

Teaching Well Online: Part, I, Instructional Design

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Teaching online is not as simple as placing your lecture notes on the web—you must design the whole educational experience differently. This two-part presentation focuses on the need for instructional design, and also for interactive teaching and learning. Part I focuses on how to apply the principles of instructional design to online training materials or courses.

Systematic instructional design enables a course developer to answer three basic questions: (1) Where are we going? (instructional goals and objectives), (2) how will we get there? (instructional strategy), and (3) how will we know when we have arrived? (evaluation)⁹.

Where are We Going? (Defining Instructional Goal and Objectives)

The first step in any instructional design process is to define exactly what the student should know or be able to do at the end of an instructional unit. Learning objectives should be stated in terms of observable behaviors, i.e., what the students will do once they have achieved the learning objective. These learning objectives (outcomes) are critical for two reasons: (1) to give students a clear understanding of the learning task, and (2) to keep the instructor focused on the learning process. In addition, clearly written learning objectives allow both the student and the instructor to measure whether that goal has been met. Learning objectives drive the instructional strategy, delivery, and assessment (see Figure 1).

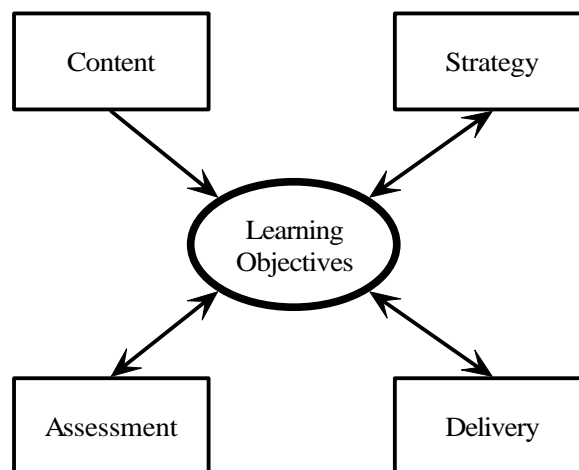


Figure 1. Relationship between learning objectives and instructional design process.²

Unfortunately, generating learning objectives is not as easy to do as it appears. The main reason is that as teachers, we tend to focus on our *instructional* goals, not the *learning* goals and objectives. For example, we may want our students to understand a concept or to apply a mathematical theorem. But, how do we assess their ability to do so? Our instructional goal must be restated in terms of an observable or measurable behavior that indicates mastery of that goal.

For most of us in education, these observable behaviors are in the cognitive domain (as opposed to psychomotor or affective). A useful tool, which appeared to be helpful to my colleagues, is a table of verbs from which they could select an observable behavior. This table was compiled from several sources.^{1,2,5}

Table 1. Observable Verbs in the Cognitive Domain

Learning Level	Associated Action Verbs
Knowledge - ability to recall information	Arrange, collect, complete, copy, count, define, duplicate, imitate, label, list, match, memorize, name, omit, order, outline, place, point, recognize, recall, repeat, reproduce, state, select, underline
Comprehension - interpreting information in one's own words	Classify, conclude, contrast, describe, discuss, estimate, explain, express, fill in, formulate, identify, illustrate, indicate, judge, justify, locate, name, recognize, report, represent, restate, review, select, sort, tell, transform, translate
Application - using knowledge in a novel situation	Apply, assess, choose, construct, compute, demonstrate, dramatize, employ, explain, find, illustrate, indicate, interpret, isolate, make, operate, perform, practice, prepare, predict, schedule, select, sketch, show, solve, use
Analysis - breaking down knowledge into parts and showing interrelationships	Analyze, appraise, calculate, categorize, classify, compare, conclude, contrast, criticize, defend, diagram, differentiate, discriminate, distinguish, examine, experiment, identify, inventory, justify, organize, present, question, resolve, select, separate, test
Synthesis - bringing together parts of knowledge to form a whole and solve a problem	Alter, argue, arrange, assemble, change, collect, combine, compose, construct, create, derive, design, develop, discuss, expand, extend, formulate, generalize, manage, modify, organize, plan, prepare, propose, rearrange, recombine, reconstruct, regroup, relate, restate, reorder, set up, summarize, synthesize, write
Evaluation - making judgments on the basis of criteria	Agree, appraise, argue, assess, assume, attack, attempt, avoid, challenge, choose, compare, cooperate, criticize, defend, determine, disagree, estimate, evaluate, identify, judge, predict, rate, recognize, score, select, support, validate, value

The learning objectives for each unit of instruction should appear in a prominent position on the first page of that unit (this is true regardless of whether the unit is Web-based or face-to-face). This helps the learner focus on the task at hand. In the face-to-face teaching mode, students are able to ask the professor for clarification on what exactly it is they think they will be learning.

Because this opportunity is limited for distance education students, clear learning objectives for each unit of instruction are even more important.

Other components of a learning objective include a description of the conditions of demonstration and a description of the standards or criteria⁹. Conditions of demonstration describe the tools or information available to the learners and are usually prefaced with the word *given*. Standards or criteria refer to the level of performance that is acceptable. In our usability tests, we found that the students wanted clear performance standards, i.e., what do I have to do to pass this part of the course. We also found these standards useful for assessment purposes.

How Will We Get There? (Instructional Strategy)

Like many other instructors, we use Gagne's nine "events of instruction" in our instructional strategy:

- Gain attention
- Inform the learner of the objective
- Stimulate recall of prior learning
- Present stimuli
- Provide learning guidance
- Elicit performance
- Provide feedback
- Assess performance
- Enhance retention and transfer

We organize these nine events according to Smith and Ragan's⁹ "expanded events of instruction", shown in Table 2.

Table 2. Expanded events of instruction.

Generative....student generates	Supplative...instruction supplies
Introduction	
Activate attention to lesson Establish purpose Arouse interest and motivation Preview the lesson	Gain attention to lesson Inform learner of instructional purpose Stimulate learner's attention Provide overview
Body	
Recall relevant prior knowledge Process information and examples Focus attention Employ learning strategies Practice Evaluate feedback	Stimulate recall of prior knowledge Present information and examples Gain and direct attention Guide or prompt use of learning strategies Elicit response Provide feedback

Generative....student generates	Supplative...instruction supplies
Conclusion	
Summarize and review Transfer learning Remotivate and close	Provide summary and review Enhance transfer Provide remotivation and closure
Assessment	
Assess performance Evaluate feedback	Conduct assessment Provide feedback and remediation

An important aspect to consider when designing online courses is how much scaffolding to provide students. Scaffolding refers to the cognitive processing support provided by the instruction. In the classroom, instructors intuitively provide extra scaffolding when students are grappling with complex theories or equations. This extra help must be built into online courses, where the instructor is not available to answer questions.

Introduction

One of the attractive features of using the Web is that new sites are only a click away. However, we need to be aware of the learner's tendency to browse when they are bored or lose interest in the instructional materials. To gain and keep the student's attention, try to make the site aesthetically pleasing and stimulating through visuals, color, and format. We also try to provide links to relevant sites that provide a contextual framework for the instruction. Animation, sound, and video clips are also other ways to gain attention, but these are beyond the resources for many institutions.

Apart from gaining attention, students must be motivated to learn. Student motivation is related to perceived relevance of the material and their confidence in their ability to master it (Keller's ARCS model⁴). Keller identifies six relevance strategies: experience, present worth, future usefulness, need matching, modeling, and choice. Choosing the appropriate strategy often depends on the subject matter and the resources you have available. For example, in an introductory course on engineering problem solving, several lessons were devoted to solving equations that required unit conversions (e.g., inches to feet, or feet to meters). As part of this unit we included a picture of a Mars probe and a brief discussion outlining how the failure to convert feet to meters contributed to its loss.

The introduction should also contain clear learning objectives and a brief overview of the content and structure of the instructional unit. If the instructional unit is part of a sequence of units, we found that it helped the student if they had a clear picture of where they were in the sequence. In some courses, we provide links to previous lessons; in another we just sequentially number the units.

Body

The content of the instructional unit should be sequenced to present lower-level learning objectives first, such as knowledge or comprehension. In our introductory engineering problem solving course, all the learning objectives are in the knowledge domain, so sequencing is not an issue. However, in a junior-level industrial engineering class, the order in which the material was presented is crucial, as we found out during our usability tests.

We follow Jacob Nielsen's⁷ guidelines for writing for the web as we develop the course content. These guidelines include following the conventional guidelines for good writing (organization, topic sentences, one idea/paragraph) so that the writing is concise and to the point, chunking the information so that it is scannable, and writing informally.

Many authors recommend structuring web-based training and education that will engage the learner in active learning (see Bostock² for a good summary). However, the literature contains more examples of theory than practice. We strongly believe in the constructivist approach to learning and try to incorporate many active learning strategies such as collaboration, critical reflection, and authentic contexts for learning by using tools such as email, web boards, small group work, and "real" documents with "real" authors. See Part II of this presentation for how to design interactive learning environments.

How Will We Know We've Arrived? (Evaluation)

Conclusion and Assessment

At the end of each instructional unit, a summary of the learning objectives is provided. In two of the courses we developed, we also presented short on-line quizzes to enable the students to assess their learning. These quizzes were created using CGI scripts and provided automatic feedback to the students. Links to additional practice problems were provided for students who did poorly on the tests. (We know of several faculty members who provide links to on-line copies of their final exams.) Further assessment was conducted using standard testing procedures in the classroom. In two other courses, we provided rubrics for assessing laboratory reports and technical reports.

Evaluation from the instructional designer's perspective generally refers to evaluation of the instruction (formative and summative). Formative evaluation is much more prevalent in training than in education and often includes one-on-one or small group testing of the instruction materials, review by experts, and field trials. However, in several of our courses we had enough lead-time to conduct formative evaluations.

Based on these evaluations, we made several major changes in the instructional materials. The most significant change was reducing the number of external links. These links were intended provide sources of prior knowledge, additional information on the subject, practice assignments, or interesting related materials. Unfortunately, we found that the students had a tendency to browse these links, which often distracted them from the material to be learned. In keeping with the suggestions of Ritchie and Hoffman⁸, we now limit external links to those that were directly related to the instruction.

Instructional Design Triage (What to Do If You Don't Have Time to Do It All)

“Given three criteria for doing a job - high quality, low cost, and rapid completion of the job - you can have any two”⁹. This statement was made with respect to applying the instructional design process to developing training materials, and it certainly also applies to developing educational materials. In addition, most educators do not have a development team to support them; therefore, they take on the role of designer/developer/media specialist/ instructor. It is in this role that I offer several suggestions.

First, concentrate on writing clear learning objectives. They will serve as a roadmap for both you and your students.

Second, use the tools that you have available. There are several good web-based instructional tools that provide course templates, collaboration tools, assessment vehicles such as on-line quiz generators, and course management tools such as on-line grade books and class registration. (For a concise evaluation of 10 "off the shelf" courseware products, see Gray⁶). I have used both CourseInfo by Blackboard, which I found very easy to learn, and WebCT, which has a little steeper learning curve.

Third, start by putting your existing materials on line. Then, every time you teach an instructional unit, evaluate it to see what active learning strategies can be incorporated into the unit. I particularly like using listservs, and have one established for each of my classes. Team projects and peer reviews are also effective.

Finally, enlist the help of your students. Very often, they may be more skilled at developing web pages than you and can be an excellent resource. I have assigned parts of several ISD projects to my students as class/home work. Because these assignments are 'real-world' tasks, they pitch in with enthusiasm.

In summary, at whatever level you apply the instructional design process to developing web-based education or training, it can be a challenging and rewarding experience. Good instructional design results in clearer instruction and, hopefully, a better learning experience for the student, which should be our ultimate goal.

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