

Instructional Design Principles in the Development of LearnFlex™

A White Paper by

Dr. Gary Woodill, Ed.D.
Chief Learning Officer, Operitel Corporation
gwoodill@operitel.com

Dr. Karen Anderson, PhD.
Senior Consultant, Operitel Corporation
kanderson@operitel.com

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Introduction

In 1998 we were part of the team that was asked to design, build and deliver a learning management system (LMS) for a major Canadian bank. Since that time, the product has evolved into the current version of LearnFlex™, a full-featured LMS offered by Operitel Corporation. This paper describes the instructional design principles that were built into LearnFlex™ from the start, and which continue to be the foundation of the current version.

Instructional design may be defined as the act of finding the best method or combination of methods to teach a specified learning objective to a learner or group of learners. Good instructional design does not fix the method(s) of instruction *prior* to identifying both *what* is to be taught and *to whom* it is to be taught. Different learning objectives require different instructional designs. Different learners have different cognitive styles, motivations, abilities, and needs - they also require different instructional designs.

Any rapid development, web-based training software package that purports to have one specific instructional design in place, ready to be immediately used by trainers, is problematic. A good rapid development instructional software package must provide trainers with the flexibility to choose among a variety of teaching and testing methods and procedures. Trainers should be given every opportunity to exercise their expertise and judgment in determining which instructional design model(s) are best suited to teaching specific learning objectives to a particular learner or group of learners.

LearnFlex™, while primarily designed as a web based training product, is based on a flexible modular pedagogical model for computer-based training that applies to *both* the Internet and CD-ROMs. The modular design of LearnFlex™ allows trainers to choose among a wide variety of “learning objects” and support structures in creating learning programs. LearnFlex™ adapts to the teaching of both “lower order” educational objectives such as learning facts, and “higher order” educational objectives such as evaluation and analysis.

LearnFlex™ offers trainers maximum flexibility in constructing courses and in customizing them to the needs of individual learners. LearnFlex™ supports instructional design that draws on adult learning principles, Bloom’s Taxonomy of Educational Objectives, and Competency-Based Training, the newest approach to skills and knowledge learning.

LearnFlex™ And Adult Learning Principles

LearnFlex™ supports instructional design that uses the following adult learning principles:

- Individualization
- Interactive learning (versus passive reception)
- Self-directed study
- Learn what you need to know
- Work on relevant, realistic problems
- Learn at your own pace, including “just-in-time” learning (performance support)
- Work in your own place

- Provide both one to one and group interaction
- Leverage meaning, context and motivation in engaging the learner

LearnFlex™ is a software platform that can support all the above principles, although the actual practice of the principles depends heavily on the instructional designer and the content used to teach online.

Bloom's Taxonomy Of Educational Objectives

Bloom's Taxonomy of Educational Objectives details six hierarchically arranged levels of cognitive achievement that are applicable to most learning situations. These levels are:

Level 1: Factual knowledge: the recall of information

Level 2: Comprehension: the translation, interpretation or extrapolation of knowledge

Level 3: Application: the application of knowledge to a new situation

Level 4: Analysis: the breakdown of knowledge into its parts, showing the relationships among the parts

Level 5: Synthesis: bringing together parts (elements, components) of knowledge to form a whole and to build relationships for new situations

Level 6: Evaluation: judgements about the value of material and methods for given purposes

These six levels of cognitive achievement are arranged in a hierarchical ordering and are further divided into two broad categories: higher order thinking and lower order thinking. Factual knowledge (Level 1) is designated as the lowest level of cognitive achievement (lower order thinking) and evaluation (Level 6) is designated as the highest level of cognitive achievement (higher order thinking). Bloom maintained that knowledge is built from the 'ground up'. Thus, Levels 1, 2, and 3 are foundational and focus on information that can be explained or demonstrated by an instructor. Levels 4, 5 and 6, on the other hand, focus on information that is discovered by an individual learner, with, or without the informed guidance of an instructor.

LearnFlex™ And Bloom's Taxonomy

Bloom's Taxonomy helps instructional designers formulate learning objectives so that learners know clearly what they are expected to be able to accomplish after the lesson. There is no good or bad level of cognitive achievement. Different types of tasks require different orders of thinking. LearnFlex™ accommodates instructional design directed at each of the six levels of cognitive achievement identified by Bloom, thus including learning objectives that require both higher and lower order thinking skills.

Lower Level Thinking

Level 1: Factual knowledge. At this level of cognitive achievement, learners acquire an understanding of "who, what, where, how". Students learn to describe, define, match and select from among a range of choices. They are able to identify best choice among a number of options, and to indicate reasons for that choice. At this level learning objectives include acquiring

the skills to provide factual answers to direct questions and testing focuses on learner recall and recognition.

Examples of how to use LearnFlex™ to teach factual knowledge include drill and practice exercises, computerized flash cards, and the presentation of text and sound in a lecture format. Testing for factual knowledge is accomplished by multiple choice, true or false questions, and "fill in the blanks".

Level 2: Comprehension. Here learners acquire the ability to interpret and extrapolate from an existing body of factual knowledge. They learn to explain the meaning of terms, select parts that don't fit, identify statements that support an existing body of knowledge, match parts of a whole, and select the correct response from a group of responses. Testing focuses on selecting the best definition, indicating what will happen next in a series of steps, reading graphs, and tables, and demonstrating an understanding of the correct ordering of a sequence of steps.

LearnFlex™ can be used to teach comprehension by segmenting knowledge into layers, presenting both a top-level view and the ability to drill down at any point for more details or background. Testing comprehension can be accomplished by properly framed multiple-choice questions, multiple answer questions, reordering lists, matching, and/or by selecting themes from a body of materials presented to the learner.

Level 3: Application. At this level of cognitive achievement learners are able to apply existing knowledge to situations that have a new slant, differentiating them from situations the learners are already familiar with. Students learn to judge the effects of a change, predict what will happen if certain elements are varied, and tell how, when, where and why a change will occur. Testing this level of cognitive ability focuses on requiring the student to select from among a series of statements that might apply, identify the results of a particular action, and explain what would be the result of a specific set of actions.

Application knowledge can be taught using LearnFlex™ through demonstrations, animated sequencing, and simulations. Testing of application level objectives can be achieved through drag and drop placement of elements, and through case studies where knowledge learned is applied to specific problems.

Higher Level Thinking

Level 4: Analysis. By the time they reach this level of cognitive achievement, learners have moved from acquiring information based on explanation and demonstration, to learning based on a discovery mode. At this level students learn to break down a complex problem into its constituent parts and forms. They can identify the relationship between parts, identify the main parts, and subsidiary parts, identify what is central, extraneous, and not applicable to a system, identify underlying assumptions and choose among possible conclusions. Testing at this level of cognitive ability focuses on identifying inconsistencies, identifying variables as related, extraneous or not applicable to a given system, distinguishing between relevant and irrelevant statements, identifying most and least essential elements, stating points of view, justifying conclusions, and explaining the function of parts of a system.

Teaching analysis through LearnFlex™ is accomplished through the use of dynamic models that break down into constituent parts, as well via as content analysis exercises which follow complex readings. Testing for analytic abilities can be accomplished with an outlining exercise that can then be submitted via e-mail to an instructor, or with a discovery exercise in which students are asked to find hidden elements in a graphic or text.

Level 5: Synthesis: At this level, students are able to combine elements into new and original patterns. They learn to create new systems, propose alternatives to existing systems, solve problems that draw on information from multiple systems that are not necessarily related to each other, and develop and design their own plans of action. Testing at this level focuses on problem solving, including formulating alternative means of achieving a specific end, developing means of testing the efficacy of new systems, and stating rules that are applicable to new systems.

Synthesis skills can be taught and evaluated in LearnFlex™ through the use of puzzles of many kinds, and through the presentation of creative exercises.

Level 6: Evaluation: At this level of cognitive development, students practice evaluating processes and systems according to a set of criteria. They are also able to justify the evaluations they make on the basis of a set of explicit criteria. Students learn to appraise, judge, critique and defend their judgements and critiques. Testing at this level focuses on student ability to identify fallacies, inconsistencies and errors, and to identify logical, valid and appropriate statements.

Evaluation of learning in LearnFlex™ can be accomplished through a variety of rating scales, and from making judgements and then comparing them with "experts". Testing can include exercises in identifying errors of judgement, inconsistencies and logic.

Competency-Based Training

In addition to supporting different types of learning based on adult learning principles and Bloom's Taxonomy of Educational Objectives, LearnFlex™ also supports competency-based training, a relatively new approach to skills and knowledge learning.

Competency-based training addresses specific competencies, or task outcomes, that must be performed. It focuses on workplace requirements and expectations, linking the knowledge of a subject, or the demonstration of a skill to a specific outcome, or job requirement.

Competency-based training gives learners a greater choice of and diversity in what, where, and how they learn. Because the focus is on what a person can do, rather than how much time s/he spends in training, existing knowledge is taken into account, regardless of how, or where, that knowledge was acquired.

Key features of the competency-based training approach include:

- Based directly on skills and abilities required to do a job
- Takes account of learners' existing level of competency. Prior learning is recognized as contributing towards a competency.

- Learner can practice a specific skill at his/her own pace, until s/he is satisfied
- All steps necessary to achieve a skill are readily available to the user
- Additional help is immediately accessible
- Learners are able to choose which points to enter and exit a learning sequence
- Training can take place in a variety of settings
- Assessment is a personal process. Learners can choose to be assessed when they are ready
- Learning outcomes and assessment requirements are detailed at the start of training sessions, avoiding surprises
- Learners are provided with a record of the competencies they have already achieved, and competencies they have yet to achieve

LearnFlex™ And Competency-Based Training

LearnFlex™ has a built-in database for dynamically storing job-related competencies, and the ability to generate individual learning plans that specifically address the individual competency needs of each user. LearnFlex™ provides the tools to assess the gap between each individual learner's existing competencies (via test results and other means of collecting data) and the required competencies for the learner's current or future job. Another database tracks each learner's progress through the required educational materials, and generates reports at every specified stage.

As an example, employing LearnFlex™ to teach the use of a software application that combines Bloom's Taxonomy with competency-based training and adult learning principles might look like this:

1. Identify competencies necessary for using a specific software application (identify what learners *should* be able to do when training is complete).
2. Identify different groups of users of the specified software application, and their different competency requirements (if needed)
3. Set competency expectations (performance objectives) for each user group. Establish procedures to determine individual level of competency
4. Establish individual learning plans based on a) level of competency (determined in step 4 above), and b) group membership
5. Provide appropriate training on basis of steps 3, 4 and 5.
6. Provide appropriate form of evaluation, specific to organisational requirements, and to individual user
7. Provide means for user to return to training for more learning if necessary and continue learn/evaluate cycle until organisationally determined acceptable evaluation is obtained.

Flexible Architecture

Today, there are over 500 separate learning management systems on the market. Yet, many of them lack sufficient *flexibility* in order to be really useful to either learners who use or organizations that install such systems. There are two main reasons why flexibility is important in

the design of learning technologies.

First, human beings learn in many different ways. Because of that fact alone, learning technologies must be flexible. Second, the organizations that use learning technologies often want a high degree of customization for each system that is installed. They may want a myriad of report formats, many different ways of teaching and testing to be tracked and reported, a user interface that switches languages and/or graphical design, personalization of content for each learner, and/or the ability to choose different software features for different learner populations.

A set of flexible learning technologies can be combined to produce a specific *flexible learning system*. In *component based software architecture*, such as Operitel's LearnFlex™ technology, a large variety of configurations are possible, depending on the requirements of each client.

All this makes the design of truly flexible learning technologies quite complex. At the same time, users (both learners and administrators) need to experience all flexible learning technologies as simple to use. LearnFlex™ was designed to be flexible in the following ways:

- *Flexibility of time and place* - learners want to study on their own time, within their own timeframe and in a setting of their choosing.
- *Personalization of content and/or media* - a flexible learning technology is one that can be adjusted to the individual learner and provides for individual learning plans.
- *Control and choices* – adult learners want to control what they will learn and how they will learn it. These choices can be made in a “learner centred” system. In other systems, there is a flexible menu of content choices made by instructional designers, teachers or administrators. This would be seen as a “teacher centred” system. LearnFlex™ can be adapted to either approach, or a mix of both.
- *Changing "business rules" and processes* - administrators and teachers will want to be able to easily change the rules of how various parts of the system work. While schools and universities may not see themselves as businesses, they do have specific meanings for grades, passing, deadlines, and other procedures in the educational enterprise. The introduction of e-commerce to online learning systems has furthered the demand for flexible systems to control and change business rules in educational applications.
- *Customizability and interchangeability of software components* - teachers and administrators often want to choose what features of a learning system that they want to implement. In addition, there is often demand to use legacy data and/or "rich media" in multiple formats, and any flexible learning technology needs to accommodate this demand. LearnFlex™ is able to automatically launch, display and track educational materials in a number of different file formats.

The *power* of computer-based learning technologies is that the computer can sort through many options and process complex algorithms in order to come up with individualized teaching strategies, test learners in different ways, and report the results in multiple formats. Truly flexible learning technologies need the following features:

- They need to be based on a powerful relational database.
- They need to use legacy data combined with new information.

- They need to be based on software components that connect together easily.
- They need multiple ways of entering data into the database.
- They need a customizable report generator that can be configured to draw on the data sets that are needed for relevant reports.
- They need to be networked using World Wide Web protocols so they are available at any time and any place.
- They need to accommodate multiple languages.
- They need to test and track learners against learning objectives or competencies, and adjust the teaching according to the test results.
- They need to accommodate multiple teaching strategies, delivered according to the learning task and the learner characteristics.
- They need to store data on individual learners in a meaningful way so that personalization and adaptation of teaching is possible.
- They need to be interoperable - that is, the system needs to be able to read data from other systems and send data to other systems.
- They need to be able to change the look and feel of the interface according to the identity of the user.

LearnFlex™ is designed to do all of the above. And, because the needs of end users can be very different, flexible learning technologies can be built in layers in order to build a variety of versions at different levels of complexity. The architecture is similar to that found in Russian dolls, the kinds that come apart to reveal smaller components inside.

In summary, LearnFlex™ is a flexible system of easily constructed and modified educational objects for delivery on any computer network that uses Internet protocols. By accommodating a wide variety of educational materials based on different instructional design models, LearnFlex™ offers an excellent environment for the rapid development of courses designed to maximize learning and retention, and minimize disruption of business processes.

Dr. Gary Woodill, a former Professor of Education at Ryerson University in Toronto, Canada, has taught teachers for over 20 years. He has developed educational models for children's CD-ROMs and for web-based training. He is currently Exec. VP, Aipta Corporation, a consulting group for effective online learning. He can be reached at woodill@alipta.com.

Dr. Karen Anderson is an Associate Professor of Sociology at York University, Toronto, Canada. She has been an adult educator for over 20 years, and is a Senior Consultant for Aipta Corporation. She can be reached at karenand@yorku.ca.

For more information on LearnFlex™ please visit www.learnflex.com or contact info@learnflex.com.