DON'T BOTHER ME WITH INSTRUCTIONAL DESIGN:

I'M BUSY PROGRAMMING!

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INTRODUCTION

A recent comment by Larry Lipsitz, the editor of Educational Technology Magazine, caused me to remove my PASCAL disk from my disk drive, temporarily put aside my attempts at programming educational software, and boot my word processor and write a few comments about educational program design. "We publish very few instructional design papers anymore;" he said, "I think instructional design is dead!"

"Dead!" I exclaimed. "How can instructional design be dead? Hundreds of people, most of whom have never even heard of instructional design, are at this very moment sitting in front of their personal computers entering computer code to create educational software. Many of these programs have been, are being, or will be reproduced and sold to unsuspecting parents, teachers, and students. If these self-styled cottage-industry educational technologists are not engaged in instructional design, what are they doing?"

Rather than being dead, instructional design is undergoing a new birth. The academic approach of formal education is being challenged by creative ideas that are radically different from the past. The explosion of new software promises greater achievement than has ever before been possible.

However, for every effective innovative program that appears, there also appear many programs that are innovative only because they are on the computer. These products frequently lack even the fundamentals of effective educational design. In this paper I will explore a few basic

techniques of instructional design which are too often ignored by the developers of many of these new educational products.

The earliest educational programs were merely drill and practice and were little more than workbooks put on the computer. In fact some publishers did exactly that -- they put their already published workbooks on the computer. The result is a very dull program that may provide some skill development if the student already knows the material and if sufficient external reward or punishment can be arranged to keep the student at what otherwise is a very boring activity. Unfortunately, many people still equate computer based education with such boring drill and practice programs. Advocates often cite the patience of the computer as a virtue of such programs. Little is said about the patience of the student.

Figure 1 illustrates a short sequence of a drill and practice program on fractions from a major publisher. There is no instruction prior to what is illustrated. After signing on, the student is presented frame A. The ? symbol is flashing. The student responds by typing in the missing number. If the student is incorrect frame B appears. The incorrect response flashes. After two incorrect tries the student is given the correct answer and presented the next problem. If the student is correct frame C appears. The cute graphic apple with the worm is in color and the worm crawls out of the apple. Pressing the return key gets the next problem. There are only three correct reward graphics. Frame D shows a dragon which breathes fire when the student is correct. The effectiveness of such reinforcers is quickly dissipated and the student

is left with the boring task of doing one problem after another with nothing but right and wrong feedback. If the student does not know how to do the problem there is no remedial help, except to call the teacher. Ironically, this program is very expensive!

Too many educational product designers assume that their only responsibility is to provide opportunities for practice. In my opinion educational software should do more than merely present a workbook to the student. With the capacity provided by a personal computer, courseware should provide not only opportunity for practice but information about how to perform the task as well. Adequate educational software should teach.

In this paper I shall review three classes of instructional design techniques that are necessary if educational courseware is to teach. These techniques can be grouped into: instructional strategy, screen design, and human factors. With the exception of one additional example drawn from another program on fractions, each of the techniques discussed will be illustrated by two versions of a program on poetic meter. The NOT-SO-GOOD version appears in Figures 2 and 3, and is really a straw man program created especially to illustrate what not to do. Perhaps it resembles programs you have used. The second version (Figures 5 through 11) is a commercial product which I designed.[1] In this product I have attempted to use most of the design techniques disscussed. The displays included represent only a few of the displays in the program.

1. Introduction to Poetry: Poetic Meter. Two disk program for Apple II or IIe. Includes a teacher editor. Developed by MicroTeacher, Inc. Distributed by Edu-Ware Services, 28035 Dorothy Drive, Agoura, CA 91301

INSTRUCTIONAL STRATEGIES

This section identifies design strategies which are believed to have a direct impact on the amount of learning that occurs as a result of instruction. Instructional design strategy involves the arrangement of content elements and other information in such a way that learning is facilitated. In this section I have attempted to identify a few strategies which have been shown to enhance or inhibit learning.

Page Turning

In the early days of educational television lectures were often put on the TV screen. The result was deadly. Today we have textbooks put on the monitor. Also deadly! If the monitor merely substitutes for a page of text there is little reason to put the material on the computer. Too many educational computer programs present a paragraph of text and then asked the student to press the space-bar or return key to continue. Continuing means to turn the page and see the next paragraph of text.

Many authors and instructors are accustomed to one-way linear presentations such as lectures and textbooks. In such presentations student interaction is seen as an interruption, not an essential part of the presentation. As a consequence few designers conceptualize instruction as a conversation or, if they do, the input from the student seems to be of secondary importance serving only to indicate readiness to continue.

Look at Figure 2. This represents the first few displays of the NOT-SO-GOOD Poetic Meter program. Frames A, B, and C are consecutive;

several displays are skipped between frames C and D. This is an example of the text-on-the-screen characteristic of too many educational software packages. A paragraph is presented and then the computer waits until the student presses the return key which results in another paragraph being presented. The material takes no advantage of the dynamic nature of the screen. As can be seen from the illustrations one paragraph scrolls up to make room for the next at the bottom of the screen.

To be effective, educational software must be more than text on the monitor. There is no advantage to having students read text from a monitor which they can more easily read from the printed page. In short, **avoid merely putting text on the screen; avoid mere page turning.**

Generality-rich, Example-poor

Since instructors usually understand what they are presenting, there is a tendency to present one idea after another with little illustration. Illustrations and examples often seem to slow down the presentation. Textbooks often contain few illustrations because of the need to cover the subject matter in limited space. Adding unnecessary illustrative material "pads" the book and makes it unnecessarily lengthy and expensive. As a consequence of this disposition much of the CAI which has been prepared models lectures and textbooks rather than conversations. Ideas are presented one after another with little illustration and little opportunity for student interaction. As a consequence students do not have a chance to digest one idea before the next one comes.

Look at Figure 2. Note that one idea tumbles after another each time the return key is pressed. In frame A the purpose of the lesson is stated but not illustrated. In frame B important prerequisite

information is reviewed but not illustrated. In frame C three different ideas, stressed syllables, rhythm, and poetic feet are each presented one after another without illustration.

Instruction is more effective if each major idea is represented by a general statement of the idea (generality), followed first by examples and then by the opportunity for the student to demonstrate that the idea is understood (practice). In short, **avoid generality-rich but example-poor presentations. Each idea should be presented by a generality, examples, and practice.**

Remember Only

Perhaps the biggest problem in all education is the tendency to tell the student something and then ask him or her to repeat what was said rather than applying the idea to a new situation. It is easy to ask a student to repeat what has been learned but much more difficult to figure out how the student should apply the information. Application means that we must find specific cases which can be represented in our instructional materials and then we must figure out what the student does when he or she applies the information that has been presented. Furthermore, all of us have had many examples of remember only testing but many fewer examples of application testing. In formal educational settings we are accustomed to recall but not to application.

In Figure 3, frames B and C, we see examples of remember questions. In these displays the student is asked to remember the definitions of each kind of meter. If the student is right the next question is presented; if wrong a message instructs the student to try again. The try again message is repeated until the student stumbles onto the correct answer. Too often this is the only kind of practice that is provided for

the student. However, in the NOT-SO-GOOD Poetic Meter program the student is also asked to apply the definitions by identifying the type of meter involved in a series of words (See Figure 3, frame D). A running total indicates how many the student correctly classified.

Too often educational products neglect having the student apply what has been learned. Or if there is application it does not allow the student to demonstrate what has been learned or the designer to determine if the student has learned what was taught. Instruction is more effective if the student is required to apply ideas to new situations rather than merely repeating the statement of the idea. In short, **avoid remember only practice.**

Attention Focusing

Not all communication is designed to be instructional. One of the things that characterizes instructional communication is the addition of information that is not part of the subject matter but which is included to help the student understand the subject matter content. Text books use headings, bold face lettering, italics, arrows, exploded drawings, and many other devices to facilitate the student's understanding of the content presented. This attention focusing information serves two primary functions: first, it attempts to relate the illustrations to the generalities being taught, and second, it points out the critical characteristics of the example being presented.

Computer displays have a wide variety of characteristics which can be used for this attention focusing function. All of the characteristics of text presentation are also present on computer displays. For example, words can be underlined, appear in bold face, italic, or other type styles. The display can include color which can be used to tie ideas

together or emphasize important portions of the display. However, many dynamic characteristics of the computer display are not available in print. These include: timing, where text is put up a little at a time for emphasis, animation, where text or figures are moved about to show relationships, flashing or inverse text, which can direct attention to a given portion of the screen, and sound, which can attract attention or show patterns in the presentation.

Too often these characteristics are used for entertainment and have no instructional function. Putting text up letter by letter, word by word, or moving across the screen like a sign may be clever but often only serves to make the text harder to read. Having the computer beep when text is entered or displayed often does little more than disturb others in the room. Colorful displays that show rainbow patterns of text or figures too often are only aesthetic and distract from the purpose of the instruction. If these devices are used they should serve an instructional purpose. If they do not they may prove to be more of a distraction than a facilitation.

Look at Figure 1 --fractions -- again. The animated figures used for reinforcement are entertaining the first time they appear but they have no instructional value over that of saying, "You are right." They do not show the relationship between an example and a generality nor do they focus the student's attention on relevant aspects of the examples.

Look at Figure 4. This is a short sequence from another commercial program on fractions.[2] In frame A an animated figure pulls the shading from the first box across the screen to the second box (frames B and C). After moving the shading the figure walks to the bottom of the screen

2. Edu-Ware Fractions. Agoura, CA: Edu-Ware Services, Inc., 1982.

(frame D) to point to the symbolic equivalent of what has been done. This enables the student to visually and dynamically see that 1/2 is equal to 2/4. In this sequence of frames the animation directs the student's attention to relevant characteristics of the display and helps the student understand the relationships involved. The animation is not only relevant but probably shows relationships that would be difficult to explain with words or symbols alone.

Look at Figure 7, frame A. The directions at the top of the display indicate that the student should "Listen to this passage." The syllables of the poem are then displayed one by one. Each syllable is accompanied by a tone. Stressed syllables are accompanied by a high tone and unstressed syllables are accompanied by a low tone. In this way the student can hear the stress pattern in the passage while seeing the passage displayed. Again the sound is used in an instructionally relevant way to direct the student's attention to the critical characteristics of stress.

The computer provides a considerable arsenal of display possibilities. If these devices are used to focus the student's attention on critical aspects of the subject matter being presented then they can substantially facilitate the learning which occurs. If, however, they are used indiscriminately merely to be clever with no clear instructional intent, they may distract from, rather than enhance, the learning which may occur. In short, **use attention focusing devices to relate examples to generalities and to point out critical characteristics of the illustrative material.**

Active Mental Processing

In an attempt to promote interactive instruction as opposed to

linear presentations the early advocates of programmed instruction recommended that students be required to respond overtly to the material being presented. Attempts to demonstrate the effectiveness of overt responding were often disappointing because they failed to show a distinct advantage for programs which required overt responses versus those which did not. More recent research has shown that it is not just overt responding that is important but the degree to which the student is required to mentally process the information being presented. Effective instructional conversations must engage the student in a way that requires thinking about the important aspects of what is being presented rather than passively observing information on the screen.

One of the techniques which promotes active mental processing is the use of rhetorical questions. A rhetorical question is one which is used to emphasize a point or introduce a topic and for which no answer is really expected. The advantage of using rhetorical questions rather than statements is that the student is more likely to engage his or her mental processes in formulating an answer rather than passively processing a statement. When this answer is confirmed by the presentation the point is more likely to be remembered.

Compare Figure 2, frame B, with Figure 6, frame A. The NOT-SO-GOOD program makes a simple declarative statement about the role of rhythm in distinguishing prose from poetry. The program in Figure 6 makes this same point but does it with a series of rhetorical questions ending with one which requires the student to actively engage in the conversation. The program does not wait for an answer to the first two questions: "What makes a poem a poem?" "Why is a poem different from prose?"

The purpose of these questions is to cause the students to think about what they already know, thereby activating their mental processes so that when the point is made that one of the primary differences is the rhythm pattern they are anticipating this information and more likely to remember the point.

A related technique for promoting active mental processing is to engage the student in a conversation about the topic. Many educational programs use multiple choice questions as a way of interacting with the student. From a programming standpoint such questions are much easier to evaluate. However, in a conversation we are not interested in evaluating the student's answer. The questions we ask or the response we prompt are another form of rhetorical question. We request an answer but the purpose is not to see if the student knows what we have said or is able to give the correct answer; rather, the purpose is to cause the student to think. If the comment made by the student is something we anticipated, we want to acknowledge that the student's thinking is consistent with our intent. If, on the other hand, the student provides a statement that we have not anticipated we carry on much like we do in live conversations when we do not understand; that is, we merely restate our point in the hope that the student will then see where we were going. We do not say, "That is wrong!" or "I do not agree." We merely continue with the conversation.

Again compare Figure 2, frame B, with Figure 6, frames A through D. In Figure 6 frame A we anticipate that the student will make a response to the third request and the program provides a cursor to indicate to the student that we anticipate such a response. The program is written such that the student can type anything as a response. If the student is

following our conversation, and is serious about interacting with the program, it is very probable that the response will be rhyme, since that is the most widely known characteristic of poetry. The program anticipates this response, including a dozen different ways to spell the word (rime, rhime, etc.). In response to this input from the student the program displays the information in frame B by acknowledging the student's input and suggesting that there is yet another characteristic which we are thinking about. If the student anticipates our intent and responds with meter, beat, or rhythm (including likely misspellings) the program responds with frame C. If the student responds with meter or rhythm to the first question the program displays frame C instead of frame B. Finally, the program displays frame D which now makes the point in a declarative statement. If the response to either the question on frame A or frame B is unanticipated the program responds with frame D. The result of this conversational programming is that the student has the feeling that the computer is really carrying on a conversation rather than merely presenting information. Furthermore, the student is being required to think about the idea being presented.

Other examples of this conversational approach can be seen in Figure 7, frame A. In this frame, after presenting an example of poetry and an example of prose, the student is asked to observe the difference. Our conversation anticipates that the student will observe the regular pattern of stress or meter. The program anticipates a wide range of key words expressing this idea. If the student uses any of these key words

in his or her response the program acknowledges with a simple, "Yes, passage 1 has regular or steady rhythm." If the student does not anticipate a key word then the "yes" is dropped from our reply but the rest of the statement is presented. The program then asks the student about passage 2. The conversation continues in this same way.

Figure 7, frame B provides yet another example of conversational programming. The program asks the student, "What is a stressed syllable?" Many students reply, "One which is stressed." This response does not go beyond the question so the program asks, "Can you think of another word?" If the student anticipates loud, emphasized, higher, or synonyms of these words the program acknowledges with, "GOOD!" and the statement indicated on frame B. It should be noted that all of the displays are dynamic and the pieces shown come up one at a time so the second part of this display showing the passage of poetry actually appears after the student has been asked to read the passage aloud. Then the passage is chanted with sound enhancement to allow the student to compare his or her reading of the passage with the program's version of stressing the syllables.

Educational software should be conceptualized as a conversation rather than a lecture or a book. The interaction with the student is far more than merely asking the student if he or she is ready to continue. The interaction should not be limited to asking the students questions for the purpose of seeing if they know the "right" answer. Rather, the purpose should be to stimulate thought and actively engage the student in

an interchange which will lead the student to understand what we are trying to teach. In short, **promote active mental processing by asking rhetorical questions and engaging the student in a conversation which requires constructed (as opposed to multiple choice) responses to which we do not provide right-wrong feedback but rather an anticipation of a reasonable reaction much like that which would be expected from a live conversation.**

Examples

All of us know the cliche that there is nothing that teaches like a good example. For some reason this cliche has not found its way into the rules for effective educational software. The most common approach for tutorial programs is to immediately begin to ask the student questions, not of the rhetorical type discussed above, but questions testing the content being taught. If the student is uncertain about the content this approach often causes anxiety because the student does not know how to answer the question, and being required to respond with the "right" answer when a student knows that he or she does not know causes frustration. Most educational software would be improved if the ideas were illustrated for the students by means of expository examples which show the application of the ideas being presented. Then, after the student has had an opportunity to study these worked examples, practice in applying the ideas is less threatening and more likely to be productive in promoting acquisition of the neccessary skills.

The NOT-SO-GOOD poetry program moves immediately from a page turning presentation of ideas to a series of questions asking the student to

remember these ideas and then to a series of questions asking the student to apply these definitions to new words without seeing any examples prior to this practice exercise. This is typical of many educational software packages. In the improved version of poetry Figure 8, frame A shows one form of example presentation. The student has the opportunity to examine as many words of each type of meter as he or she feels are necessary to understand each of the meter types. Pressing the space-bar moves the pointer from one box to another. Pressing the return key causes the example word or phrase to appear in the box together with sound enhancement showing the stress pattern.

Figure 9, frame A shows a similar display for practice. After the student has seen as many examples as he or she feels are necessary, the practice display can be requested by pressing the escape key. In this practice display words are presented one by one. The student uses the space-bar to point to the correct meter type. This is a form of multiple choice question. Note that in practice the intent is to determine if the student has mastered the concepts being taught. This display differs significantly from the conversational displays that were used to teach the ideas in the first place. If the student answers incorrectly the display indicates that the student is wrong, points to the correct answer, and chants the word or phrase.

A similar set of example and practice displays are used for whole verses. The student is shown a passage of poetry. The dynamic display then shows the student how to divide each word into syllables, points out which syllables are stressed, where the poetic feet are divided, how the

poem is chanted and, finally, the type of meter involved. After examining as many of these expository examples as the student feels are needed to understand each type of meter, a series of practice verses are presented. After the student has classified each verse the option is given to do a detailed analysis of the verse.

Too often educational software moves immediately from the presentation to the practice without presenting illustrative examples of the ideas being taught. Students are able to learn more efficiently when they have the opportunity to study examples of the ideas prior to being asked to apply the ideas to new examples. In short, **provide expository examples as well as practice.**

SCREEN DISPLAY

This section identifies screen display techniques which are believed to facilitate the student's ability to interact with the materials. Screen display refers to the way that information is exhibited on the monitor. In this section I have attempted to identify a few display characteristics which may enhance or inhibit learning.

Scrolling

One of the advances in computer technology was the ability of a computer display to scroll material automatically as the text being entered reached the bottom of the screen. For many applications such as programming or word processing this automatic scroll is a real advantage because it eases the user's task in entering material into the computer. However, what is an advantage for some applications is a disadvantage for others. When a student is trying to read a display it is very

distracting if the text jumps up to the next line or, worse, jumps up several lines. The student loses his or her place and must then reread the material to find where he or she was. This interruption causes a distraction which often interferes with learning.

Students often use the location on the page as a cue to what was read. When reviewing material we often remember where it was on the page and use this spatial information to help us remember the content. When a page of text scrolls, the material appears at a different place in the screen each time it is seen thereby eliminating this spacial cue which often assists learning.

Look at Figure 2 again. The displays shown here illustrate scrolling. When the return key is pressed the material on the screen jumps up line by line as the new material is being written at the bottom of the screen. The student must read the text as it jumps or wait until the whole message is written before reading the screen. When the scrolling stops, also, what was just read now appears in whole or in part at the top of the screen and the new material appears at the bottom of the screen. The student may be confused about what has been read and what is new.

While scrolling is an advantage for word processing, programming, and other applications it is usually a disadvantage for educational programs. There may be some situations where it has an instructional purpose but usually it is an unnecessary distraction and should be avoided. In short, **no scrolling for educational programs.**

Text Output

When a student opens a book, the page is already filled with text. With a computer display the text is written on the display before the student's eyes. Unimaginative programs often model the book and place a whole screenful of text up at once. Merely placing the text on the screen ignores the dynamic character of the computer screen and the possibilities for using text output to enhance the instructional effectiveness of the presentation.

One of the dangers of the dynamic display of text stems from the fact that students read at vastly different rates. When the text is removed from the screen under program control there is a danger that the student has not yet finished reading the message. This is like reading a book with someone who reads faster than you and having him or her turn the page when you are still in the middle. When the text is removed before the student has finished reading, the resulting confusion and frustration considerably inhibit learning. It is a good idea to allow the student to indicate when he or she is ready to continue (a good aspect of the "please press return to continue" message). Or, when the text is removed by the program, there should be some means for the student to retrieve that which was removed.

Look at Figure 7, frame D. This dynamic display presents the information a little at a time with a slight delay between each new part. The title comes up first, "FOUR KINDS OF POETIC FEET," followed by

a two-second delay. Then the four boxes appear. The headings are written one by one: "first syllable stressed," delay, "last syllable stressed," delay, "two syllables," delay, "three syllables," delay. Then the names of the four types of meter appear one by one: "TROCHAIC," delay, "IAMBIC," delay, etc. Then each type of meter is illustrated. The name is repeated, "TROCHAIC" with the definition, "2 syllables, 1st stressed." Then the direction, "LISTEN" flashes a few times along with the arrow pointing to the lower box. Finally, an example word is placed in the box one syllable at a time, while the stress is indicated by sound. After a delay of a few seconds the next type of meter is shown in the box until each of the four types have been illustrated. Examples of the different types of meter are presented and removed under program control. What if the student has not finished studying one type before the next appears? After all four types of meter have been illustrated a black stripe appears at the bottom of the display like the one shown in frame B. The directions, "[RET] REPEATS," means that pressing the return key will repeat the entire dynamic display again. In this way the student can control the text output even though individual elements are under program control.

For very short messages it is not necessary to provide means for the student to repeat the text presentation. For example, look at Figure 9, frame B. When the student chooses the wrong type of meter the program displays the message, "WRONG" and shows an arrow pointing to the correct choice. Then the program chants the correct version of the word. The

program then goes to the next word. The feedback information is presented under program control. In this case, allowing the student to tell when to remove the "WRONG" and go on requires an unnecessary response on the part of the student since there is no difficulty in understanding the feedback message.

Computer displays, unlike text, can use the dynamic presentation of text and graphic material to focus the student's attention and facilitate learning. However, if critical text is removed before the student has had a chance to finish studying the information, the result is frustration and interference with learning. A means should be provided for the student to indicate when he or she is ready to continue or for repeating information which is presented under program control. In short, **the student should control text output. Never erase critical information until the student indicates readiness to proceed OR provide a way for the student to repeat dynamically presented information.**

Dynamic Displays

Unlike a page of a text book, a computer screen is a dynamic medium. We have the added dimension of time which allows text to be displayed or erased at will. Furthermore, text can be black-on-white or white-on-black (inverse). Text can flash. Text or graphics can be animated and be moved about the screen to show relationships. Too many educational programs assume these features are only for arcade games and so do not take advantage of them for tutorial programs. These dynamic characteristics, when used in an instructionally relevant way,

can do much to increase the effectiveness of the instruction.

Timing of text output can be used for stress or to improve readability. Look again at Figure 7. In frames A and B the stress patterns in poetry and prose are indicated by displaying a passage, syllable by syllable, with each syllable accompanied by a high sound when stressed or a low sound when unstressed. Frame D uses timing to emphasize the attributes of the various kinds of meter. Rather than putting the entire diagram up at once the attributes are put up one by one with a pause between so that the student will focus his or her attention on the attributes one by one. The names of the kinds of meter are displayed one by one so that the student will focus attention on each name as it appears. This timing of text output makes the presentation more easily understood because the student's reading pattern is directed rather than left to chance.

Flashing text can also be used to direct attention and prepare the student for that which is to come. Look at Figure 7, frames C and D. In these frames examples of the different types of meter are presented to the student one after another. If the words appeared without the direction to listen the student would not be prepared and would likely miss the use of sound to show the stress pattern. In this display the word, "LISTEN," and the arrow pointing to the box where the words will appear flash for a second prior to the word appearing. In this way the student is anticipating the sound and the word when it appears.

If there is not an instructional purpose the use of these dynamic

characteristics can be very distracting. Text which flashes or animation which occurs with no apparent purpose distracts rather than enhances learning. Look at Figure 1. The cute cartoon characters which are used to indicate a correct answer soon lose their value. On the other hand the animation which occurs in Figure 4 enhances the idea which is being taught by directing the student's attention to the critical aspects of the display.

Computer displays, unlike textbooks, can be dynamic. Timing can be used to direct reading behavior, direct attention to particular portions of the screen, or to stress certain ideas. In short, **use dynamic displays in which timing of text output, inverse text, flashing, and animation are used for stress and emphasis.**

Display Planning

When text books are put together a graphic designer often lays out the pages for aesthetic appearance and consistency. Effective layout can greatly facilitate the learning which can occur from the printed page. Too often, with computer displays, the need for graphic design is overlooked because the production process is simplified and steps which are usual in the production of books are eliminated. As a result too many programs look like rough drafts of printed material rather than carefully planned displays.

The screen should be planned as a unit. Each element, whether letter, word, or graphic, should be carefully placed on the screen at the location that the designer selects. Furthermore, the designer should have a purpose for placing information on the screen. If this purpose is

aesthetic, more pleasing appearing displays will result. If this purpose is instructional as well as aesthetic, more learning will result. Following are a few characteristics of good screen design which should be considered.

Dark on light. The nature of a cathode ray tube makes turning on dots the natural way to write to the screen. Hence, white (or lighted) letters on a dark screen became the norm. After one has worked at a cathode ray tube for many hours lighted letters and a dark screen begin to appear as normal. However, for a student who may be learning from a computer for the first time light letters on a dark screen seems very unnatural. Students are accustomed to seeing dark letters on a white page. Consequently, it may be more desirable to paint the screen light and cause the print to appear as dark letters on a light screen.

Look at Figures 1 and 2 which use light letters on a dark screen. Does this seem confined or closed in? Now, look at Figure 6 which uses dark letters on a light screen. This gives an open, less restrained feeling. Which appears more natural? It should be noted that for clarity on the printed page some of the NOT-SO-GOOD poetry program (Figures 2 and 3) were printed in inverse. That is, the program used light letters and figures on a black background. I feel these programs would be easier to read if the programs used the black-on-white appearance of the printed page as they appear here.

In short, **dark letters on a light screen will appear less confined and more natural to the student.** [3]

[3]It is interesting to note that the new APPLE Macintosh uses dark letters on a light screen.

White space. Printed media have cost. A book of 100 pages costs more for materials than a book of 50 pages. To conserve costs (not to mention ease of use) printed materials try to put a lot on the page. In fact, because of some unscrupulous home study businesses, the postal service has standards about how much print must appear on a single page of instructional material sent through the mail. It is unlawful to send materials through the mail that do not meet this minimum. You cannot make the materials look to be more by putting fewer words on a page. A computer display, on the other hand, is free; that is, 20 displays cost no more than one display in terms of paper. Hence, there is no good reason to fill the screen with text. Conversely, there are often good instructional reasons to display on the screen only what the student needs at a given time. After a given piece of text or graphic has served its purpose it should be removed. Leaving it on the screen merely clutters the display with unnecessary and possibly distracting information.

Look at Figure 2. Each of the screens are busy and full of text. Rather than inviting the student to read them they seem to promote the feeling, "Do I really have to read all that text?" Furthermore, after the student reads the first paragraph it (or worse, part of it) remains on the screen. This is unnecessary information which merely fills the screen and makes it more difficult to find the new paragraph.

Contrast the displays in Figure 2 with the displays in Figure 6. In Figure 6 the displays were carefully planned and sentences appear only

where the designer intended for them to appear. There is plenty of white space between sentences making them easier to read. In contrast, the displays in Figure 2 were determined by the built-in computer functions of word-wrap at the end of the lines and scrolling. The author merely entered the information and let the computer determine the display.

In short, **leave plenty of white space and erase information when it is no longer needed.**

Short lines and natural phrases. In the early days, before 80 columns became commonplace, I often heard designers of educational software complain that there was not enough space on the screen. Having only 24 lines of 40 characters seemed very confining when we are used to up to 60 lines of 70 to 80 characters. However, the discipline of stating things more concisely may actually improve instruction if each of the ideas to be presented is carefully considered and the words carefully chosen. When, as a designer, you realize that it is not necessary to start every line at the left margin and fill to the right margin, then you begin to realize that the placement of text on the screen can actually enhance comprehension. Since we are no longer constrained to use the page economically we are free to use the layout to convey the message we are trying to present.

Look at Figure 7, frame B. Notice the response supplied by the computer to the rhetorical question, "What is a stressed syllable?" The stem of the statement is on the second line, "A stressed syllable is." Then each of the important ideas are expressed one per line, "louder,"

"emphasized," "higher in pitch." This listing tends to emphasize the individual characteristics so that they are not lost in a long string of prose. A similar use of short lines with a single natural phrase on each line is illustrated in the last part of frame B. The stem of the statement is on the first line, "Stressed syllables are." The two ideas related to stressed syllables are emphasized by placing each on a separate line and indented from the stem, i.e., "higher in pitch" and "often found by reading aloud." A similar use of short lines with one natural phrase or idea per line is illustrated in frame C of Figure 7. The stem appears on the first line, "A POETIC FOOT is." The characteristics are separated with one idea to a line and indented considerably; "a group of 2 or 3 syllables," "where 1 syllable is stressed," "and 1 or 2 are not stressed."

The Poetic Meter program sometimes does not use complete sentences when the idea can be presented with a list of abbreviated phrases. Some educators feel that educational software should demonstrate "good language use" and should therefore avoid sentence fragments and other incorrect usage. The use of short lines where one phrase appears per line can still be used as illustrated by frame C in Figure 7.

In short, **use short lines and separate natural phrases or ideas on each line.**

Fill justify. The thing that impressed me most when I first started to use a word processor was the fact that by merely giving a simple instruction I could have my document printed with right hand

justification as well as left hand justification. The resulting document looked so professional, almost like it had been printed by a press. However, some research has shown that a ragged right edge is easier to read. In fact the aesthetics of straight margins on both sides of the page may be detrimental to learning. What looks nice when a page is opened may in fact make it harder for the message to come across. If this is true for the printed page it is even more true for a computer screen.

In short, **don't fill justify text on the screen.**

Upper case. In the early days of personal computers, machines appeared which had no lower case alphabet. Many programs developed for these early machines were done in all upper case letters. Unfortunately, the BASIC programming language that still exists on many machines will allow lower case letters only with some difficulty. As a result it is sometimes easier to program in all upper case. However, the data show that children often use the shape of the word as a cue to its meaning. When words appear as all upper case this cue is gone and reading becomes more difficult. There is no real excuse for professional programs to use all upper case and there is considerable evidence that all upper case presentations are more difficult to read and comprehend.

An isolated word or title in all upper case tends to make it stand out and is one form of creating emphasis. The use of all capital letters for emphasis probably enhances the instructional impact and is desirable. But if all the letters are capitals this emphasis is lost.

In short, **do not present information in all upper case except for emphasis.**

Text style variety. The printed page is often made more pleasing by the inclusion of different styles of text. If this use of text style is haphazard and not related to the instructional purposes of the presentation it is probably distracting. On the other hand, use of a different style of text can enhance the presentation if it is used for emphasis or to indicate that the text appearing in the new style has a different purpose.[4]

The examples included here have not made wide use of different text styles except the use of inverse (technically reverse inverse). In Figure 7, frame A the passages are shown as white-on-black to set them apart from the instructional text which is black-on-white. This is consistent throughout the program. All of the sample words and poetry are shown inside a black box as white-on-black. This helps the student to find the illustrative material and separate it from the instructional text.

In short, **use a variety of text styles to indicate different kinds of messages.**

HUMAN FACTORS

Human factors refer to those characteristics of the software that make it easy for the student to use. The difficulty of using many

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[4]Newer personal computers allow different text styles on the screen even for ordinary document creation.

computer programs has become folklore. It is frequently necessary to memorize a long list of control characters or other commands in order to interact with the program. The most recent advances have attempted to deliver software that requires little or no knowledge of computers -- software with which the user can interact by pointing. In this section I suggest some of the human factor concerns which will make educational software easier to use and thus result in more efficient learning.

Control of Location

Many educational programs have the characteristics of an adventure game. The student has wandered into a maze and cannot see the way in or the way out. The only choice available is to keep working in the hope that the light at the end of the tunnel will soon appear. The problem with this approach is that the student may find that he or she already knows what is being presented and would like to skip ahead to the next section; or, worse, the student is having difficulty and would like to return to a previous section. Many students have learned that a quick survey through the material before beginning more serious study greatly facilitates the ability to integrate the new information with that which is already known. When there are no indicators as to where you are or where you are going this survey activity is impossible.

By the use of indexes and tables of contents, books enable us to preview, survey, find an isolated piece of information, skip ahead, or review. If we do not provide similar devices in educational software we

have created not more flexible but less flexible educational materials. Some possible devices for allowing more student control over the materials are as follows:

Table of contents. Like a book, a table of contents is a useful tool for an educational program. This should list the major topics to be covered and provide a way for the student to "turn to" a given topic. Look at Figure 5, frame B. In the Poetic Meter program after the title page the student is presented with a list of the program's sections. In this program the student is required to keep track of his or her own progress (there is no student manager program) and this table of contents was necessary to enable the student to pick up where he or she left off. But even if this was not necessary, having the table of contents as an option facilitates preview and review.

In short, **provide a way for the student to skip to the major sections of the program in order to preview, review, or repeat portions of the material.**

Location indicators. A table of contents provides a map of where to go and the mechanism for getting there, but do you know where you are when you get there? The size of a software program is transparent to the student. It is hard to turn to the last page and see how much more you have to study before it is convenient to take a break. Books use page numbers. On the table of contents page you can observe that a given section is 10 pages long. Then by monitoring the page numbers you can tell how much of the section is left. Some similar concept is needed for

educational software. Perhaps a page number is sufficient.

Look at Figures 6 through 11. Notice that each display has a number at the bottom of the screen. This is an attempt to tell the student where he or she is in the program. By comparing this number with the table of contents the student can determine where he or she is in the total program. In short, **provide some sort of location indicator so that the student knows where he or she is in the total program.**

Pages. If a student gets distracted when studying a book it is easy to turn back to the previous page and reread the material to pick up on the train of thought. Too often in educational software after the return key has been pressed the last presented material is gone, never to be retrieved unless the program is started over. While a table of contents allows preview or review of whole sections of material, there is need for a mechanism for short term review or preview. The student must be able to "turn back" to the previous page, to "turn forward" to the next page, or in the case of dynamic displays, repeat the current page.

Look at Figure 6, frame D and Figure 7, frame B. At the conclusion of each page in the Poetic Meter program the student is given the option of going back to the last page by pressing the left arrow key, going on to the next page by pressing the right arrow key, or repeating the current page by pressing the return key. In short, **allow the student to "turn" the pages by going back to the last page, repeating the current page, or going forward to the next page.**

Keyboard Anxiety

More people are afraid of keyboards than are afraid of computers. Typing has been seen as a skill for typists (a job description rather than merely a qualification), clerks, and secretaries. It is still taught as an elective course in high school (usually in the business department). It is apparent that like handwriting typing will be a basic skill in the future but for the time being we must realize that the majority of the population do not have keyboard skills. This means that lengthy keyboard input is likely to cause anxiety and frustration. Therefore, programs should be designed that minimize the amount of information required from the keyboard.

The latest technology in computer programs uses pointing as the primary input device. Pointing, using a mouse[5] or an easily located key, is much easier than finding a particular letter or number on the keyboard. Pointing is much easier than typing a word or phrase. There are times when we want unstructured input from the student. Figure 6 represents this type of situation. Other times when we are involved in selecting a menu or choosing a response to a question pointing will facilitate the student's interaction. Figure 5 illustrates pointing on a menu. The student merely presses the arrow keys to move the pointer up and down the menu. When the arrow points at the choice that the student wishes to select he or she merely presses the return key. A similar pointing procedure is used in selecting examples and answering practice

[5]A mouse is a hand-held device which rolls on a desk and moves a pointer on the screen. A button on the mouse selects the function which the arrow points to on the screen.

problems. Figure 8, frame A, shows the use of a pointing device for selecting the type of meter the student wishes to see illustrated. Pressing the space bar moves the pointer (the brackets around the choice in this case) which rotates past each of the choices in turn. The return key gets the choice. Figure 9, frame A shows a similar pointer for practice. In this case the student uses the space bar to select the type of meter illustrated. Pressing the return key accepts the student answer.

Many students get frustrated when required to use the keyboard and this anxiety interferes with learning. In short, **minimize unnecessary typing by using a pointing device whenever possible.**

Advisor

One aspect of effective teaching is to monitor the student's process and progress and to provide advice for the student to guide further study efforts. This type of monitoring function is difficult to implement in the classroom where there are usually many children for every teacher. One advantage of the computer is that in addition to presenting information to the student it can also gather information from the student. This student generated information can then be used to monitor the student's progress and can serve to trigger advice to the student which may facilitate his or her learning.

The most obvious thing to monitor is the number of practice problems that a student misses. However, there is a great deal of other information which can be used to determine if the student is using the instructional program effectively. This determination can include monitoring the number of examples studied by the student, checking to see if the student has used the resources provided by the program, as well as checking on practice performance.

Look at Figure 8, frame B. This display is shown to the student if he or she presses the escape key to terminate the example portion of the program before the designer feels that an adequate number of examples have been studied. In fact there is a prior message in this section of the program. If the student tries to escape from the example section before looking at a minimum of two examples of each type a message says, "You must study at least 2 examples of each type." In this example display the amount of prompting material is slowly decreased. Early examples are shown divided into syllables and the word or phrase is chanted for the student. After a few examples the colon which divides the words into syllables is removed and the words are no longer divided into syllables for the student. After a few more examples the chant is turned off and the student merely sees a word or phrase of the type indicated without additional prompts. If the student escapes before seeing at least 2 nonprompted examples of each type the warning message of Figure 8, frame B appears. If the student does exceed this criteria then the danger frame is replaced by a frame which says, "GO, you should be ready for practice." Notice that in either the case of the danger or go advice the student has the option to follow the advice or ignore the advice. The black stripe at the bottom of the page gives the student the option of returning for more examples by pressing the left arrow key or going on to practice by pressing the right arrow key. If the student elects to return to the example section of the program the software remembers where the student left off and begins presenting examples from this point.

A similar advisor function follows practice. Look at Figure 9, frame C. In this case the student is given a score board showing how many of each type of meter were classified incorrectly. If the student misses more than 2 of any type the warning includes a stop sign and the advice, "You should study more examples." If the student misses less than 1 of each type the display contains a "GO" sign and the advice, "OK to study the next page". If the performance is between these two criteria levels the display contains a "CAUTION" sign and the advice, "Perhaps you should study more examples." The student is given three options. He or she can turn to the next page by pressing the right arrow; go back to the example section by pressing the left arrow; or do some more practice by pressing the return key. Again the student has the option to override the advice.

Computers provide the mechanism to monitor not only the student's performance but all of the student's learning activities. The teaching function of advice can easily be implemented. In short, **monitor the student's activity and provide advice when potentially decremental action is taken. In most cases provide a mechanism for the student to override the advice.**

Learner Control

In the early days of computer assisted instruction advocates often stated that someday we would have a computer system which could assess the readiness and aptitude of the student, and then present that information which was an optimal match to the individual student. Even if it were possible there remain some serious ramifications of this assumption. If a significant part of the curriculum was constructed

around such adaptive instruction, the student's gains on the subject matter being taught might be considerable but the side effects could be catastrophic. The students in such a system would be spoon fed and might never learn to feed themselves. The real world is seldom so accommodating. If one of the primary aims of education is to assist the student to be an independent learner and acquire additional learning by self teaching, then our highly adaptive CAI system may turn out to be maladaptive after all. Students who have a major part of their learning on such an accommodating system would not learn the important metaskills necessary to learn from less than optimal information.

A better approach might be to teach students to adapt the system to themselves rather than for the system to adapt itself to students. The mechanism for this student adaptation is to provide learner control so that many decisions about the next best display are left to the student. Rather than big brother providing the information thought to be best for the student, the student must select that information that he or she thinks is best for himself or herself.

Text output. In an earlier section I discussed student control of text output. This is an obvious area where students can determine for themselves when they are ready for the next display. Exceptions might be in timed tests or when speed reading is the objective but usually the student should indicate, "I'm ready to continue."

Number of examples. Research has shown that most students can determine how many examples they need to study in order to understand an idea. The number of examples required by different individuals may differ considerably but if an individual is shown less than he or she

feels is needed there will be a decrement in performance. On the other hand, showing students more than they think is needed serves only to prolong the instruction without any accompanying increase in performance.

Look at Figure 8, frame A. In this presentation the student can determine the number of examples needed to understand each type of meter. When the student feels that enough has been studied he or she presses the escape key and jumps to the practice section. Note that the advisor function previously discussed comes into play to monitor the student's use of learner control. If, in our opinion, the student might be using learner control to avoid what might be necessary study, the program provides a caution to the student. However, the student is still in control and can usually override the advice.

In short, **allow students to select how many examples they need to study.**

Optional help. Students differ significantly in the amount of elaboration they need to understand an idea. Some students need a step-by-step explanation while others understand after the general idea has been presented or after they have seen an example. It is inefficient and may cause frustration for the student if forced to work through every step of a detailed analysis. On the other hand if this detailed analysis is not available some students will be lost.

Look at Figure 10. This sequence of frames illustrates the detailed analysis of the poetry scanning procedure. First, the student is advised to read the poem aloud and take a guess at the type of meter involved (frame A). The scanning editor then "chants" the poem for the student using the sound to indicate the stress pattern involved. In frame B the student is advised to separate multisyllable words into separate

syllables using the colon. In frame C the student is advised to mark the stressed syllables using the underline. And in frame D the student is advised to divide the passage into poetic feet using the up arrow. Finally the student is asked to observe the pattern of stress in each foot and indicate the type of meter involved.

Some students need to repeat this detailed analysis many times while others will get the idea very quickly. Students can jump to the practice at any time by pressing the escape key. In the practice section (see Figure 11) the student is asked to classify the type of meter involved in the passage (frame A). In frame B the word **RIGHT!** or **WRONG!** is flashed in the upper right part of the screen to indicate whether or not the classification was correct. The passage is then chanted for the student to allow comparison. The correct choice is not indicated to the student when he or she is wrong. The student can then choose whether or not to engage in the more detailed analysis. Pressing the [?] key causes frame D to appear and then follows a detailed scanning analysis such as was presented in the example section.

Because students differ in the amount of detailed elaboration they need they should be given a choice as to whether or not they wish more explanation. Forcing all students through a linear path consisting of the same level of detail may be boring for some students because the pace is too slow and frustrating for others because the pace is too fast. In short, **provide optional help; don't force every student through the most detailed presentation.**

Escape. Sometimes students are interrupted while studying. There are many causes for such interruptions. If a student is in a long sequence he or she is very hesitant to merely pull out the disk and turn

off the computer. This may mean that they must start over the next time or they may fear that this will somehow ruin the program. The program should provide a way for the student to return to the menu or some other starting place.

Poetic Meter allows the student to escape from any sequence by pressing the escape key. Usually the program indicates the consequence of such an action. In the example sections the program uses the escape as a means of learner control for the student to tell the program that he or she has seen enough examples and wishes to go on. The advisor warns the student if he or she should study more examples. This program does not have a student manager so if the student uses escape to leave the program it goes to the beginning when it is restarted. Including a student manager is better. This provides a way for the program to restart where the student left off; the student does not have to keep track and use the menu to find his or her place.

Everyone suffers from interruptions and needs a way to exit in an orderly way short of pulling the plug. In short, **provide a means of escape from any lengthy activity but advise the student about the consequence of such an escape.**

Directions

Those of us who have been in the computer business for some years have come to accept a number of conventions that seem like second nature. For example, everyone who has used a computer very long soon learns that to enter a response it is usually necessary to press the return or enter key. This is so obvious to us that we usually feel that

to inform the student about this convention is unnecessary. However, more and more first-time users are beginning to use the computer. What may be obvious to an experienced user is not at all obvious to the first-time user. The learner will have a more pleasant experience if the program contains complete directions about what to do and when.

Often documentation will contain the necessary directions, but if they are at all complex, as in editions where there are several options available, most users find it is necessary to have a summary card in order to remember which commands go with the program. If possible, the current options should be available to the student as options on the screen.

Look at Figure 9, frame A. This is a simple exercise, but the directions for the student are shown on the screen so that what is necessary to make the selection is clearly indicated. The Poetic Meter program makes a poor assumption on Figure 6, frames A and B. It assumes that the student will know that when the cursor appears he or she should enter an answer and then press the return key. It would be an improvement if this direction appeared on the screen, at least for the first few times the student is expected to make some constructed response to a request from the program.

Directions to the student should not cause an interference. Sometimes in an attempt to make it clear to the beginning user the procedures become very inconvenient for the experienced user. This is probably less of a problem in an educational program than it is in some utility such as a word processor or data base. Nevertheless, we should be careful to balance directions so that the program is easy to use for the beginner but convenient to use for the more experienced user.

The directions should be as natural as possible. There is nothing more difficult than a long menu that is numbered. The user must look at the menu, get an arbitrary number, and hunt for the number on the keyboard in order to make a selection. Mnemonic choices using the first letter of the word may be easier to remember. Pointing, as already mentioned, is easiest of all. Keys should be used in a natural way or in ways consistent with other systems. Unique combinations of key presses make it unnecessarily difficult for the student. Even the advice to the student should use already known symbols. In the Poetic Meter program the advisor uses "STOP," "CAUTION," and "GO" as ways to get the student's attention quickly and to leave little ambiguity about what is being said. (See Figure 8, frame B and Figure 9, frame C.)

In short, **provide adequate directions including all of the options available to the student. If possible make these available on the screen or accessible with the press of the [?] key. Use the most natural procedure.**

Program Structure

This paper has not dealt with programming design but it is necessary to border on the architecture of the program for one final human factors concern. While the power and capacity of personal computers seem to increase daily with each new product on the market, there are still severe limitations of space and size. These limitations can interfere with effective educational design. Some popular programs are very annoying because they continually access the disk drive. For the student it seems like half the time is spent waiting for the computer to load the next part of the program. The polite message, "Thank you for waiting" gets very old in a hurry. By carefully structuring the program these

long delays in processing or accessing information can be minimized. It is especially important that there be no delays between the time when a student enters information and the computer reacts to that information. If there is a delay the student often feels that the computer is not operating properly and may try to enter additional information. Whenever possible the next part of the program should be anticipated and loaded during a time when the student is busy with other activities on the screen. Thus, when the student indicates that he or she is ready to continue, the next part of the program is already in memory and easily displayed to the student.

In short, **plan disk access to avoid long waits while the computer retrieves information.**

In Conclusion

Terrel Bell has recently criticized educational software as "electronic page turning [that] hasn't been designed to do a good job of interacting with the mind of the student." He further states that computers could be used as "slave mechanisms" to check spelling, punctuation, and sentence structure but he doubts that computers could ever teach writing. As a designer of educational software (including software that teaches writing and poetic meter) I was ready to go to battle. Then I realized that a random sampling of educational software might very well create the impression that computers are pretty limited in what they can teach. It is time that the consumers of educational programs become more discerning and refuse to purchase software that does not meet at least the minimum standards of acceptable instruction. This paper has attempted to provide a few suggestions about some of those minimum standards.

SUMMARY

Instructional Strategies

The first section of this paper identifies design strategies which are believed to have a direct impact on the amount of learning that occurs as a result of instruction. Instructional design strategy involves the arrangement of content elements and other information in such a way that learning is facilitated. The following guidelines are suggested:

1. Avoid merely putting text on the screen; avoid mere page turning.
2. Avoid generality-rich but example-poor presentations. Each idea should be presented by a generality, examples, and practice.
3. Avoid remember only practice.
4. Use attention focusing devices to relate examples to generalities and to point out critical characteristics of the illustrative material.
5. Promote active mental processing by asking rhetorical questions and engaging the student in a conversation which requires constructed (as opposed to multiple choice) responses to which we do not provide right-wrong feedback but rather an anticipation of a reasonable reaction.
6. Provide expository examples as well as practice.

Display Techniques

The second section of this paper identifies screen display techniques which are believed to facilitate the student's ability to

interact with the materials. Screen display refers to the way that information is exhibited on the monitor. The following guidelines are suggested:

1. No scrolling for educational programs.
2. The student should control text output. Never erase critical information until the student indicates readiness to proceed OR provide a way for the student to repeat dynamically presented information.
3. Use dynamic displays in which timing of text output, inverse text, flashing, and animation are used for stress and emphasis.
4. Dark letters on a light screen will appear less confined and more natural to the student.
5. Leave plenty of white space and erase information when it is no longer needed.
6. Use short lines and separate natural phrases or ideas on each line.
7. Don't fill justify text on the screen.
8. Do not present information in all upper case except for emphasis.
9. Use a variety of text styles to indicate different kinds of messages.

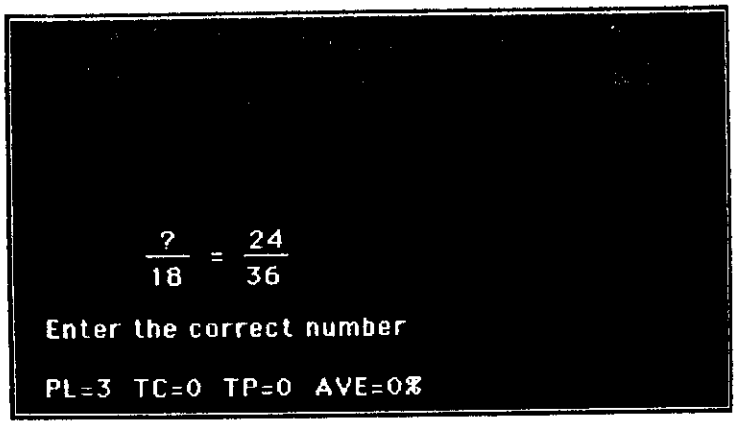
Human Factors

The third section of this paper identifies some human factors characteristics which will make educational software easier to use and thus result in more efficient learning. The following guidelines are suggested:

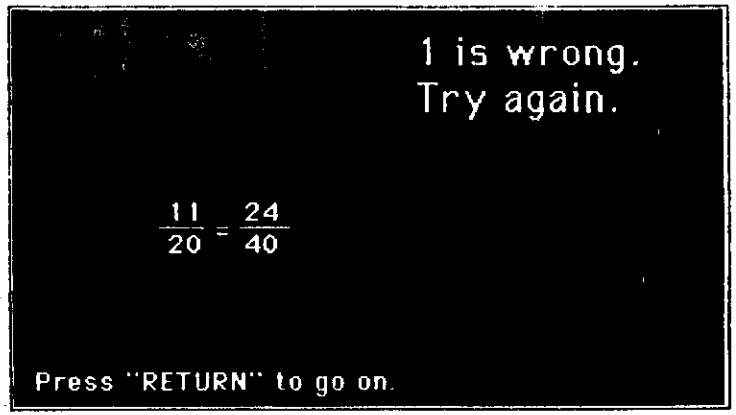
1. Provide a way for the student to skip to the major sections of

the program in order to preview, review, or repeat portions of the material.

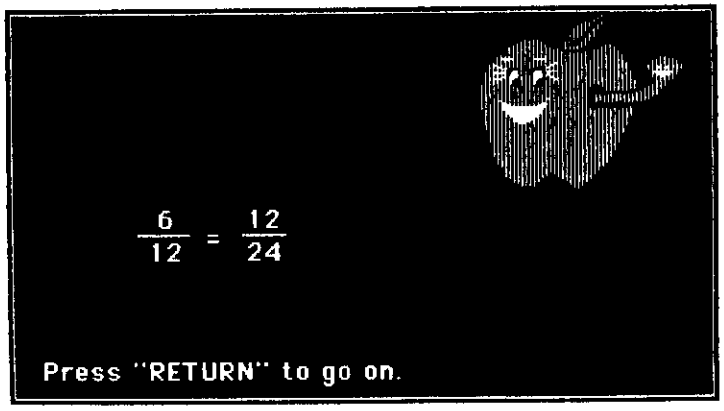
2. Provide some sort of location indicator so that the student knows where he or she is in the total program.
3. Allow the student to "turn" the pages by going back to the last page, repeating the current page, or going forward to the next page.
4. Minimize unnecessary typing by using a pointing device whenever possible.
5. Monitor the student's activity and provide advice when potentially decremental action is taken. In most cases, provide a mechanism for the student to override the advice.
6. Allow students to select how many examples they need to study.
7. Provide optional help; don't force every student through the most detailed presentation.
8. Provide a means of escape from any lengthy activity but advise the student about the consequence of such an escape.
9. Provide adequate directions including all of the options available to the student. If possible list the available options on the screen or make them accessible with the press of the [?] key. Use the most natural procedure.
10. Plan disk access to avoid long waits while the computer retrieves information.



FRAME A



FRAME B



FRAME C

FRAME D

Figure 1 Drill and practice program.

TYPES OF POETIC METER

PURPOSE

The purpose of this lesson is to teach you to determine the different types of rhythmic patterns that distinguish poetry from ordinary prose. You will learn to recognize and name four different rhythmic patterns.

Press RETURN to continue

FRAME A

different types of rhythmic patterns that distinguish poetry from ordinary prose. You will learn to recognize and name four different rhythmic patterns.

Press RETURN to continue

BACKGROUND

A major feature of poetry that distinguishes it from ordinary prose is the arrangement of words so that the stressed syllables tend to occur at regular intervals. This regular arrangement of stress produces a rhythmic pattern. It is this rythmic pattern that is one major factor distinguishing poetry from prose.

Press RETURN to continue

FRAME B

BACKGROUND

A major feature of poetry that distinguishes it from ordinary prose is the arrangement of words so that the stressed syllables tend to occur at regular intervals. This regular arrangement of stress produces a rhythmic pattern. It is this rythmic pattern that is one major factor distinguishing poetry from prose.

Press RETURN to continue

A STRESSED SYLLABLE is louder and/or higher in pitch than an unstressed syllable. RHYTHM in poetry results from a recurring pattern of stressed and unstressed syllables.

Press RETURN to continue.

FRAME C

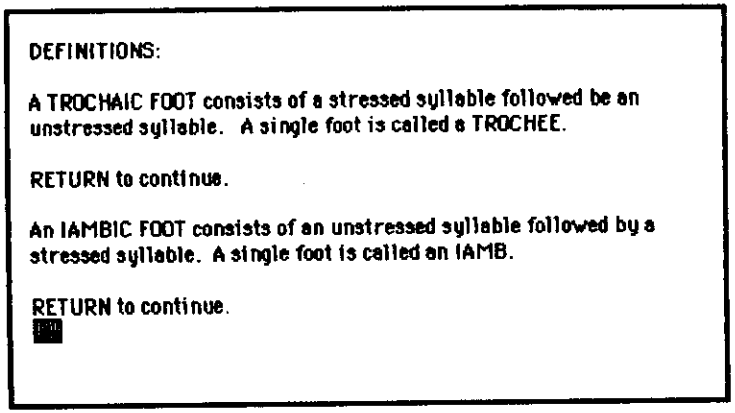
The four kinds of stress patterns to be taught can be represented by the following table:

	FIRST SYLLABLE STRESSED	LAST SYLLABLE STRESSED
TWO SYLLABLES	TROCHAIC	IAMBIC
THREE SYLLABLES	DACTYLIC	ANAPESTIC

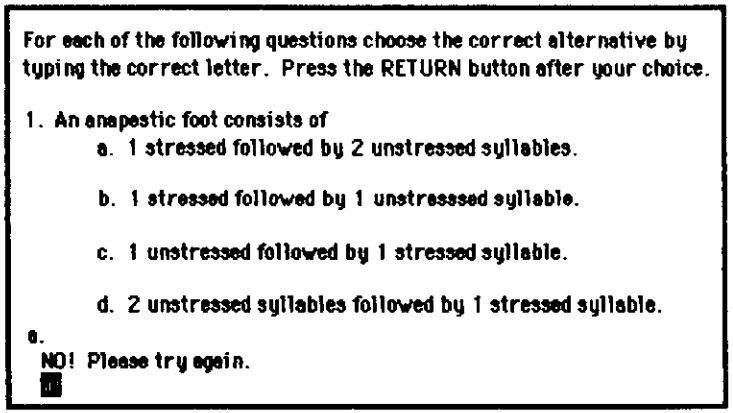
RETURN to continue.

FRAME D

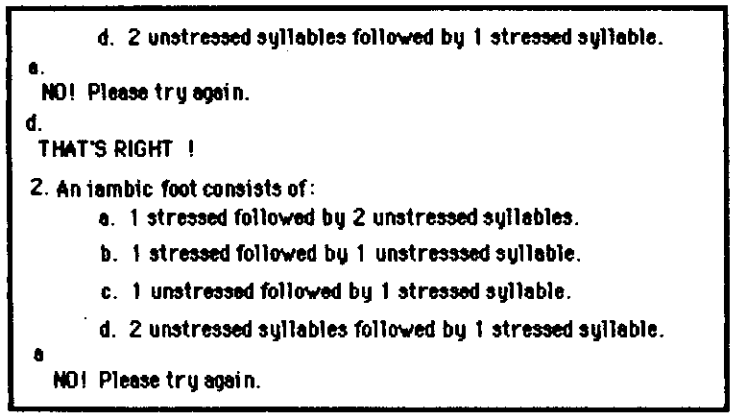
Figure 2 NOT-SO-GOOD Poetic Meter



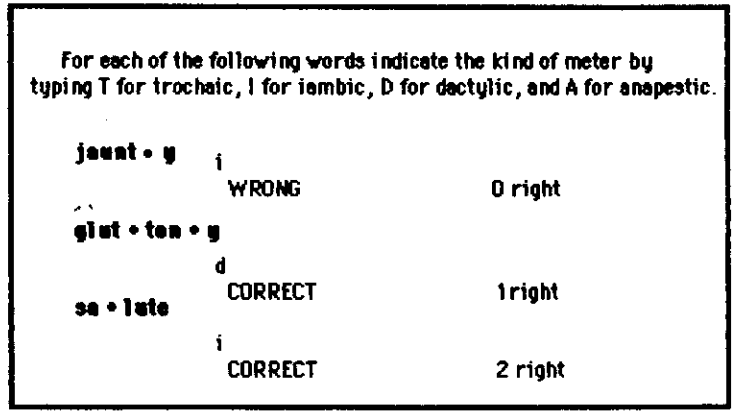
FRAME A



FRAME B

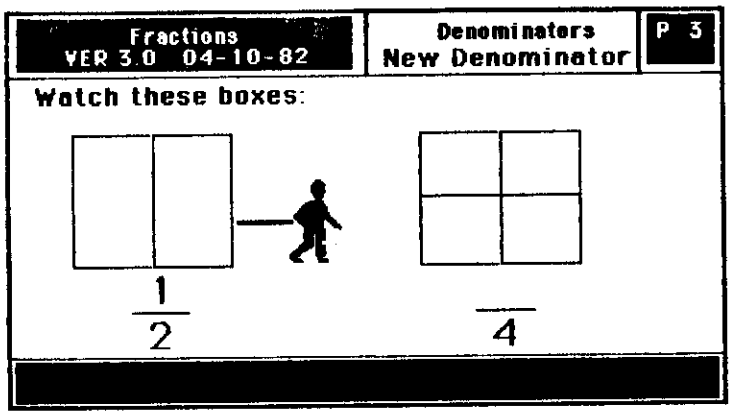


FRAME C



FRAME D

Figure 3 NOT-SO-GOOD Poetic Meter continued



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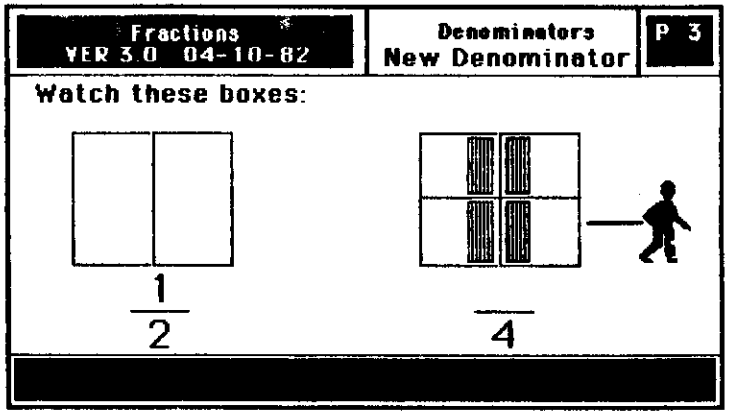

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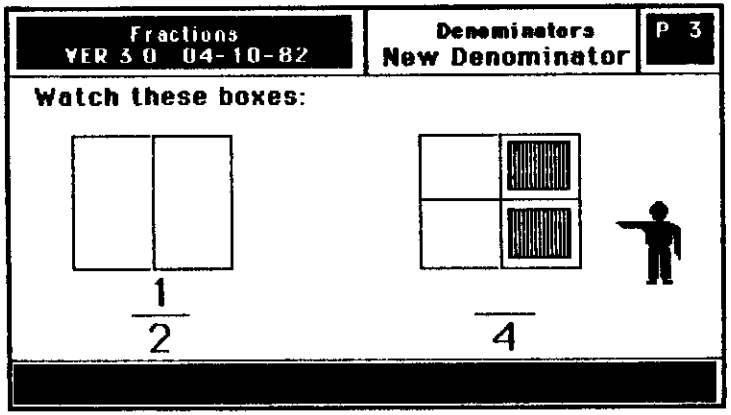

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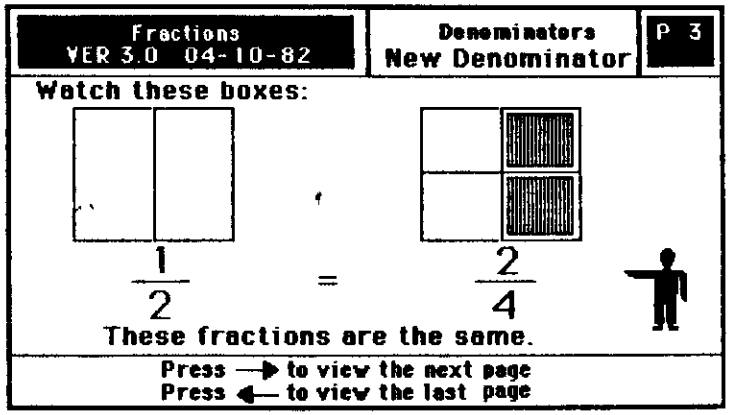

FRAME D

Figure 4 EDU-WARE FRACTIONS with animation

FRAME A

POETIC METER

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Arrow keys to select.
RETURN goes to selection.

FRAME B

Figure 5 Table of Contents - Poetic Meter

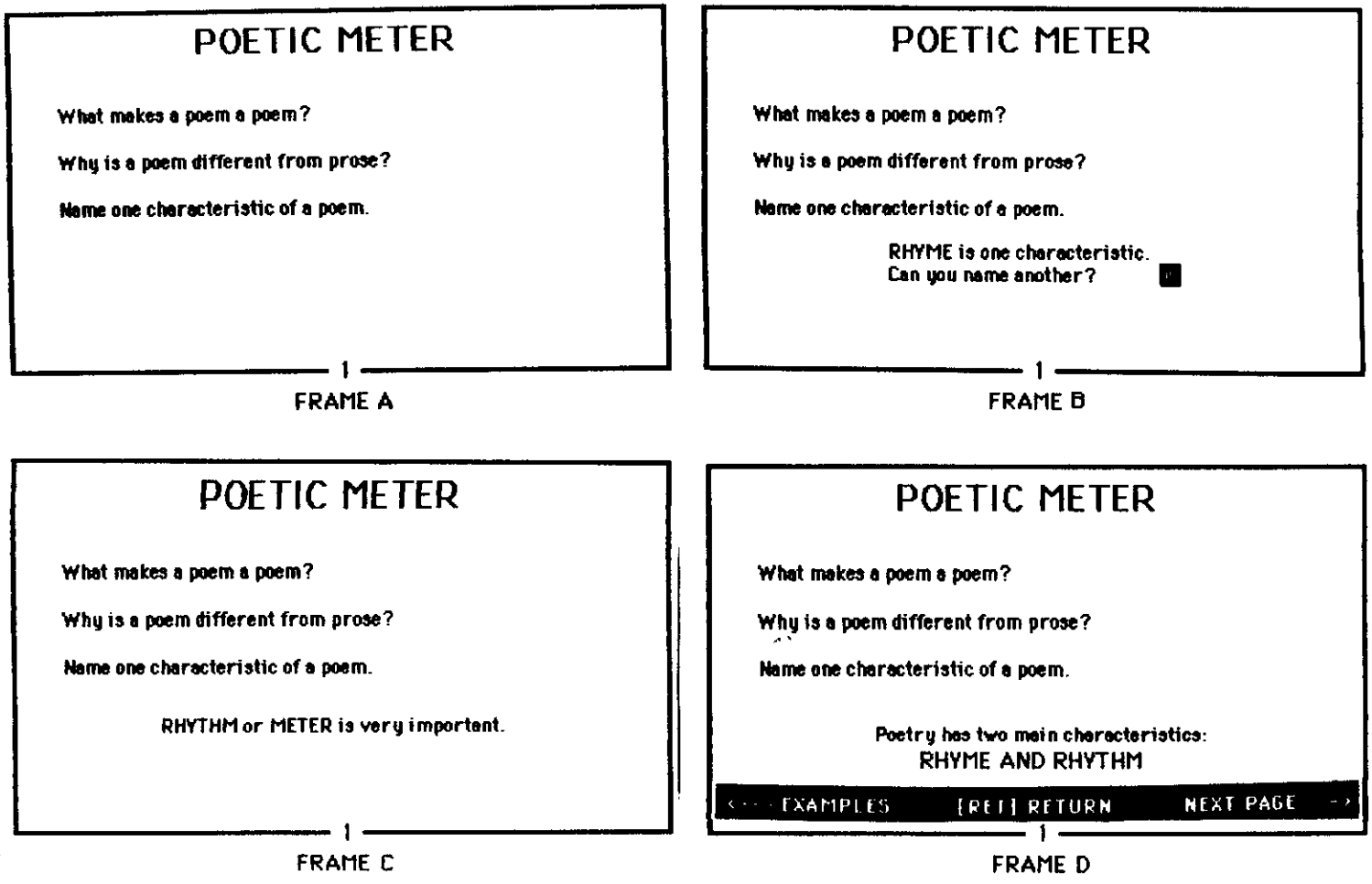
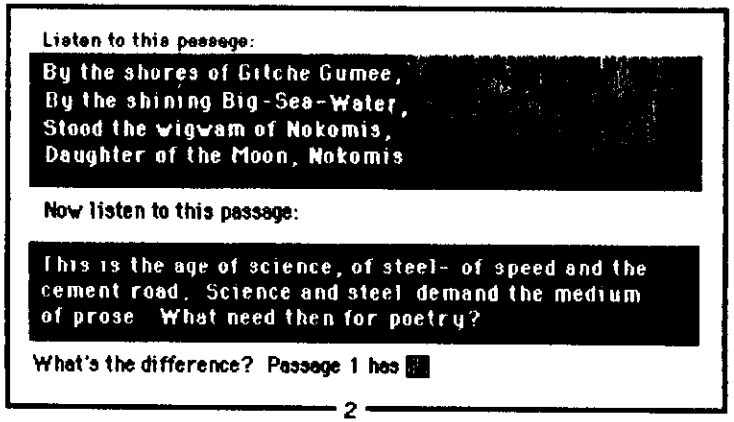


Figure 6 Presentation page 1 - Poetic Meter



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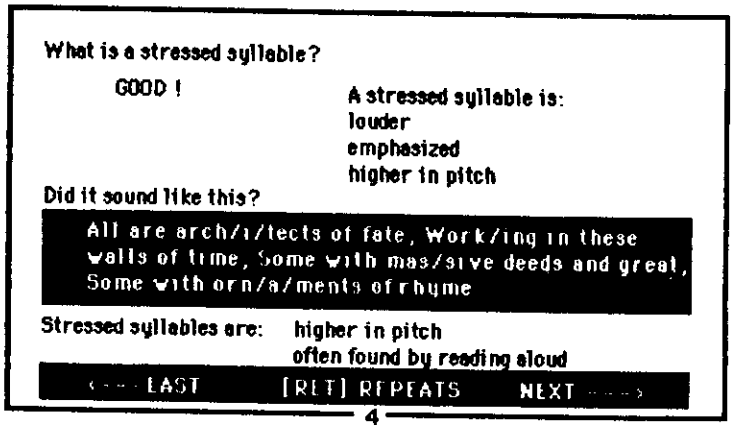

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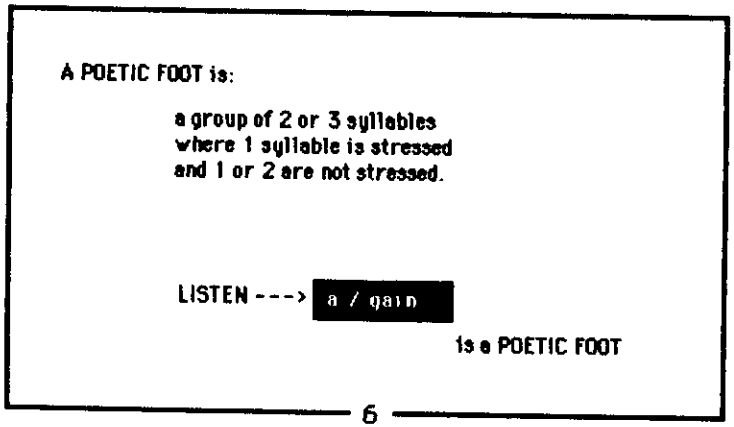

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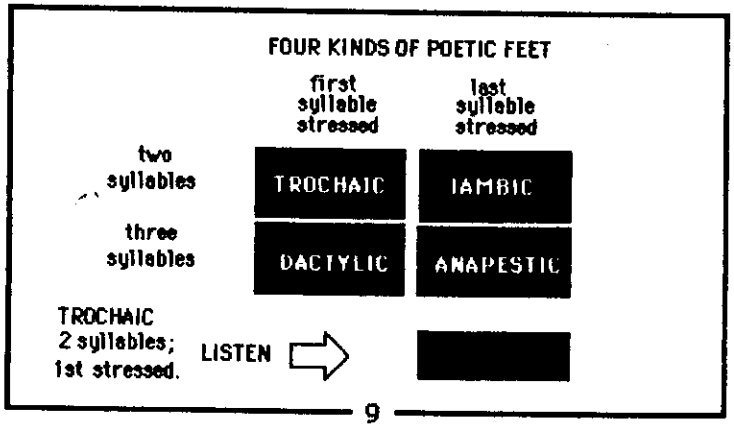

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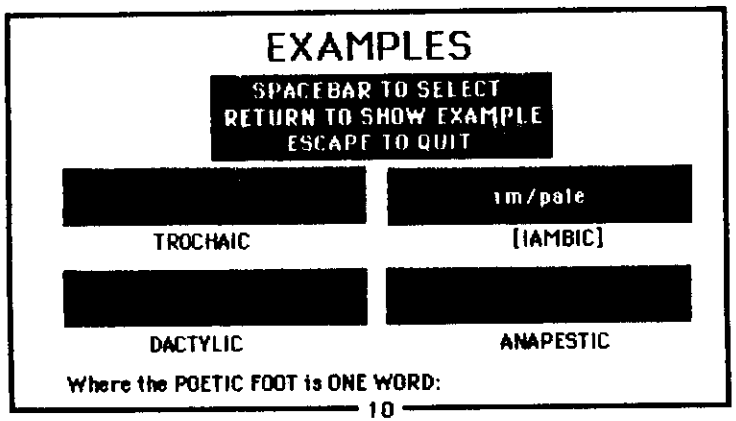
Figure 7 Presentation selected pages - Poetic Meter



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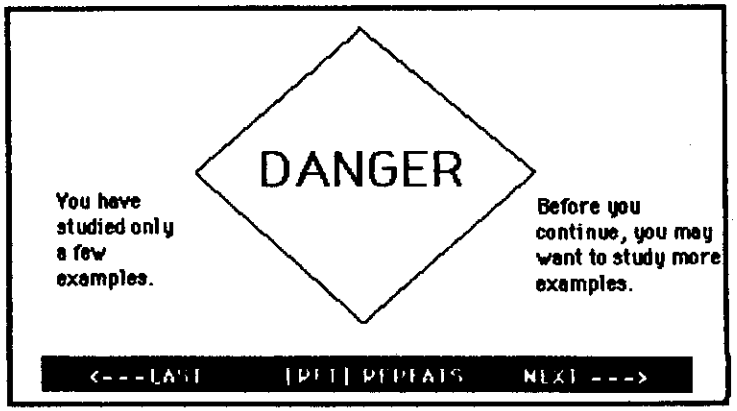
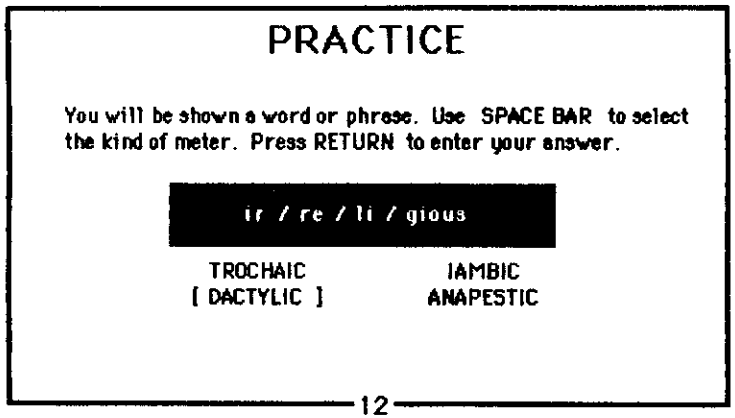


Figure 8 Word Example - Poetic Meter



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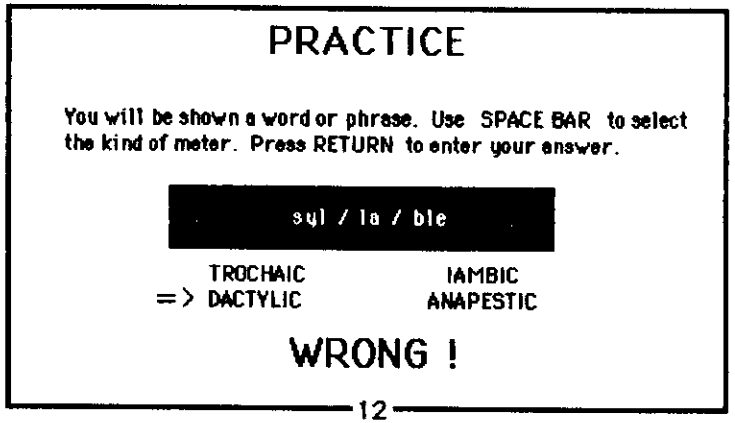

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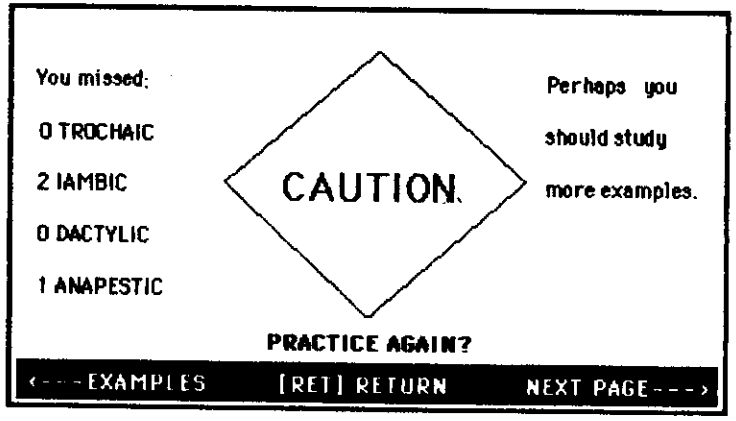


FRAME C

Figure 9 Word Practice - Poetic Meter

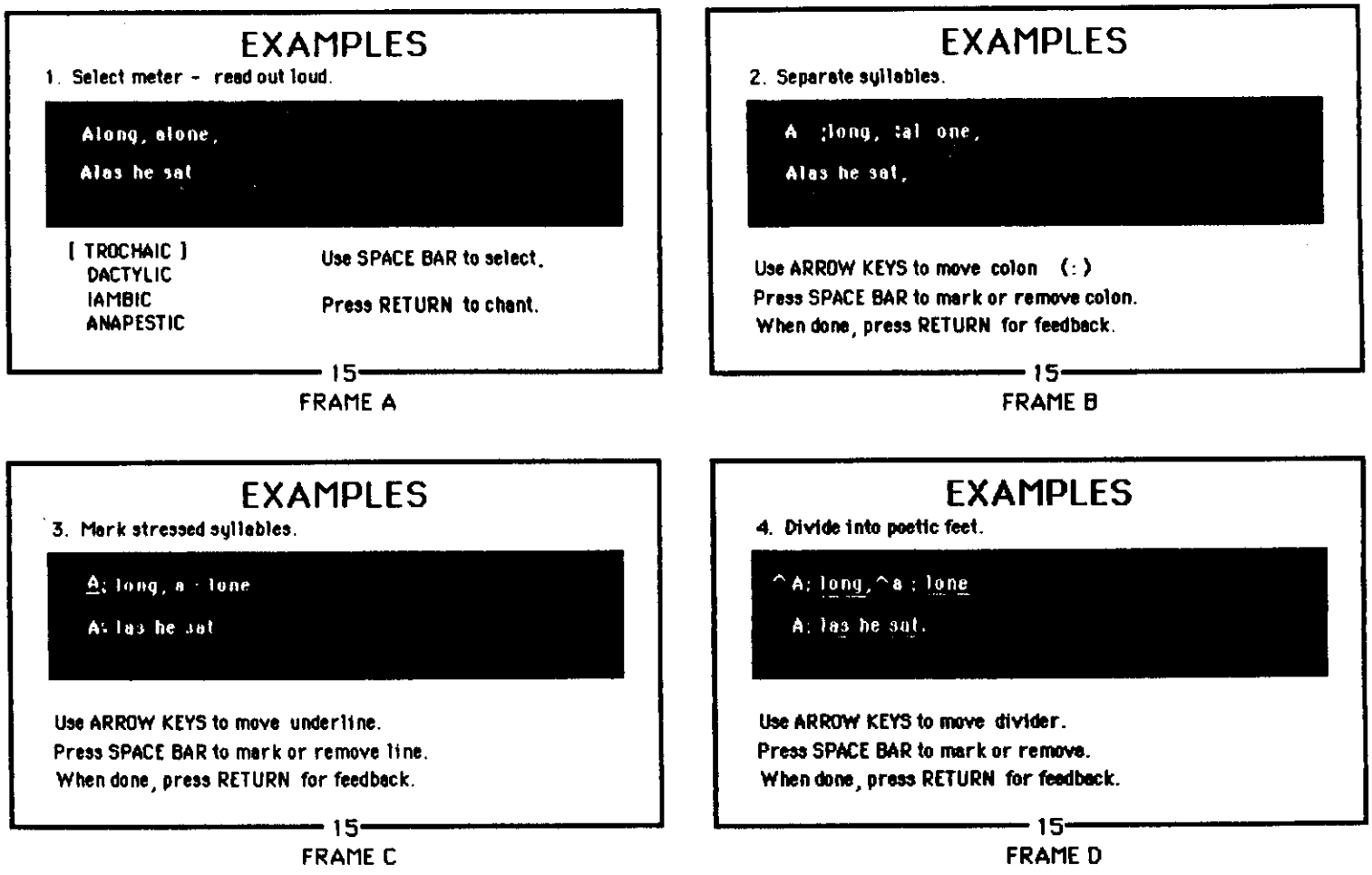
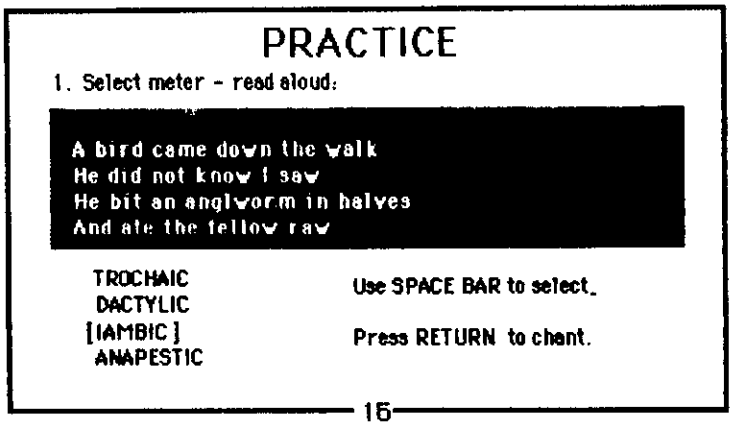
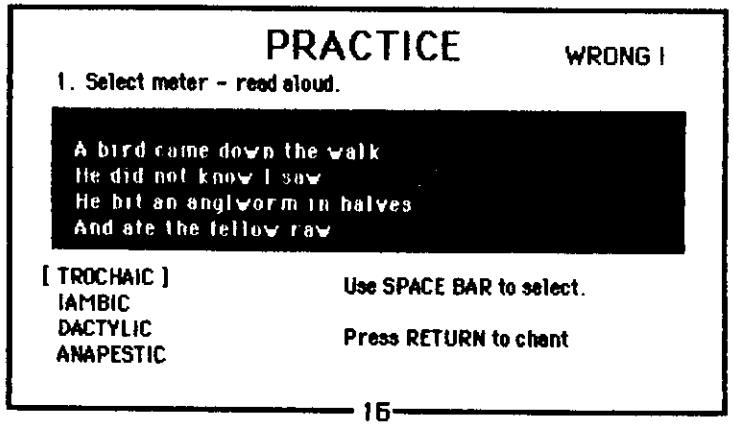


Figure 10 Verse Example with scanning editor - Poetic Meter



FRAME A



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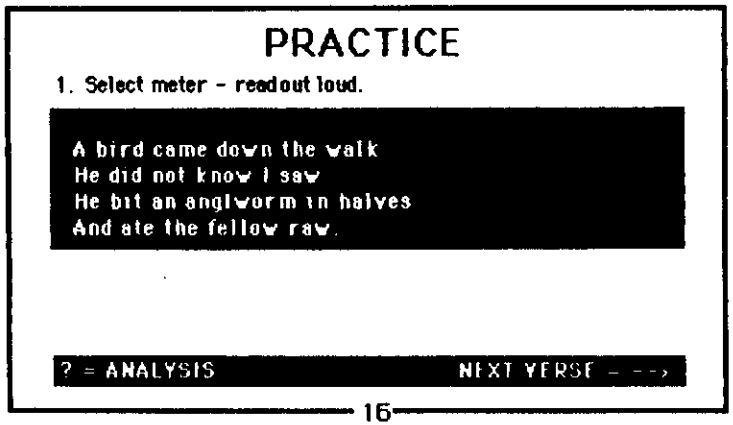

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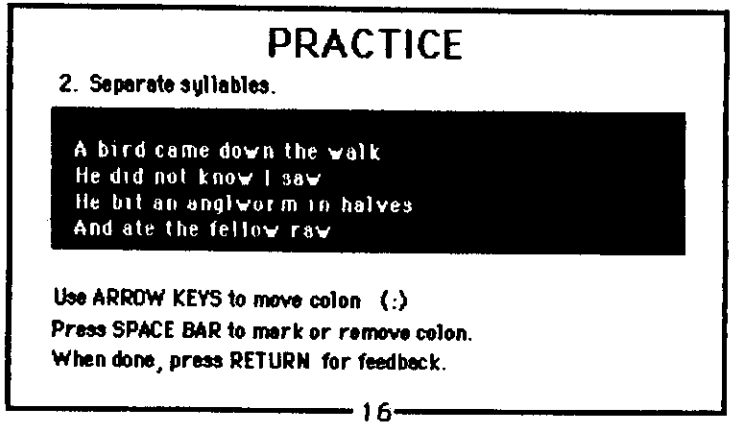

FRAME D

Figure 11 Verse Practice with scanning editor - Poetic Meter