INSTRUCTIONAL BUILDING BLOCKS OF COMPUTER-BASED TRAINING


INTRODUCTION

In many ways, developing a computer-based training (CBT) course is similar to building a house. There is a planning stage, a construction or development stage, and a testing and cleanup stage.

You wouldn't dream of building a house without extensive planning and preparation. In this stage, you select the site, consult an architect, determine the arrangement of rooms, and draw the blueprints. Likewise, you need to plan and prepare extensively for CBT development. You determine that a training need exists and that CBT is an appropriate mode of training to address this need. You identify the audience to whom training is to be directed and the content to be covered. You pinpoint the exact behaviors you expect students to perform once they have completed the course successfully. These are your behavioral objectives. Then you design an instructional strategy (the instructional blueprints) for the entire course, outlining how and when content is to be presented.

In the last stage when you have finished building the house, there are a number of activities you will want to have done before moving in, including testing and inspections, finish work, and general cleanup. In CBT there are also a number of activities to perform before considering the course complete, including testing the course to determine that all bugs have been fixed, validating the content with typical students to determine that the course teaches what it is supposed to, and cleaning up any grammatical errors or deviations from company standards.

This paper assumes that CBT is both well planned and thoroughly evaluated with necessary revisions implemented. The paper focuses on the development stage and examines the nuts and bolts of creating a successful CBT course.

When you construct a house, you use a variety of materials and tools. It is the quality of the materials and the skillful use of the tools that determine the quality of the finished house. The same can be said of CBT. CBT, like house building, is a difficult and challenging endeavor. Good CBT is not easy to develop. Countless hours can be invested in course development and result in an ineffective course. It is not time, but the interaction of a number of variables that make a good course. These variables are the instructional building blocks we will examine in this paper. While many of them are the same for any instruction, the emphasis will be on their use in CBT. The following discussion is presented from the viewpoint of an instructional developer, but it can apply to the evaluation or selection of a CBT course. The instructional building blocks this paper examines are content, organization, writing style, screen format and design, branching, interactivity, and motivating factors.

CONTENT

Content is to CBT like wood or brick is to a house—basic and of primary importance. Without the right materials, your house will be flimsy and inefficient. Without the right content, your course will be flimsy and ineffective. You select the content based on your course objectives. Everything required to achieve the objectives you have identified should be taught, but nothing should be taught that does not contribute to meeting course objectives. You may want to provide additional information for context, coherency, or continuity, but this information should be kept to a minimum. Your goal is to provide lean training that teaches only what is necessary for students to master course objectives. You do this by carefully matching content to objectives.

At the most fundamental level, for any instruction, your content must be accurate and clearly presented. It must teach what it purports to teach in the most efficient manner possible. It must be presented in a manner that is appropriate for the target audience, and it must be free of bias against any group of people.

But it is not enough simply to provide information. You need to present examples of how the information is applied. It is easier to grasp a concept or understand how to use a skill when it is placed within a context illustrating its application. Examples should be relevant and as universal as possible so people can easily transfer the idea to their own situation. You may want to use an analogy to common everyday occurrences if the idea is an entirely foreign one. For example, SAS data libraries are sometimes compared to file cabinets and SAS data sets to files to convey the idea of data storage in the SAS System. If you are writing for only one field or industry, your examples can be specific to that area. You may also want to provide fun, humorous examples to liven up your course, as long as they accurately reflect the concept or skill.

ORGANIZATION

Organization in a CBT course is like the mortar in a brick house. Organization holds the content of a course together. Content must be organized coherently and consistently. People should be able to move around easily in a course and know where they are at any time. There should be titles and headings where appropriate and clear, simple directions. The directions should always appear in the same place on the screen if possible. You should have a menu system so students can make choices, but avoid excessive layers of menus. Students should know how to get out from wherever they are and should always be able to exit with only a few keystrokes. In our CBT mainframe courses at SAS Institute, students need to press the END function key only one or two times to reach a menu that gives them the option of leaving the course.

The structure of a CBT course should be explicit to students. You may want to provide a map of the course either on-line or in an accompanying student handbook. A course that is confusing to the viewer will be as ineffective as one with blatant errors in content. In a word, make your course user-friendly.

The content of each lesson should also be made explicit so students know what they can expect to learn from each lesson. You can do this by listing the objectives at the beginning of each lesson or by providing a brief overview. You should also summarize the material at the end of each lesson or repeat the objectives so students can review at a glance what was just covered.

WRITING STYLE

A house is not just a pile of bricks stuck together with mortar. It has an overall purpose and appearance. It has doors and windows with shutters. It may have molding on the inside and outside. There may be a deck or a porch. These are features that when used together communicate a style to which the viewer
react. CST also has a style and an overall look that are communicated through writing, CBT is different from any other form of instruction for a number of reasons:

- Your sole method of communication is written language and any form of computer graphics you have available.
- Students are reading from a computer monitor, which is more tiring than reading print.
- You cannot necessarily depend on an instructor's presence nor on other media to clear up misconceptions or to clarify an idea.
- You cannot as easily flip through screens in CBT as you can flip through pages of a manual.

Writing in CBT needs to be clear, coherent, logical, and easily comprehensible. It also needs to be tight, concise, and to the point. Convey your message in as few words as possible without sacrificing accuracy. You cannot elaborate in quite as much detail as you can when writing print. Writing concisely is one of the most important (and difficult) skills in CBT.

One way to compensate for brevity in CBT writing is to repeat important information when students need to recall it. Repetition also alleviates the problem of trying to scroll through previous screens in a lesson to review some piece of instruction. Also, you cannot assume that students took a previous section since CBT is not necessarily taken sequentially. This may be the first time they see the information. Be selective about what you repeat, repeating only essential information, and be creative. Phrase the repeated information differently, so if students didn't grasp the material the first time, they have a better chance of understanding it the second time.

In a sense, the computer is acting as a tutor to a student taking CBT. It provides information, asks questions, responds to questions, and so on. You want the student to feel relaxed and comfortable using the computer, so it is best to use an informal, conversational tone when writing. Use active voice and second person and avoid jargon. Whatever your style of writing, be sure to maintain a level and tone that is appropriate for the target audience.

SCREEN FORMAT AND DESIGN

You can fill a house with furniture, appliances, utensils, gadgets, and so on, but you have to consider where and how to place them. For example, you wouldn't fill your dining room with so much furniture that people had to climb over desks and tables to sit down to eat. You consider what the room is used for, and you consider the total look. You want it to be both practical and pleasing. The same is true for CBT, only instead of interior design, this process is called screen format and design. Your objective is to design screens that are both instructional and visually pleasing.

You want to place the right amount of information on the screen, not so much that students are overwhelmed by it, but enough to convey the message accurately. You want to vary the amount of text you provide so screens don't become monotonous. You also want to break up the text by using graphics, color, and other video attributes, such as highlighting, reverse video, underline, and blinking. You use graphics, color, and attributes to:

- compensate for consciousness in writing
- clarify or illustrate a point
- provide another learning mode for people who learn best visually
- motivate
- emphasize a point or a part of the screen
- direct or focus a student's attention
- provide variety both as an alternate depiction and a change of pace.

When you use graphics, color, and attributes, be sure to maintain a balance between them and the text you provide. Consider the frame as a whole, a visual image that requires spacing and proportion. Too much clutter and too many colors are exhausting to look at after awhile. The screen should not be so busy as to detract from the message. Graphics should be related in some way to the content: they should not be purposeless. Graphics are either instructional or motivational.

When you design graphics, you need to keep in mind who your target audience is and whether graphics are appropriate for that audience. For example, new SAS users may need more motivational tactics to keep them interested in the material and may be more receptive to fun graphics. More advanced SAS users may not respond positively to light-hearted motivational graphics.

Color and other video attributes are like the paint and stain of a house that make the house more appealing and can enhance the durability of the wood. Color and attributes in CBT make instruction more appealing and can enhance its instructional value. To use color and attributes, you, as well as at least some of the students, need a color monitor and a computer that supports extended video attributes. Limit the number of colors you use in text because too many colors tend to become distracting. You should also be consistent with the use of color to signal different types of text. For example, in our mainframe courses, we use cyan for text, white for directions, yellow for highlight, and green for SAS code. So whenever students see text in green, they know it is SAS code. However, instruction should never be dependent upon color or attribute references. For example, don't refer to something by its color or attribute as in: "The code displayed in pink above serves the function of..." Students that do not take the course on a color monitor will not be able to understand the reference.

You may also want to use animation occasionally to demonstrate a process that is not as easily depicted with a static graphic. Although animation is desirable at times, it uses precious computer resources and can take a considerable amount of time to develop. You may want to use short fun animations occasionally, but use animation primarily for instructional purposes.

BRANCHING

What would a house be like with no doors, no windows, no stairs? You can build a house like that, but the options it provides for places to go are greatly reduced. The same holds true for CBT. You can design linear instruction in which all students follow the same instructional path with no options. But you don't have to; in fact, you shouldn't.

One of the strengths of CBT is the ability to branch people to different instruction based on their needs or preferences. No matter how homogeneous your target population, there will be individual differences among students either in background and previous experience or in personal learning objectives. You can accommodate these differences by setting up opportunities for people to branch. You can provide options for people to select different pieces of instruction, giving them a sense of control over what they are learning, or you can branch people based on their responses to questions. You can then provide remediation, further practice, further information, more examples, or different instruction altogether.

Most CBT courses will have a menu system on a general level where students select different sections or lessons to take. Then within lessons you can provide further opportunities to branch, some voluntary some involuntary. However, just because you can branch doesn't mean you should. Branching requires extra work and putting in pieces of instruction that some percentage of students will never see. If that percentage of students is too high,
It may not warrant your branching. When students miss a question, you should branch them for additional instruction and practice only if the concept or skill is difficult or confusing enough that students will conceivably miss the question without just being careless or if the concept or skill is critical to achieving course objectives. Instead of branching, you can provide feedback and another try.

When you do provide branching, it should always relate directly to your behavioral objectives. Don't branch students to topics outside the domain defined by your objectives. This is going off on tangents.

**INTERACTIVITY**

You can equate interactiveness in CBT to all the appliances, fixtures, and facilities you interact with in a house, such as lighting, plumbing, radio, stereo, and telephone. You certainly wouldn't want a house without these features. CBT is just as dismal without its interactive features, and to learn effectively, students need to take an active part in the learning process. Having them interact with the computer on a decision-making, problem-solving level gets them involved. Branching is one interactive feature in CBT in which the computer responds to student input. Some other interactive features in CBT are practice, questions, feedback, and personalization.

**Practice**

One way to involve students is to provide opportunities for them to practice what they learn in the course. You can ask questions to test students' comprehension of concepts, or you can provide exercises in which they practice skills. People learn best by doing, so the more opportunity you provide for practice the better they will learn and the better they will be able to transfer their skills to their own work situation. You can program as much practice into CBT as you think any one student may need. CBT never gets impatient. You can provide optional practice for students who need or want the additional practice. Provide practice for every objective, but don't provide practice for anything that is not a stated course objective. You can provide post tests periodically so students can verify their mastery of course content. For a change of pace, you may want to combine on-line practice with written practice in supplementary print materials.

**Questions**

Part of the practice you provide involves asking questions. Question-writing is an art in itself. First you need to determine what knowledge or skill you are trying to test for. Then you decide whether it is something people can easily look up or something they really need to memorize. You examine the content, context, and the behavioral objective the student is trying to master, and then choose the type of question to ask. You can ask true-false, fill-in-the-blank, matching, multiple-choice, or another type of question. You should have a good reason for asking the type of question you do.

Any questions you ask should be stated positively as often as possible because negative questions are more difficult to understand. If you ask multiple-choice questions, you have to think up wrong answers as well as the right answer. In order for the question to be effective, your choices must be plausible mistakes a student might make. It is often difficult to anticipate errors students might make, but providing students the opportunity to make mistakes in your course helps prevent their making them on the job.

**Feedback**

Whatever kind of question you ask, you need to provide feedback to students' responses. The feedback should come as soon as possible after the students make the responses. If they are correct, you can commend them, reinforcing the learning behavior. If they are wrong, you can

- branch them to a remedial section with more explanation and practice
- give them the right answer
- give them a hint and another try

Whatever you do, don't make students feel stupid for answering incorrectly, and always let students know the correct answer or give them some way of finding it. Students should never be stuck on a screen that requires a correct answer to continue. Anticipating wrong answers and providing appropriate feedback are difficult skills in CBT, but providing instantaneous feedback either as reinforcement or remediation is one of the principal advantages of using CBT for instruction. It is often not possible with other forms of instruction.

**Personalization**

Part of making a student feel involved is personalizing the course. Use the second person (you) so students feel you are addressing them individually. If you can program the computer to do so, use the person's name. This gets a favorable response from people if used in moderation. Overuse tends to be condescending and can be more irritating than useful.

**MOTIVATING FACTORS**

Part of your job in designing instruction is to motivate students to learn. Motivating factors in CBT are like all the things in a house that don't need to be there but make it enjoyable and comfortable to live in, such as carpeting, pictures on the wall, mirrors, cabinets, and so on. In CBT, motivating factors are graphics, animation, color and attributes, already discussed in other sections of this paper, as well as reasons for learning, humor, and variety.

**Reasons for Learning**

Adults like to know why they are learning something. Then they can determine for themselves whether or not it is beneficial to them. If it is, they're more motivated to learn. If it isn't, they can choose not to learn it. In this way, they take a more active role in their own learning process. Therefore, let students know how they can benefit from the instruction you provide. For example, you could tell students one reason to learn the FSLETTER procedure is to be able to send masses of letters at one time, thereby saving a great deal of time and effort. Adults want to learn what will be useful to them; they want to know why, and they don't want to waste their time.

**Humor**

Using humor is a way to make learning fun, and having fun is always motivational! But humor can be a double-edged sword. Humor used appropriately communicates that one can have fun and still learn. But humor used inappropriately can backfire. What's funny to one person may be downright stupid or even offensive to the next. So, you have a choice. You can either not incorporate humor at all and risk being dull and dry, or you can try using innocuous or subtle forms of humor and risk being silly. Humor should never be tasteless or offensive to anyone and should never pick on any particular group of people. Senses of
humor vary from country to country, region to region, and cultural
group to cultural group, as well as from individual to individual.
So, if your audience is particularly diverse, you have to be espe-
cially cautious. Use humor judiciously and appropriately.

Variety

Variety makes a course more interesting and, therefore, is a
motivating factor. If all your lessons look and act the same, they
are going to be predictable and boring. Don’t use a formula to
write lessons. Use your imagination; be creative. You want peo-
ple to remember what you teach, so try out different ideas. Use
lists, charts, graphics, dialogues, mnemonics, and case studies,
as well as straight narrative. Experiment with new tactics, but
keep in mind the target audience, and keep your ideas fairly sim-
ple or at least consistent to the skill level you are teaching. Your
goal is to motivate people and to keep them motivated, not to
make your presentation tactics so involved that they distract from
the task of learning.

CONCLUSION

When you coordinate skillfully and painstakingly all the building
materials and components of a house, your effort is rewarded
with a stable, attractive, well-built house in which you can live
comfortably. When you coordinate all the instructional elements
of CBT in the same manner (skillfully and painstakingly), you are
rewarded with an effective, motivating, and interesting CBT
course! Developing CBT is an involved, challenging process, just
as building a house is. Because of its non linear nature, the pro-
gramming required, and the complexity of CBT design, CBT
development is a time-consuming and labor-intensive process,
no matter what authoring system you use.

This paper has examined some of the many different instructional
building blocks that make up a CBT course. This discussion has
not exhausted the many different components of developing CBT
and each instructional block could have been explored in further
depth. But you should have a good idea of what to consider when
developing, evaluating, or selecting CBT. There’s no magic to
CBT. Without careful design and development, CBT can be dull,
unorganized, confusing, and ineffective, just like any other kind
of instruction. But the reverse is also true. With careful design
and development, CBT can be a particularly stimulating and suc-
cessful form of instruction!