSEY

JANUARY 1975

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Report CTS-TR-75-1

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EFFECTIVE WRITING FOR A COMPUTERIZED TRAINING SYSTEM

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13. ABSTRACT

This report provides information and guidance on the preparation of course material for training by the implementation of a computerized training system.

This report by no means covers all of the aspects of preparing course material. However, a course development effort using the guidelines in this report was successful in the use of the "one-man" concept, or approach, in the preparation of course material. Each course instructional programmer assumed the responsibility for lesson content, quality, and presentation.

This report covers many of the major aspects of lesson preparation such as: lesson research and organization, writing style, display screen format, preparation of graphics, audio preparation and presentation, instructions to follow after the completion of the preparation of the lesson, and guidance on the critique of the completed lesson.

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Prover-Type Questions						
Reinforcement						
Remediation						
Terminal Performance Objective						
Tutorial Instruction						
Visual Aids						

NOTICES

This report has been reviewed and is approved.

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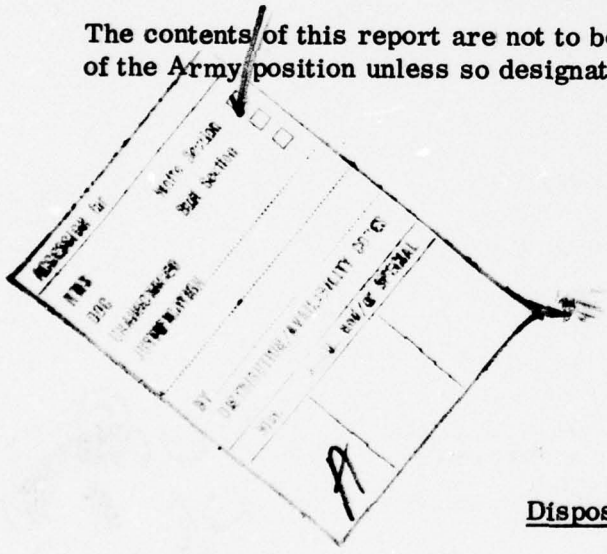
Disclaimer

The contents of this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.



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FOREWORD

Computerized training systems provide the Armed Forces with an array of training strategies, media techniques, and data collection/evaluation methods never before available to training managers at any cost.

The routine, tedious, repetitive tasks which have been the burden of educators everywhere can now be automated with considerable savings of time and money while increasing the effectiveness of military training at every level.

High quality instructional support can be consistently realized, lessons presented, graded, and results recorded with very little human intervention. However, an often overlooked but, nevertheless, extremely important fact is that high quality information must be initially entered into the computer to attain the expected results.

The possibilities for use of this new philosophy/technology are limited only by the imaginations of the users. Each user will certainly have his own ideas on how to improve upon the system. This brings about the need for precautionary restraints especially in regard to the software aspects of course developments.

As we begin to implement the techniques peculiar to the computerized training discipline, we must continue to maintain that there is still no substitute for orderly, factual course material prepared by motivated, knowledgeable instructors who care about their students.

The selection and training of course development personnel is of such paramount importance, that all other aspects of the job to be done are reduced to insignificance by comparison.

The best hardware in the world will do absolutely nothing for poorly prepared training material, whether it be tutorial lessons, simulations, or simply management of the training program.

The most significant point I can make here, is that no one knows the military student better than the military instructor. It is up to us to make it easy for these instructors to use a computerized training system and to provide the best possible training for them so that they can broadcast their expertise to their comrades in the most effective manner.

This report has been prepared with the above ideas in mind and is based upon practical experience gained by training hundreds of military personnel using the computer as a surrogate instructor. It represents valuable, time tested approaches

to the very real problem of getting good information into the computer, however, it is but a scratch on the surface of what the future holds.

Finally, computerized training is not the panacea to all our problems. It must be viewed in proper perspective. Innovation for innovation's sake is not our objective.

G. B. HOWARD
COL, SigC
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Purpose

A serious problem which has continued to plague computerized training is the length of time required to prepare interactive Computer Assisted Instruction (CAI) course material for the computer. Various estimates have been advanced, from 88 hours per hour of conceptual course material, to 218 hours per hour of technical or complex course material.[1]

There is no question that much time is wasted by writers casting about for a reasonable set of guidelines to follow that will result in lessons requiring a minimum of editing and revision.

This report has been prepared to provide some of the mechanics of writing Computer Assisted Instruction course material for the TRADOC Computerized Training Systems (CTS) Project. However, it is suggested that the guidelines presented can be applied to the development of interactive CAI course material for any computerized training system.

The report is based, for the most part, on pragmatic experience gained during the CAI feasibility and follow-up studies conducted here from Nov 1967 to May 1972.

The report is written to reflect most of, but by no means all, the common pitfalls encountered when preparing CAI course material and to provide as much positive guidance and direction as possible considering the present state-of-the-art.

Background

The "one-man concept" applied to lesson preparation appears to be a reasonable approach to the production of course material for computerized training systems.[2] The concept has withstood the rigorous test of application in the Army's CAI project at the United States Army Signal Center and School, Fort Monmouth, New Jersey. Since 1968, it has resulted in a considerable amount of experience gained in the preparation of CAI course material; a considerable amount of CAI lesson material developed; and most important, a large number of students successfully trained in basic electronic subjects using CAI.

The "one-man concept" suggests that the writer or course author (instructional programmer (IP) in the CTS Project) be at least an instructor/subject matter specialist and have a desire to improve upon conventional teaching methods. He must learn to illustrate, program (minimal), and objectively criticize his writing. (Hereafter, the writer, course author, or lesson preparer will be referred to as the instructional programmer, or the IP.)

One might argue that so much time would be required for an IP to attain a reasonable degree of proficiency in these areas that the ends do not justify the means. Or one might argue that specialists with the required technical skills should be assigned to each of the job areas to assure productivity.

The first argument is lost because of the challenge and appeal of writing a CAI lesson to an individual's creativity. The final, polished CAI lesson is a satisfying creation which endures as a monument to the author's wisdom, creativity, resourcefulness, and understanding of human nature. When an IP creates a CAI lesson with all its intricate branches and subtle psychological nuances and watches it perform like a fine watch to impart his wisdom to others, he is rewarded, satisfied, and motivated. He will vow that his next lesson will be even more sophisticated and effective so that his craftsmanship will be appreciated by all. The second argument is lost probably because of reasons already given. An IP does not wish to have others meddling into his creation. The IP wants to be responsible for all aspects of the lesson and to be identified with it. He will weather all kinds of diabolical criticism by his peers because he knows intuitively that for the most part, his lesson is better than even the best conventional-instruction lesson.

The IP's feeling of responsibility for the lesson (because it reflects upon his ability) has a manifold affect upon administration. One need not look very far to find someone to complain to when a hitch develops in a lesson. The IP is right there looking, and in fact asking, for constructive criticism. He does not relish the idea that anyone should view his lesson with disfavor and will scurry about to make sure that it is corrected as soon as possible.

With these thoughts in mind, this report endeavors to provide those creative individuals who will prepare and write CAI lesson material some simple and sound advice which has been gleaned from past experience and which is not couched in the complex terms of the sociologist, or psychologist. Hopefully, these tips will give the novice IP more time (much of which, in the past, has been spent licking wounds) to devote to writing more effective, and innovative CAI lesson material.

Introduction

The CAI instructional programmer must learn to express his thoughts in short and simple form. This basic premise is perfectly in step with modern-day writing style. When one stops to consider that every single word and sentence on the CAI screen is subject to intense scrutiny, as though it were engraved in stone, it should be a signal to the careful IP to warily consider what has been said and how it has been said in his lesson.

Sentence structure, grammar, screen format, art work, diction and sequencing must fit together fluidly and perfectly lest the viewer become more obsessed with the flaws, than with the content of the lesson. Vigorous CAI writing with clear purpose, clearly and simply expressed, will ultimately reveal the intent of the medium to teach, rather than to simply impress. Any other writing style cannot help but reflect unfavorably upon the IP, the administrator, and the medium, and will result in limping progress for computerized training when it is capable of revolutionizing the entire educational system.

There is an acronym called "GIGO" which stands for "garbage in - garbage out" and has been applied to data-handling computers over the years. GIGO is particularly appropriate when applied to CAI, and should stand as the watchword for IP's who would like to see the medium materialize as a truly unique and effective educational innovation.

Research and Organization

The research and organization of a CAI lesson are two of the many aspects that must be given very thoughtful consideration both in time and applicability.

The instructional programmer must exhaust all possible sources of information for applicable matter plus drawing from his own knowledge of the subject. Once an appropriate amount of information pertaining to the subject matter has been compiled, he must sift through it and make a determination of what is usable and what is not pertinent to what he has in mind as to the content of the lesson. He must also use discretion in the matter of the amount of material he intends to present on the subject matter. Too much material will definitely lead the student into a state of boredom, while too little material will result in confusion of the subject matter. The happy medium, from the student's viewpoint, is midpoint between too much and too little material. In other words, in his research, the instructional programmer must definitely discern what is of utmost importance and what is of unnecessary significance for presentation to the student. In the process of researching the subject matter, the IP must determine what material will satisfy the terminal performance objectives (TPO's) of the lesson to justify the time and effort expended in the preparation and presentation of the material in an interactive computer-student CAI lesson.

Once the instructional programmer has researched, sifted, and made his decisions as to the appropriate subject matter, he must organize his material for the most effective presentation. To do this, he must, at first, visualize the proper chronological order for presentation. Next he should prepare a written outline of his presentation. The outline will show whether or not the presentation will cover the concepts of the subject matter with the proper continuity and transitional steps. He can also perceive if the method of presentation is consistent with

the instructional model and if his subject matter outline will permit him to use the strategies incorporated in the instructional model. When he is convinced that his outline indicates the best presentation of the concepts of the subject matter, he then is in a position to start to construct his lesson.

Instructions on Research and Organization

1. Research lesson subject matter by reading text books, technical manuals, or other literature in the area of interest. Be a subject matter expert before writing one word.

2. Read the Terminal Performance Objectives (TPO's), tasks, skills, and knowledges for the entire course before beginning the lesson planning. This will prevent the expansion of the lesson out of proportion to other lessons in the overall course.

3. Do not attempt lesson writing until you are thoroughly familiar with the instructional model.[3] This model provides the framework of strategies from which a sound, consistent, and efficient lesson will emerge.

4. Check all instructional material files to see if parallel lessons, or lesson plans exist, and use as much of the text, slides, scripts, and other documentation as possible.

5. Get the equipment and the equipment manual involved in the lesson and set up the equipment in the same way that it will be used in the lesson. Familiarize yourself with the equipment's peculiarities before writing the lesson. This will avoid a lot of rewriting problems later on.

6. Organize the lesson into logical subdivisions; easy-to-difficult, simple-to-complex, whole-to-part, or part-to-whole. Outline the lesson: pick out the specific tasks, and put them in the proper teaching order. This will help you to see gaps and excesses in the lesson.

7. Identify the lesson documents immediately, preferably with a felt-tipped marking pen, on the lesson binders. Paste-on lables have an unerring ability to get lost. Identify the lesson documents by at least giving the lesson name, computer segment number, lesson number, and of course, put your name on the document. There is a tremendous quantity of original documentation floating around in a CAI course development activity. It's handed back and forth and massaged by oldtimers and newcomer operating personnel at all levels who understandably have a desire to know what they're reading, how to read it, and who wrote it.

8. Be inquisitive: check around and gather together all the available documentation or formats which have been designed to help save valuable time in lesson preparation.

9. Here are some typical CAI activity planning guides which will assist in preparing the lesson with a minimum of strain:

a. Display guide formats for constructing electronically-produced graphics and screen-text displays.[4]

b. Rough graphic formats (usually screen-size blank forms with space for a drawing and pertinent information).[4]

c. Frame-labeling formats.[4]

d. The instructional model, of course.[3]

e. Slide labeling and sequence number formats.[4]

f. Technical reports on macros, functions, branching techniques, etc., having to do with the Computerized Training System.

g. Storyboard formats.

h. Computer character sets and dictionaries.[4]

i. The block of slide addresses assigned to you if this applies.

10. Do assemble a library of reference material pertaining to your overall writing job. Here are some excellent sources of raw material:

a. Technical manuals.

b. School Information Texts and PI texts.[5]

c. Lesson plans and practical exercises booklets.

d. Programs of instruction.

e. Lesson preparation guides.

f. Training aids catalogs.

g. Index of military publications.[6]

h. Television and motion picture production catalogs.

i. TASO publications.

11. Assemble the lesson document with an eye toward final review. Typically, the lesson goes into a three-ring binder: rough graphics in a separate three-ring binder for easier reference for your review. Make copies of the rough graphics for references. Submit originals for final artwork. The lesson will eventually be subdivided or structured into teaching elements followed by prover-type questions according to the model. This natural (model enforced) structuring of the lesson brings about a need to separate these subelements with labeled manila sheets. This facilitates finding things in the lesson. Experience shows that page numbering only works after the lesson is completed and ready for final review because of the constant shuffling of lesson pages as the lesson is constructed, reconstructed, and modified.

Writing Style

In general, much has been written about writing for commercial or military publication. However, very few instructions are available about the writing style to be used for training with a computer as the instructional medium. A reasonable declaration, to begin with, is that the educational philosophy of the institution which is practicing CAI probably has more to do with establishing writing style than any other single facet.

We must consider writing style from the Army's point of view, which brings us to our audience, the students. A cross section of student population may range from the student who can barely read and write (low-performance/aptitude) to the sophisticated young college graduate who can read a screen full of text and digest it at a glance (high-performance/aptitude). It stands to reason that to direct writing to the latter is going to leave the former student rather dazed. Conversely, to direct writing to the former student will have the college graduate climbing the walls out of sheer boredom.

This means that the IP must develop a split-personality writing approach to please and teach everyone in order to motivate all types of students. This boils down to an inspection and modification of the IP's attitude as he approaches the writing job. When the IP addresses the student who has difficulty writing his name, the IP must force himself to think as the student thinks, and write the material accordingly. When the IP addresses the college level student (who can read between the lines) he must shift gears, and so write as not to insult the student's intelligence.

This brings us to the middle student - the "average student" (middle-performance/aptitude). This student is hard to describe but assume that he possesses some, or at least a few of the following characteristics: capable, eager to learn, reads well, is motivated to some extent, and that his manual skills are reasonably well developed. The IP must consider this type of student because this type of student probably represents a large percentage of the student population. Very simply, the approach to generating a lesson path for this student is more of an exercise in instructional-model technqiues, than a writing job. Once the low- and high-performer students' paths have been solidified, the average student's path may be determined by branching techniques using existing visuals and lesson textual material from both the low- and high-performers' paths as desired.

The final word here to be dwelt upon is "motivation". Consider the student as a soldier. The question: what incentive does he have to proceed through the self-paced course as quickly as possible while soaking up knowledge like a sponge? The answer: practically none. The reason: the student knows that to complete the course involves him in a set of unknowns which mainly revolve about where he is going and what he'll be doing. A possible solution: the IP, may appeal to the student's innate desire to get something for nothing: the course that he is getting cannot be duplicated anywhere. He can apply his knowledge gained in the course and the experience gained in the field to a better job when he is discharged. The student can also use his knowledge to save money in his domestic life (everyone knows how much it costs to have a color TV or an appliance repaired); and, of course, knowledge, once gained, can never be taken away. Students must be subtly and frequently reminded that they <u>are</u> getting something that they can unquestionably use later to their monetary benefit. To further pin this avenue down, consider relating course material to domestic analogies, for example: TV does use circuits and components similar to army equipment; present day automobiles have an ignition system that resembles any number of army semiconductor circuits (and everyone knows how much a tune-up costs), and so on. The essential point here is that the motivational problems do exist which should nag you. Therefore, slant your writing to address all types of students in the school's population.

<u>Instructions on Writing Style</u>

1. Use multiple-choice three or four alternative questions in your dialogue with the student.[7] Computerized training requires a great number of responses from the student to maintain his involvement and interest and to keep track of his progress through the lesson paths. The multiple-choice question is the all-around best type of question to construct while still maintaining a reasonable degree of plausibility, validity, and reliability. The previous statement takes into consideration the present state-of-the-art of computer analysis of constructed responses (sentence or word string analysis).[8] Here are some substantiations for the

multiple-choice type of question for computerized training:

a. The question stem is inherently simple and easy to tailor to the problem since there is only one right answer and relatively few wrong answers to be considered.

b. The distractors are easily written to provide precise remediation or reinforcement.

c. The remediation can be based upon anticipated student misconceptions and be accurately directed toward these misconceptions.

d. The reinforcement is unerring in that it gives credit for only the correct answer.

e. The remediation and reinforcement writing job is held to, generally, four short phrases, one for each alternative.

f. The question subject can be analyzed and rapidly answered by the student when he is given a choice of answers which are clear cut and definitive. (His answer is not muddied by spelling, typing, or choice-of-word difficulties, etc.)

2. Do not use constructed response questions unless total recall of a word is required. The argument against constructed response questions (except numerical responses) for dialogue is essentially that of obfuscation. This type of question clouds the real issue of the question discrimination, validity, and reliability with other factors. It is difficult to generate this type of question because the writer must think of, and program for, a great number of variables, i.e:

a. The set of all possible synonomous correct answers for which reinforcement must be provided (you don't want to tell the student he is wrong when he comes up with a synonomous correct answer which you didn't consider).

b. The set of probable or anticipated wrong answers for which remediation must be written and programmed for.

c. The set of all possible spelling, punctuation, capitalization, numerical, in other words, typographical errors which will be permitted in an acceptable response from the student.

d. When sentence input is permitted, the set of all possible acceptable ways the student may construct the sentence as well as the set of grammar remedials.

e. The set of explicit correct answers toward which the explicit correct answer reinforcement is tailored.

f. The set of unknown responses and remediation.

All of these facets require a great deal of work and research to come up with a truly meaningful question, answer, remediation, and reinforcement set which is completely lacking in ambiguity. It is doubtful that the copious number of conditioning problems (responses) envisioned in CTS course development are worth all this work just to maintain dialogue and minor remediation. It is also doubtful that the constructed response is useful as a prover-type question or as a statistical-measurement tool except in certain cases because of the unknown factors introduced by its subjective nature and the considerable amount of time required to generate a fool-proof question.

3. Use good written test item construction practices when you write your questions. When in doubt, read WRITTEN TEST CONSTRUCTION and PERFORMANCE TEST CONSTRUCTION.[7] Ambiguous questions are time wasters as well as confidence robbers. This applies to all problems requiring a response from the student.

4. Do not assume that the low-performance student knows anything other than how to read haltingly. Tutor him every step of the way and check each step with a response to avoid instructor calls on insignificant details which wastes the instructor's and student's time.

5. Do not use the computer to deliberately call the instructor unless it is really a definite area of possible confusion for the student. Anticipate problems the student will have, make him respond, and always remediate him using the computer's built-in remedial capabilities if possible.

6. Select plausible distractors for all questions. Anticipate the student's response when you select distractors. This provides the opportunity to then remediate and clear up misconceptions based on the way the student responds.

7. Do not tell the student "you'll get more on this later". Why bring up the subject in the first place? Save it for later.

8. Do not use sarcasm in remedial statements. Remember, the computer is touted as having infinite patience when remediation or drill and practice exercises are required.

9. Do not write the lesson and completely code it as you go until you are completely familiar with CTS writing techniques. It frustrates the review process and creates problems.

10. Write your low-performer's path first, complete with all drill and practice routines, graphics, and remediation. This is naturally the longest path through the lesson and will permit you to look at all sequencing with a critical eye. The high- and middle-performer's path through the lesson will make use of some of this material which you have already generated. Thus, you have saved valuable production time.

11. Analyze the lesson to determine if a high-performance path through the material will make the lesson more effective. Remember, CTS should allow the better student to progress more rapidly.

12. Show lesson objectives at the beginning of the lesson. Several short numbered sentences will suffice to "tell em what you're gonna tell em".[9]

13. Introduce the lesson material by relating to prior subject matter or analogies which the student is already familiar with, and has a desire to know more about.

14. Use a positive word or phrase immediately in reinforcement frames to tell the student that he has responded correctly.

15. Tell the student he is wrong when he responds incorrectly, preferably first, before remediation begins. Use a negative word or phrase to let him know (without sarcasm) that he is wrong. In this way he is prepared for the remediation which follows.

16. Do not write a block of instruction on some concept and then negate it all by saying "you probably won't use this very often" or words to that effect. Always use positive statements in the lesson presentation to remove any doubts that you do, in fact, know your subject, and that what is presented is important.

17. Prepare a pretest to give to students who have prior experience if the subject matter in the lesson is sufficiently general enough and there is a significant number of students who are familiar with the subject matter. This way, the better students can skip around the lesson material.

18. Assume that the high-performance student can read fairly well and can organize his thoughts reasonably well. He will, however, require almost as much drill and practice and hands-on as the low-performance student when he encounters unfamiliar subject matter.

19. Construct your prover-type questions so that they bring together as many knowledges, skills, and concepts as possible. Have the student do something using these knowledges, skills, and concepts if possible. Successful completion

of the provers should prove that the student has mastered the material in the previous skill element. Several provers may be required to accomplish this aim.

20. Present the lesson material using succinct statements of fact and plenty of simple visuals, followed by a response probably every other frame. This will check the student's acceptance of your statements and concepts presented.

21. Use thought provoking questions with plausible distractors when constructing conditioning problems. Then quickly remediate and get back to the main-line instruction. Conditioning problems should be written to maintain simple dialogue on simple concepts. Difficult conditioning problems will reduce the student's confidence level and his motivation to continue.

22. Do use short, simple sentence construction.[10] Construct your sentence so that little punctuation is needed. Each sentence should stand alone, crystal clear in its meaning, and devoid of reference to previous sentences in other frames.

23. Use three alternative-type multiple choice questions for conditioning problems. These give you the opportunity to quickly clear up misconceptions which you should anticipate by providing two plausible distractors for remediation purposes. You may use four alternatives if you wish, provided that you can come up with three plausible distractors. This usually requires "racking your brain" for that third distractor and may reduce the effectiveness or discrimination of the question.

24. Use learn-by-discovery methods in the higher-performance path where your better students will benefit by this approach. Slower students will take a dim view of what appears to them to be your deliberate obfuscation of the issue.

25. Do not use the learn-by-discovery method where complex concepts are keyed together one upon the other. Instead, use tutorial methods so that the student builds upon knowledge gained frame-by-frame in simple steps, easy-to-difficult. This applies to all students.

26. Tell the student, generally, what he should be looking for, before presenting him with a long winded exercise where he is to "learn-by-discovery". He may lose sight of what he is supposed to discover.

27. Do not ask rhetorical questions in your remediation. Present facts clearly, concisely, straight from the shoulder, and key the facts to the student's misconception as indicated by his response.

28. Don't use keyboard (constructed response) questions with more than one word for the correct answer. As a matter of fact, experience tells us to avoid keyboard questions if at all possible. Considering the state-of-the-art, if you

must use them, accept only short easily spelled words for total recall. With the exception of numerical type questions, constructed responses waste time, not only for the student, but for the writer who struggles to prepare such questions.

29. Do not present a rhetorical question followed by an indefinite pause unless you give the student some clue as to how long he should try to discover your hidden meaning. It wastes the student's time.

30. Do not present a rhetorical question with a difficult or vague solution. It wastes time and confuses the student.

31. Define a new term when you bring it up in the text. Use a picture immediately or a short concise word picture (definition) using simple terms to define the complex term.

32. Do not use faddish humor or words. A lot of the humor you encounter in the public media won't be so funny a year from now. A good rule to follow is to occasionally work humorous situations into the lesson which are closely connected with the lesson subject. This type of humor will always be funny because it's unexpected and timeless.

33. Use four alternative multiple choice questions for prover-type questions. This improves question discrimination and reliability.

34. Use provers that show that the student can perform, if at all possible, rather than merely pick the correct word or phrase.

35. Do not use YES or NO-type conditioning problems as they do not provide sufficient remedial capabilities.

36. Get the student's hands on the equipment as soon as possible in your lesson.

37. Present proof of your statements as you go with hands-on exercises. If not, then do the hands-on as soon as possible thereafter.

38. Use transitional statements rather than jump abruptly from one skill element to the next.

39. Present a picture of the subject of the text to the student as soon as you bring it up. If not a picture, get his hands on the actual subject item which the lesson is about so that tangible proof of your statements is immediately available.

40. Speak to the student as you write just as though he were at your side. You are his private tutor.

41. Use remediation that leads the student to the answer. Use hints or suggest; use every trick in the book to make the student think, but don't deliberately hide the answer. The student wants and needs a straightforward explanation when he responds incorrectly.

42. Use the active voice where the subject of the verb performs the action. Sentences using the active voice are always shorter and stronger.

43. Use personal pronouns I, we, you, etc. When personal pronouns are used, a more direct style is obtained and the reader is led to feel that the subject is intended for him, not for some unnamed person.

44. Do not use vague pronouns far removed from the subject of the sentence. This results in strange, humorous sentences.

45. Punctuate merciliessly as you write. It's a lot easier to remove extraneous punctuation on line, than it is to insert needed punctuation. Sometimes it is necessary to reformat several sentences just to get a needed comma in the display.

46. Do not write long sentences which require a lot of punctuation. No one is impressed when the IP trys to show his writing skill this way. The students are very observant in this department and will quickly relegate you and the lesson to the "stuffed shirt" department.

47. Do not use a long word when a simple one will do. IP's who cloud the issue with polysyllabic profundity and ostentatious gradiosity are usually obsessed with their own importance. (Get the message?)

48. Do not use nonstandard schematic symbols in the lesson except where a training advantage is gained.[11] For example: you may draw a symbol in an unorthodox way to get a point across but you should ultimately define the proper symbol.

49. Be consistent throughout the lesson in the use of terms, abbreviations, symbols, and other unique identifiers.[12, 13, 14] Check with other IP's to be sure that your lesson agrees with their lessons.

50. Identify the abbreviation of a word immediately on its first appearance in the text.

Primary Display Screen Format

As you generate your lesson display format, think logically, and keep in mind all the books you have read. If you do this, you will realize that you are dealing with the printed page, whether it be displayed on a cathode ray tube, plasma panel, or what have you.

To read a text book you like to start at the top, proceed toward the bottom, perhaps go back and reread a sentence, look at an illustration, arrive at the bottom and then turn the page with satisfaction, knowing you're one page closer to the end.

The computer display permits all kinds of sometimes cute, sometimes weird, variations of this basic routine. If not careful, you'll become so infatuated with the neat and unique ways the material is presented that you'll lose sight of the fact that it's hard to read for anyone but you.

Some very good examples of erratic and inconsistent display screen format to be avoided are presented herewith from the standpoint of the reviewer (and the student):

. Words that suddenly appear in a sentence and blink ON and OFF are distracting. Before the sentence can be digested, the reader must wait for the distraction to end. (Blinking for emphasis is OK but don't overdo it.)

. Words or sentences that suddenly disappear or reappear at new locations on the display screen are distracting because the reader is annoyed by the inconsistency of presentation.

. Words or sentences which suddenly appear in previously-read text force the reader to go back and read it all again to see how the overall intent is affected by the new word or phrase.

. Remediation or reinforcement phrases which never seem to appear in the same place twice on the screen are disturbing to the reader. Many times these errant phrases are missed entirely by the student causing him to lose continuity.

. Remedial statements which present another question are ambigious. Remedial statements should provide help in arriving at the correct answer to the original question posed to the student.

. A large amount of text which appears on the screen simultaneously with another action such as a slide or audio causes consternation as to which action should receive primary attention.

. Blocks of text which appear on any extreme of the screen cause the student to wonder whether he may have failed to observe some important information on the balance of the screen if it is left blank.

. Sentences which are rapidly rolled on from the top of the screen toward the bottom cannot possibly be read at the rate of the roll-on. This antagonizes slow readers. In addition, new rolled-on text as it appears below text which the reader has begun to scan, causes the eye to lose its place in the text being read.

. Timed frame displays which advance to the next frame before the reader finishes reading the present frame are distracting for obvious reasons.

And on and on and on since the number of ways to present the text are only limited by the imagination of the writer. No one wants to suppress the individuality of the writer, but you must agree that text which is hard to read because of poor format is not defensible from any standpoint. This will relegate you to the "gobbledygook" writer category by a technicality.

Be consistent, if nothing else. The student viewing the lesson, after reading a few frames into it, will expect the IP to do certain things as he identifies the presentation displays with the IP. Give the student the satisfaction of knowing what you're going to do next by remaining cool and unimpressed by the media and do just what he thought you were going to do. He'll appreciate it because it gives him confidence, boosts his morale, and enables him to learn easily.

Instructions on Primary Display Screen Format

1. Do not crowd the screen with text. Space the material on the screen by presenting several sentences and then skip a line before the next line of text. Intersperse sentences with indefinite pauses to permit the reader to control text presentation. This makes reading easier and gives the student a sense of progress as he passes through the material. It also forces you to use simple sentence structure.

2. Do not key present frames to sentences presented in previous frames. Each complete frame should stand alone. Each frame should be intelligible even though the student forgets what he read in the previous frame. This requires a constant updating and summarizing of actions which are taking place in each new frame you construct.

3. Do not erase previously given information on any given frame when it is related to the overall picture. The student should always be permitted to reread the frame if he desires.

4. Use questions which present a complete problem in the stem.[7] The remediation or reinforcement phrase will then make sense when it is presented beneath the problem stem on the screen.

5. Put your remediation or reinforcement under the complete question stem. If possible leave the entire question on the screen including distractors. Separate your remediation or reinforcement phrase from the question by a blank row or two, or by a row of unique symbols which form a border. At least be consistent in where you put the remediation or reinforcement phrases.

6. Organize your distractors in ascending or descending order, line them up neatly, and place a zero in front of all decimal points (values less than 1).

7. Allow the student to back-up and read previously-read frames and visuals where particularly difficult concepts are encountered. This is contingent on whether or not the training system is capable of this branching feature.

8. Do not use hyphenation of words at the end of a row of text. Bring the entire word down to the next row.

9. Indent one space for new paragraphs.

10. Put one space after a comma and period.

11. Consider the balance of your screen display. Balance contributes to easier reading.

12. Do not have the student read anything from the bottom to the top of the display. Always sequence textual material and visuals so that the normal way of reading is followed.

13. Do not have words or phrases suddenly appear in text which the student has already read. This means he has to go back and read it all again to see how the added information affects the meaning of the text. This wastes the student's time.

Preparation of Graphics

"A picture is worth a thousand words" but a bad picture is worth a thousand lashes (to complete the quote).

Nothing contributes more toward spawning wordy, hard-to-understand textual displays than busy (too much detail) or ill-conceived visuals. Experience tells us that busy graphics or slides are glossed over quickly but simple visuals are regarded with suspicion and are studied with great diligence - possibly because the student thinks "nothing could be as simple as this", or "there must be more to this than meets the "eye", or if for no other reason, to look for flaws (which are easier to find on simple slides than you might think).

The inescapable fact is, that simple visuals do teach, whether by some perverse fluke of human nature or simply because all the veneer of artificality is removed when one looks at a good, clear picture of an idea. It is far better to take each step in the concept you're developing and make a picture of the step, rather than try to cram all the steps into one picture. You'll save literally thousands of words ($) this way. Even though artwork and photography do require considerable expenditures of time and money in preparation, you'll win the time and money race in the long run when you support your lesson with copious, easily digestible visuals - mainly, because the lesson will teach thousands of students quickly, efficiently, consistently, and painlessly. A lesson without a sufficient number of good illustrations to support it will groan and screech along like an overloaded (with words) oxcart, eventually arriving at its destination, but with much sound, fury, and wasted energy.

Instructions on Preparation of Graphics

1. Try to appeal to the student's interests. Visuals which hold interest are those which relate to sports, automobiles, hobbies, or most any recreational activity.

2. Use animated visuals if you have a difficult concept to show. A rough form of animation can be accomplished by calling slides at one second intervals (if the computer permits this). You must be sure that any slides used this way are kept in registration, otherwise they will jump around on the screen.

3. Keep the visuals as simple as possible. The student will not take the time to study a complex picture. A busy visual should be broken into individual pictures of the concepts involved.

4. Do not make reference to commercial products. You may infringe on copyright laws and other legal problems.

5. Try to use simple line drawings as much as possible. It keeps the production time and cost down. This type of drawing is easiest to modify, especially if your CTS permits storing it in the computer memory.

6. Label your visuals with a general heading of what they purport to show. Each visual should stand alone so that the student learns from it even though he doesn't understand the text.

7. Use colorful call-outs (part identifiers) to draw attention to important points.

8. Do not use pastel colors on a positive (clear or white background) slide because they wash out. Use bright red, green, or blue. Dark colors like brown, or black are good for lines in line drawings on positives. Yellow and orange are poor.

9. Use pastel or bright red, green, yellow, or orange, on a reversal (black background) slide. These colors provide good contrast.

10. Use color where it contributes something to the lesson such as important points or areas on the screen, call-outs, arrows, color photographs, cartoons, etc.

11. Do not try to use color unrealistically such as labeling all current green or all volts red. There will always be exceptions where the color you used can no longer be used validly or consistently.

12. Be careful about letters and numerals that look alike to the artist when you generate a rough sketch for a visual. Good examples of this are: the letter L and the numeral 1, the letter O and the numeral zero, the capital letter Z and the numeral 2, the capital letter I and the numeral 1, the letter S and the numeral 5.

13. In a flow chart or schematic diagram, show inputs on the left and outputs on the right for logical flow.

14. Don't use double subscripts, i.e.: E_{R_1}. They usually won't fit in the display row format.

15. Show superscripted and subscripted characters as such on visuals but be sure to call the artist's attention to the fact.

16. Use well proportioned bathing-beauty types in cartoons occasionally to pep up an otherwise dull presentation. For example, look at any copy of the Army's monthly preventive maintenance magazine, PS.

17. Do not use drawings which may appear to exploit the female anatomy. Some students may be offended.

18. Use humor, but be sure it is tied into the subject material so that it does not appear to be contrived.

19. Do not use ethnic or religious humor.

20. Do not generate a word picture of a graphic for photography unless you spell out <u>all</u> of the details, i. e.:

a. settings of switches

b. placement of leads

c. peculiar arrangement of equipment

d. exactly what, where, and how the picture will be taken.

It's a lot easier to generate this information at your desk than it is under the photographer's lights when you have forgotten what it was that you wanted to show. It's really better to draw the exact setup and notate it exactly as you want it rather than to generate wordy instructions to others.

21. Use standard symbols and notations on your visuals.

22. Use block printing for titles and call-outs.

23. Be sure that all electronic schematics use a consistent method for junction points, test points, ground connections, and wire crossings.[12]

24. Do not use nonstandard abbreviations.[11, 13, 14] Actually initially avoid abbreviations if you can on visual matter. Use abbreviations once the student is familiar with them.

25. Do not write notes to the artist (regarding your drawing) on a separate sheet of paper and attach this paper to your drawing with a paper clip or staple. The rule is, that these notes will immediately become separated from the drawing and will never be seen again. Instead, try to write all notes associated with a particular drawing directly on the drawing or on the reverse side. If more space is needed, the drawing should be discarded as it is probably too complicated anyway.

26. Make your sketches actual screen size.[4] This helps you to visualize the drawing's balance, proportion, and perspective as it will appear in its final form. It also provides the illustrator with an exact picture of what you want including the size of the call-outs. Thus, you are spared the tedious and time consuming process of generating copious notes ("word pictures") to the illustrator which always lose something in translation.

27. Do put pencil sketches of graphics in a separate notebook. Keep them with the lesson document. Sequentially number the pages so they can be identified in the text. One (1) copy of each original pencil sketch should be made for the illustrator to convert to pen-and-ink sketches for your approval.

28. Do not use abbreviations or symbols unless you are really sure that the student has become familiar with the subject. Visuals are supposed to be simple and straightforward.

29. Specify that line thickness be 1/16-inch and that lettering on a slide be at least 3/16-inch high on that type of drawing which conveys important data (charts, graphs, line drawings of circuits, etc.). This type of slide should be the reversal

type (white on black) so as not to overwhelm the viewer with excessive light which tends to wash out needed information. These rules insure that all important data is resolved on the screen.

30. Do not carry the 1/16-inch line thickness to extremes. Use 1/32-inch line thickness on drawings where lines are used for shading, outlining equipment, outlining cartoon characters, showing facial details, etc. This type of drawing will still convey the intended picture even though the projector optical system does not resolve each and every line in the picture. It is, however, a good idea to maintain the 3/16-inch height for lettering, if possible, on either positive- or reversal-type slides. Naturally, lettering thickness should be commensurate with letter height.

31. Specify that a positive type of slide should be used where the line drawing depicts cartoon characters, equipment, or scenes which require a great deal of color detail. It is difficult to render detailed colored scenes on a reversal because of the necessity of stripping colored acetate for each color required onto the rear of the transparency.

Audio Preparation and Presentation

Audio with Computerized Training System lessons is a little like love:

Not enough and you really miss it, too much, and you wish you had never heard of it. It's hard to say just when either extreme is reached in CTS because of the subjective reactions that occur when audio is used. However, it's fairly well known that poor readers tend to prefer more audio to help them along.[15] Good readers, on the other hand, become rather disenchanted with the whole aural show, mainly because it holds them up. A reasonably good piece of advice at this stage of the CTS game is to direct audio selectively toward the listener. An easy way out is: do not present any of the low performer's really simple (of necessity) audio messages for the high performer to suffer through. This is easily done by the program because the computer keeps track of who is doing well and who is not. A rather general audio explanation of a slide for example, can be directed to all groups. There's no law that says you cannot present specific audio messages which will be directed only to the high- or average-performers. Of course, this means more writing but you must try to appeal to all types of listeners. Just keep in mind that the better student may not want to hear the audio - so it better be good, and relevant.

Instructions on Audio Preparation and Presentation

1. Do not present the same visual message (text) on the display screen as that which is presented in the narrative. A short phrase is OK on the display screen but it's difficult to read long passages and listen at the same time.

2. Provide audio repeat capability if the system permits it. It's only logical that some audio messages will be confusing, or a distraction may make a student miss a word or phrase.

3. Use audio where it will save time for any student. For example: a student reading a schematic, text, and parts-location diagram while placing test prods in the physical equipment to make a measurement will probably welcome a brief audio message telling him how to select the proper place to put the test prods. This type of message may be simultaneously presented with visual stimuli on the display screen so that a record of steps in the procedure is on the screen for reference. HELP-type audio falls neatly into this category, that is, the audio is optional, the student requests it if he needs it.

4. Use selective branching to differentiate between high- or low-performers when presenting audio messages.

Low-aptitude students prefer to hear a simple aural presentation with visual stimuli. High performers prefer to read about their visual stimuli. They have little patience with aural presentations which contain trivial, redundant, or trite information. Their ability to read and comprehend more rapidly makes them expecially sensitive to anything which slows their pace. Long or oversimplified audio messages tend to waste the high performer's time and reduce his motivation to continue at his normally rapid pace.

5. Cue audio with an action if at all possible. This relates to the difference between listening to a lecture and watching a demonstration. Audio should be used in support of some action since audio alone is rather dull. (Studies have shown that students remember only about 10 percent of what they hear in a lecture.)

6. Prepare the student for what is coming so that he will know what to look for as the audio message proceeds. For example: "Pay particular attention to the transformer on the slide and you will see an expanding magnetic field about the primary of the transformer".

7. Use audio over slides. This saves time for every one who takes your lesson, it's called "paired stimuli" and definitely has merit because it appeals to several senses at once.[15] Beware of oversimplifying for the high-aptitude student as he may prefer to read about the slide on the primary display screen rather than listen to a long, oversimplified discourse.

8. Use audio to pronounce new, unfamiliar terms for the low performer. Remember, he does not read well which is probably why he is a low performer.

9. Use audio for "positive reinforcement". Not every time, but, perhaps, after a particularly arduous task has been completed perfectly. Audio may be used to quickly summarize the events which have transpired and to give recognition to the student for having arrived at the desired conclusion. Caution should be exercised here as most students do not wish to be held up by long congratulatory statements. Students do not like repetitive gush each time some trivial act is performed correctly. A simple "OK", "GOOD", "FINE", or "RIGHT" on the primary display screen will usually suffice for most correct responses.

10. Use audio to remediate when the student responds incorrectly. Most students recognize many more words in an oral context than in a written one where unfamiliar words and terms are encountered.

11. Audio used remedially provides "negative reinforcement" which is just as effective as "positive reinforcement" mentioned previously. However, do not get carried away and use audio for all remediation. Simply use it where it will provide <u>effective</u> remediation.

12. Do not use a rapid rate of delivery for low performers. They <u>want</u> to be told how to do the task slowly, deliberately, enthusiastically, and with empathy. Their curiosity and desire to understand will be stifled by passages which are too concise and quickly done. In plain English, talk to them on their level, not above or below.

13. Use a more rapid rate of delivery, concise statements, enthusiasm and again, empathy, when speaking to the high performer. He wants to know that you realize he is a better student and will reward you by steaming through the lesson in short order with excellent results.

14. Do not use long audio messages in any case, unless you are supporting a motion picture or rough form of animation where action takes place continuously. About 10 seconds for each message over a slide is a good rule-of-thumb which forces analyzation of each audio sentence for stark, crystal-clear purity of meaning and simplicity. This is not to imply that you couldn't have several 10-second messages over a particular slide. This should be done, however, using student pacing of the audio by his pressing the "NEXT" (or whatever) button as he digests each message and is satisfied with its connection with the information on the slide.

15. Do not bring up a detailed slide or graphic and immediately launch into a complex discussion of the finer points. Consider that the student needs time to focus his eyes on the slide and time to digest the overall picture. Any immediate audio comments when the slide or graphic first appears should be very, very general, either with pauses, or controlled by the student. Once the generalities have been explained, get on with the specifics using as many short audio messages as you like.

16. Use different voices for audio presentations. Different accents, tonal qualities, and especially male-female voice differences lend a definite flavor of interest as well as an aura of credence to the narrative. This will imply that a lot of people were involved with the lesson development and they are all in agreement as to what the student is to learn. Consider using unusual voices or exaggerated voice defects to support a comic cast of humorous aural characters which occasionally intrude into the lesson to break the monotony. These same voices may be used to complement cartoon characters in the visuals.

17. Use audio support immediately on presentation of simple, easy-to-understand photographs, line drawings, or any picture with immediate visual impact. In these cases the audio will enhance the viewer's understanding of the visual rather than detract from it. As a matter of fact, it's always a good idea to keep visuals simple so that the you <u>can</u> support them with audio immediately for impact.

18. Key the same remedial audio statements into the lesson as many times as possible if there is a random-access-audio capability. It saves writing time and satisfies the argument that redundancy is desirable when the student responds incorrectly. In other words, you may have quite a few questions in your lesson where a wrong response should elicit the same remedial phrase. Call the phrase and play it for the student each time he answers incorrectly. Sooner or later he'll get the message. You might think that this would irritate the high-aptitude student but remember, he won't hear it because he usually answers correctly which results in his <u>not</u> hearing the aural remediation.

19. Keep the number of audio messages low at any moment. Audio impact is lost where a great deal of verbal garbage is spewed forth without any connection to the action. A good rule to remember is: any time you say something orally, have something happen visually, or have the student <u>do</u> something.

20. Use sound effects where they contribute something to the lesson. Using still visuals does complicate the problem. However, the following are some examples of sound effects which do not require precise synchronization to an action:

a. power supply 60- and 120- Hz hum

b. the effect of hum in a radio receiver

c. an electrical arc in a defective component

d. a capacitor arcing when discharged with a wire

e. the sound of distortion in an amplifier

f. the sound of an audio oscillator running at various frequencies

g. heterodyne or zero beat, and so on

21. Don't permit annoying distractions to creep into your audio recordings. Watch out for changes in audio level, clicks, pops, background noises, and mispronounced words.

22. Do not use redundancy or repetition to the point where words begin to sound or appear strange.

23. Use audio at any point in the lesson where it accomplishes at least one of the following:

a. saves time for the student

b. accents a key concept

c. recaptures the student's attention

d. assists in retention

e. teaches word pronunciation

Completing the Lesson

After the lesson is completed, change your frame of mind from that of a writer to that of student and critic. It's difficult, however, to be a strict taskmaster with yourself when your mind is cluttered with thoughts of the long, tedious, complicated, attention-to-detail job just finished.

Basically at this point in time, you're prejudiced, and will tend to take a narrow-eyed view of any criticism of your scholarly contribution to the educational process.

Give it a little time to jell. You'll begin to have some second thoughts and doubts as to whether it really is the gem of perfection that it first appeared to be. Some IP's put their lesson away for awhile and do something else to help detach themselves from the rigorous mental gymnastics that lesson writing and coding requires. Invariably, a little time will have a beneficial affect upon your ego.

When you start through the lesson, after some time has passed, you may not even recognize some of the passages as your own (you may ask yourself "Did I write this"?). If you are really critical and honest with yourself, you'll find hundreds of mistakes, not only in the text and illustrations but in the minimal amount of coding you used for execution of the lesson. Make at least two passes through the lesson. The first pass should be devoted to reading the lesson text with the illustrations to see if they support each other (audio scripts also) and really teach. Of course, look superficially at your coding as you go along to fit things together

properly. After the lesson text has been reviewed, a second pass should entail completion of, and a critical look at, coding. Minimize the text whenever possible, and check the programming aspects so that all logical paths and scoring routines will execute as they have been written. A little time spent here will save a lot of debugging time at the computer terminal (which is expensive and can otherwise be used for teaching). Some systems permit on-line (at the terminal) entry or authoring of lesson material. The main advantage of on-line entry or authoring is that the IP may immediately look at the lesson as the student will see it. The IP may also save some time in lesson preparation which is traded off in terminal time and cost to some extent. However, the same basic rules for lesson preparation and editing given throughout this document generally apply to either on- or off-line entry of lesson material.

Instructions on Completing the Lesson

1. Do not turn the lesson in for review until you have gone through it with your brain in "student gear". You should deliberately look for problems as you do this. Remember Murphy's Law: "If anything can go wrong, it will, usually during the demonstration". This law takes precedence over all other laws!

2. Separate the lesson skill elements and other subdivisions with stiff labeled manila sheets, assign page numbers, identify the high-performer's path and otherwise try to make the job of review easier. Your lesson is easy for you to follow since you wrote and massaged every sentence but it is not easy for someone else to read.

3. Print clearly and use a lead which produces a good contrast when you make corrections. Erase completely and remove all conflicting notes in the margin before you submit for review or typing at the system terminals.

4. Be correct in your spelling before going to the reviewer. Misspelled words usually require a complete change of a line of text and sometimes involve several lines of text once the material is on line.

5. Give the keyboard-entry specialist (if you use this method of lesson entry) good general guidance by using clearly defined notations in the margins of your display guides. Also, give general comments on a piece of paper in the front of your book about your lesson. Each new lesson usually has some unusual characters or techniques which are unfamiliar to the keyboard-entry specialist.

6. Do not let the entry specialist enter your entire lesson before you check at least the first skill element. Otherwise the same errors will be multiplied and repeated throughout the lesson.

7. Do not forget to sequentially identify each page for the reviewer. This number or label can be used to identify pages which require correction. Here lies a good argument against coding (except superficially) before review. Coding is invariably an exercise where everything hinges upon the lesson being as pure as the driven snow (a rather egotistical presumption). Individuals who complete their coding as they write tend to be inflexible (to say the least) when problems are found in their lessons. They simply don't relish the idea of changing all that tedious, complicated coding and will defend their lesson (even though they know it's wrong) to the last gasp. Therefore, beware, to completely code as you write is the same as saying "I defy you to find anything wrong with my lesson". You're asking for it, and you'll get it. Most people will go out of their way to let you have it so good luck, my friend, if you choose to go that way.

8. Worry more about your lesson content than hardware or programming aspects. A good lesson can always be made to work by someone. This applies to lessons authored on line (at the terminal or off line on paper). Both types of lessons should contain a minimum amount of coding (only enough to permit execution in the mind or page turning at the terminal) and no more. Typical examples of coding which are better left out before review might consist of:

a. scoring subroutines or macros

b. model-oriented teaching strategy subroutines or macros

c. frame labels. (Use simple page numbers. Labels are structured and unique, changing a few as you review your text usually requires changing them all to conform to the system.)

d. electronically generated (costly, storage robbing) visuals which contain a great deal of detail. (Simple line drawings are OK.)

9. Do use peer review before submitting your lesson for final review. Your peer review will usually be tougher (on your ego) than your final review but you'll benefit immensely if you will accept your peers' criticism graciously and objectively.

Conclusions

The uppermost pinnacle on the mountain of thought in this document is that first, and foremost, positively and absolutely, and beyond a shadow of a doubt, without good lesson material to chew on, the computer will fall on its face.

Let's not kid ourselves into thinking that cute programming tricks and the novelty of the medium will substitute for good lesson material. Concentrate strictly on presenting thoughtful, articulate, interesting, and factual lessons.

As an IP you will be pleased and often rewarded by the experience of imparting your knowledge to others in a most satisfying and efficient manner, while using the most logical and powerful training innovation ever to be placed in the hands of a teacher.

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