# Problem Solving and the ADDIE Model

By

Marc R. Dastous

January 24, 2004

# Table of Contents

## Introduction

To truly understand the concept of problem solving, we must first determine a plausible definition for the word, problem. Problems can be classified in one or all three of the following categories; 1) an opportunity for improvement, 2) the difference between your current state and your goal state and 3) the results from the recognition of a present imperfection and the belief in the possibility of improvement. Therefore, we can define problem solving as the management of a problem in a way that successfully meets the goals established for treating a problem (Harris, 1998).

This paper will use the ADDIE model to demonstrate the problem solving process and the potential issues that can positively or negatively impact an instructional design project.

## Expert and Novice Paradigms

The level of skill possessed by individuals charged with solving a problem is directly related to the schemata they will use to solve the problem (Marcus, 2003). To sort this out, we will identify 2 groups of problem solvers, experts and novices, and their modus operandi for solving problems.

An expert is classified as someone who has a large amount of content knowledge within a specific domain and has practiced their craft extensively. Additionally, experts are able to “chunk” large amounts of material into meaningful patterns. They can then take the meaningful patterns and create representations that detail a solution to a problem.

The novice, on the other hand, is someone who has little knowledge or experience within a domain. Therefore, much of their problem analysis skill will focus on superficial issues with no real patterns (trial and error) being developed (Marcus, 2003).

Therefore, in the design of instruction, it is important to identify the level of expertise of the potential learners to effectively determine the scheme of the instruction.  An expert will need much less detail than a novice.  Providing too much detail to an expert could cause the instruction to become redundant.  Conversely, not enough detail may leave the novice without the content necessary to build expertise. This identification should take place in the needs analysis phase of the instructional design (ID).

A needs analysis should be used to determine where you should expend your training energies (Sloan, 2000-2003).  It should determine the differences in the performance outcomes and the current knowledge level of the target audience (Kruse, 2002).  This is critical to ensure that instruction focuses on new skills, or refining old skills, that are needed to improve expertise.

## Barriers That Can Impact Problem Solving

### Functional Fixedness

In 1945, K. Duncker's research revealed that Functional Fixedness (Mental Set) did indeed exist.  He indicated in his writings that our minds are blocked by preconceived notions about the traits of a person place or thing, based on prior knowledge (Eysenck, 2001).  The impact of Functional Fixedness on ID can be both positive and negative.

When designing a learning activity for an expert, care should be given to alter the structure of the instruction.  Developing a repetitive nature (Functional fixedness) in your instructional design could potentially lead to the redundancy we wrote of earlier.  There would be a resulting negative impact on the development of expertise.

Repeated use of similar methods for developing novice expertise would beneficial. Jacobson writes, "...a cognitive verbal protocol methodology was used in which the subjects were read the questions and then verbally reported all ideas they had as they solved the problems" (Jacobson, 2000). This study goes on to develop a model that indicates reductive understanding is more in tune with the novice; while non-reductive understanding is more in tune with experts.

**Set Effects (Mental Models)**

Set effects, more widely known as mental models, are psychological representations of real, hypothetical, or imaginary situations. Scottish psychologist Kenneth Craik (1943) wrote that our mind constructs "small-scale models" of reality that it uses to anticipate events, to reason, and to underlie explanation (Byrne, 2003).

The Design phase provides an outline for all learning objectives, modes of assessment, modes of delivery, assignments, exercises and the content of the course (Kruse, 2002). When designing instruction for experts, an Instructional Designer must take care to design instruction that will not allow learners to use their anticipatory skills to visualize an answer until the conclusion of the activity. They are already using their extensive knowledge base to solve problems; therefore any additional help would be redundant. Novices would more effectively use this method to develop the use of their anticipatory, preceptor and visualization skills, resulting in an increase in their level of expertise.

**Cognitive Load Theory (Limited Working Memory)**

There are many domains in which the student, expert and novice alike, experience a very high cognitive load due to the nature of the domain (ie. computer programming, software developers, etc). The Cognitive Load Theory is built around the idea that working memory can only handle seven "chunks" of data at a time and that a learner processes only about two or three of these chunks simultaneously.

Within ADDIE, it is inherently important to design and develop instruction in a way that the intrinsic and extraneous cognitive loads can be minimized for problem solvers. Understanding the cognitive loads, within the domain in which instruction is being developed, will prevent working memory overload that will more often affect domain novices (Garner, 2001).

The instructional designer can also utilize a third cognitive load, the germane, if the extraneous load is minimal and the intrinsic load is low. The germane load allows learners to begin consciously processing information thereby developing schema, and leading to the improvement of expertise (Garner, 2001). While experts' process information relevant to their domain automatically, novices must to process information consciously to improve expertise. This technique would greatly help their processing of information.

**Confirmation Biased**

It is imperative when problem solving, and developing instruction, that we play the 'devils advocate'; "...but what if this happens?" Confirmation bias occurs when we focus solely on the evidence which tends to support the things we already believe, or that we want to be true, while ignoring that evidence that is contrary to those beliefs or ideas (Carroll, 2004).

Within an instructional design model, like ADDIE, we must take care to view both sides of the equation. As instructional designers, we must give equal weight our view point and the opposing viewpoint to ensure objectivity within the instruction. Failure to do so could result in faulty instruction. One way to avoid this pitfall is to collaborate with a colleague that has an opposing viewpoint would be a solution. Within the analysis phase we must identify both sides of an issue, the design phase will require a determination on the mode of instruction to address both viewpoints and in the development stage we must ensure that the instruction actually addresses the needs of the target learner, whether expert or novice.

### Premature Evaluation

The unfortunate consequence of rushing to implement instruction is the potential for prematurely evaluating the results of the implementation. Johns (1996) lists three methods of premature evaluation, the first being when we evaluate certainty. When we are uncertain of what we are evaluating it is very difficult to measure success. Secondly, when we refer to incorrect assumptions or conclusions we are not legitimizing the solution to the problem, we are only exacerbating it. Finally, when we reexamine a false assumption we are only wasting valuable time in the evaluation of what is important.

## Using Divergent Thinking Strategies to Support the ADDIE model

With all the possibilities that exist for solving problems, sometimes specific strategies must be employed. Within an instructional model, instructional designers must provide avenues to help learners solve problems. This will result in meaningful instruction that will encourage novices to improve their expertise and experts to grasp more ”chunks” of information.

The concept of divergent thinking is to generate as many different ideas about a topic, in a short period of time, as possible. It involves breaking a topic down into its various components in order to gain insight about the various aspects of the topic. Divergent thinking happens in a spontaneous, free-flowing manner, such that the ideas are generated in a random, unorganized fashion (Smith & Ragan, 1999). Brainstorming, journal writing and concept mapping are examples of divergent thinking strategies or techniques.

### Brainstorming

Brainstorming is a technique which involves generating a list of ideas in an unstructured manner. The goal of brainstorming is to generate as many ideas as possible in a short period of time and have those ideas build on each other. During the process, ALL ideas are recorded, and no idea is disregarded or criticized. After a long list of ideas is generated, one can go back and review the ideas to critique their value or merit (1996, August 21).

### Journal Writing

Journal writing is an effective way to record ideas that one thinks of spontaneously. By carrying a journal, one can create a collection of thoughts on various subjects that later become a source book of ideas. People often have insights at unusual times and places. By keeping a journal, one can capture these ideas and use them later when developing and organizing materials in the prewriting stage (Routman, 1995).

### Concept Mapping

A concept map involves putting brainstormed ideas in the form of a visual map or picture that that shows the relationships among these ideas. One starts with a central idea or topic, and then draws branches off the main topic which represent different parts or aspects of the main topic; much like the example in Figure 1. The result will help learners because they will select the appropriate strategies, regulate, and then evaluate their learning.

## Conclusion

The ADDIE model is not only a structure and guide to developing effective instruction; it is a tool with which to design instruction that is effective for each level of learner. An instructional designer must have a thorough understanding of the domain within which they are creating instruction, and determine the level at which that instruction will be developed.

There are barriers that must be addressed at every level of ADDIE, but it all starts with a proper analysis. Without identifying key aspects of a problem, an effective solution cannot be achieved.

## Figures

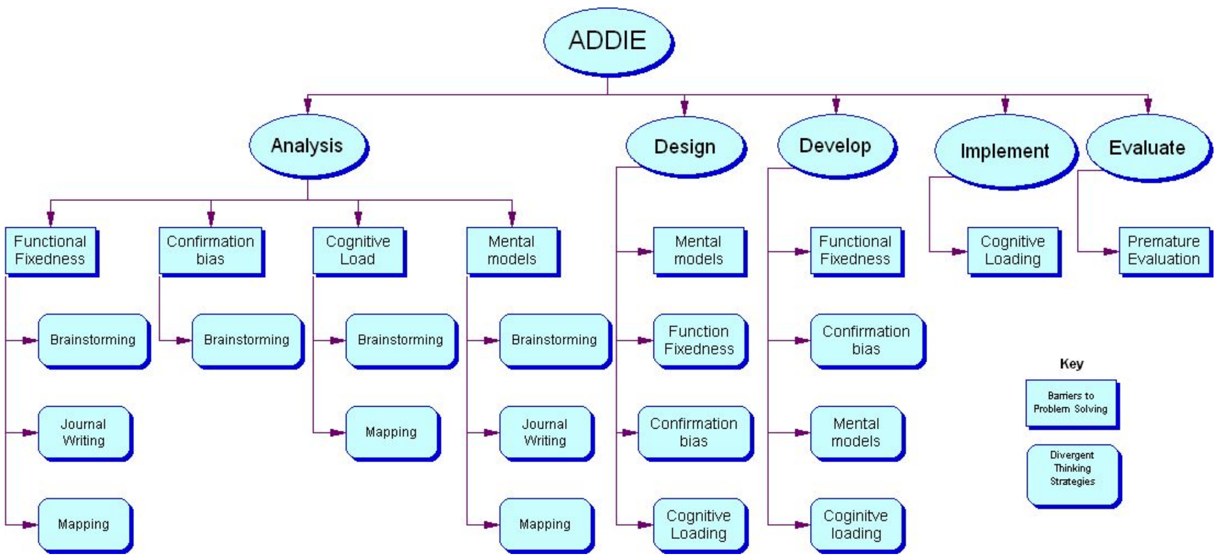


**Figure 1.**

## Reference List

*Brainstorming for teachers*. (1996, August 21). Retrieved January 24, 2004, from San Diego State University: Triton Project Web site: http://edweb.sdsu.edu/triton/guides/Brainstorming.html

Byrne, R. (2003, September 29). *Mental models: A gentle introduction*. Retrieved January 24, 2004, from The University of Dublin Web site: http://www.tcd.ie/Psychology/Ruth_Byrne/mental_models/

Carroll, R. T. (2004, January 14). *Confirmation bias*. Retrieved January 24, 2004, from The skeptic’s dictionary Web site: http://skepdic.com/confirmbias.html

Eysenck, M. W. (2001). Language and thought. In *Psychology for A2 Level* (p. 340). London, UK: Psychology Press.

Garner, S. (2001, November). *Cognitive load reduction in problem solving domains*. Paper presented at the International Conference on Computers in Education, Seoul, Korea. Retrieved January 23, 2004, from http://www.icce2001.org/cd/pdf/p08/AU107.pdf

Harris, R. (1998, July 2). *Virtual Salt: Introduction to problem solving*. Retrieved January 23, 2004, from http://www.virtualsalt.com/crebook3.htm

Jacobson, M. J. (2000). Problem solving about complex systems: Differences between experts and novices. In B. Fishman & S. O'Connor-Divelbiss (Eds.), *Fourth International Conference of the Learning Sciences* (pp. 14-21). Mahwah, NJ: Lawrence Erlbaum. Retrieved January 24, 2004, from http://www.umich.edu/~icls/proceedings/pdf/Jacobson.pdf

Johns, T. (1996, November 12). *Premature evaluation*. Retrieved January 24, 2004, from The University of Birmingham, UK Web site: http://web.bham.ac.uk/johnstf/revis014.htm

Kruse, K. (2002). *e-Learning and the ADDIE model*. Retrieved November 19, 2003, from http://www.e-learningguru.com/articles/art2_1.htm

Marcus, N. (2003, October 29). *Expert versus novice: Development of expertise*. Retrieved January 23, 2004, from The University of New South Wales, School of Computer Science and Engineering Web site: http://www.cse.unsw.edu.au/~cs3511/lectures/Lecture-13-expert.pdf

Nelson, W. A. (2000). Chapter 9: Gagné and the new technologies of instruction. In *The Legacy of Robert M. Gagné* (pp. 229-251). Syracuse, NY: ERIC Clearinghouse on Information & Technology and the International Board of Standards for Training Performance and Instruction. Retrieved January 23, 2004, from http://www.ibstpi.org/Legacy-Gagne/chapter%209.pdf

Routman, R. (1995). *Changing as teachers and learners K-12* (Rev ed.). Portsmouth, NH: Heinmann. (Original work published 1991)

Sloan, J. (2000-2003). *Read Darwin*. Retrieved November 19, 2003, from http://www.darwinmag.com/read/080103/needs.html

Smith, P. L., & Ragan, T. J. (1999). Strategies for cognitive strategy instruction. In *Instructional design* (p. 232). Hobokan, NJ: John Wiley & Sons.

Problem Solving Model for teaching experiential learning and team building activities. Plan, Do, Review and Adapt Model. View more free teambuilding challenges.Â  Having correctly identified the problem, participants should now be taught the importance of taking â€˜time outâ€™ in order to think about the whole problem and the consequences of the different possible solutions. Once, you have done this allow time for them to listen and discuss ideas and work as part of a team. This research aims to develop problem solving model for science learning in junior high school. The learning model was developed using the ADDIE model. An analysis phase includes curriculum analysis, analysis of students of SMP Kota Padang, analysis of SMP science teachers, learning analysis, as well as the literature review. The design phase includes product planning a science-learning problem-solving model, which consists of syntax, reaction principle, social system, support system, instructional impact and support. Implementation of problem-solving model in science learning to improve students' science process skills. The development stage consists of three steps: a) designing a prototype, b) performing a formative evaluation and c) a prototype revision. The problem-solving model, introduced below, incorporates an effective set of skills into a step-by-step process. The model combines the use of statistical tools, such as control charts and process flow diagrams, with group problem-solving skills, such as brainstorming and consensus decision-making. The statistical tools help us make data-based decisions at various points throughout the model. The group problem-solving skills help us draw on the benefits of working as a team. Philosophy of Problem Solving. Before we begin a discussion about the steps of the problem-solving model, we should talk a little about the philosophy that good problem solvers have about problems. Here are a number of ideas that are part of the philosophy. Developing successful problem solving techniques will help your business. Learn how to use decision making tips and develop a specific creative problem solving technique for your business challenges. All business owners and managers face problems and challenges in operating the business; it's important to find useful tactics and strategies, such as effective problem solving models, to ensure that you make the right decisions in facing your challenges. Search This Site. Custom Search. A significant aspect of managing your business includes developing and using problem solving models. Why? Because problem solving is a day-to-day activity in every business and as a business owner, you need to become very good at solving problems quickly and efficiently.