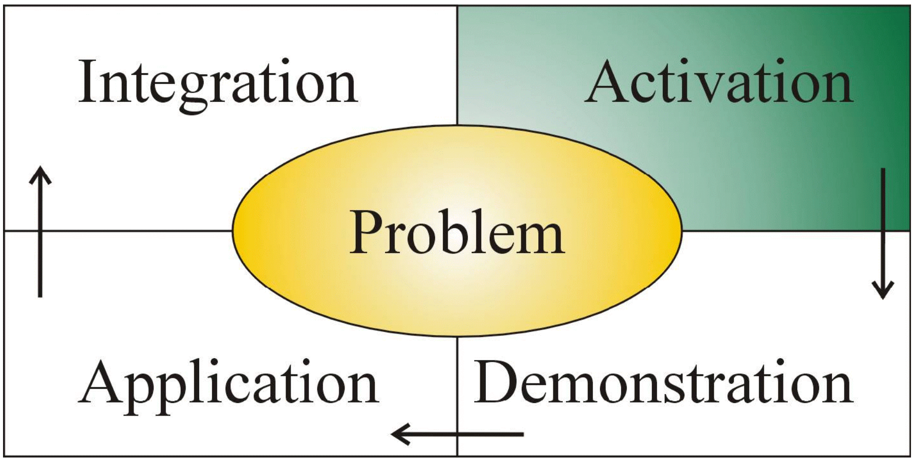
Chapter 2 - Activation



"Learning is facilitated when the learner is provided with relevant experience that can be used as a foundation for the new knowledge."

(Merrill, 2001, p. 5)

Chapter 2 - Activation

2.1 Introduction

This chapter provides an overview and a brief summary of learning theory, curriculum theory, instructional design theory and the instructional design process.

Merrill's design theory, First Principles of Instruction, is emphasised as well as the following aspects:

- the value of using a real-life problems in the instructional event
- the importance of activation of existing knowledge of the learner
- the role of demonstration
- guided problem solving and
- the integration of new knowledge with existing knowledge.

2.2 Background

Education and training worldwide is changing from standardisation to customisation; from educator-centred or teacher-centred to learner-centred, from memorisation to understanding. Learners are expected to direct their own learning, pace their learning activities and to become lifelong learners. Companies need "employees who can take initiative, think critically, and solve problems" (Reigeluth, 1999, p. 18).

This requires a paradigm shift in education and instruction. Educators become facilitators and only one of many resources available to learners. It also implies that educators have to change their method of instruction. A multitude of instructional design theories are being developed to assist educators in their new roles.

> Learning-focused instructional design theory must offer guidelines for the design of learning environments that provide appropriate combinations of challenge and guidance, empowerment and support, self-direction and structure(Reigeluth, 1999, p. 21)

Instructional design theories take into account the findings of both learning theories and curriculum theory. These three theories in turn influence the actual design process. Because of the close relationship between instructional design theory, learning theory, curriculum theory and the design process, instructional designers should be familiar with all four theories.

This section is structured as shown in Figure 2.1

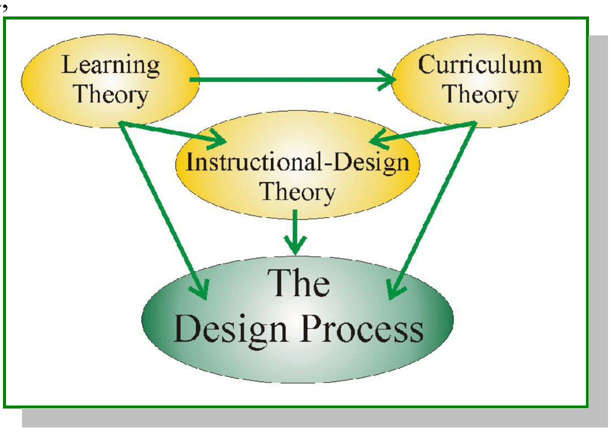


Figure 2.1 - Theories

2.3 Learning Theory

Learning Theory

Learning theories are one aspect of cognitive psychology; they describe how learning takes place. Reigeluth postulates,

> Three views of learning have emerged during the past 100 years of research on learning: learning as response strengthening, learning as knowledge acquisition, and learning as knowledge construction. (Reigeluth, 1999, p. 143)

2.3.1 Behaviourism

The first view of learning, learning as response strengthening, is also known as behaviourism. Although the concept of behaviourism can be traced back to the Greek philosopher, Aristotle, the term behaviourism was coined by John Watson and most behaviourist theories were developed in the late 19th and the first half of the 20th century. Behaviourist theories are based on studies of animal learning in laboratory settings. The behaviourist sees learning as a change in behaviour and is concerned with stimulus-response events. Key figures in the development of behaviourist theories are Ivan Pavlov, Edward Thorndike, John Watson, Lev Vygotsky (in the field of social learning) and Burrhus Skinner, whose influence is still strongly felt in education. Benjamin Bloom’s Taxonomy of Educational Objectives and Robert Gagné’s taxonomy of learning are both founded on behavioural psychology.

These theories have implications for instructional designers. Programs are designed to be linear, content is divided into small portions and the learners receive immediate feedback for each active response to a stimulus. Repetition and reinforcement are important elements of any instructional activity.

2.3.2 Cognitivism

The second view, learning as knowledge acquisition or reception learning, can also be traced back to the ancient Greeks, but the main theories were developed between 1950 and 1980. Cognitivist theories are based on studies done on humans in laboratory settings and argue that learning occurs when new information is placed in the long-term memory of the learner. “The primary focus of the cognitive approach to learning is how processing affects the understanding and retention of information” (Dills & Romiszowski, 1997, p. 634). The best-known cognitivists are Jean Piaget, Jerome Bruner and David Ausubel.

In instructional design cognitivism places emphasis on rehearsal and repetition so that the learner can better organise and remember the information.

2.3.3 Constructivism

The third view, learning as knowledge construction, is also known as constructivism or discovery learning. Although Frederic Bartlett pioneered the constructivist approach in 1932, most constructivist learning theories were only developed over the last 20 years and are based on studies done of human learning in realistic settings. Constructivist theories assume that knowledge is constructed by the learner. Advocates of constructivist theories are Howard Gardener, David Jonassen and M. David Merrill.

Instructional design therefore provides real-world, case-based learning environments with authentic tasks and enables knowledge construction through the use of branched rather than linear design. Mergel gives a balanced definition of the concept,

> Constructivism promotes a more open-ended learning experience where methods and results of learning are not easily measured and may not be the same for each learner. (Mergel, 1998, online)

2.4 Curriculum Theory

Curriculum Theory

Curriculum theories are concerned with the content of instruction, i.e. with 'what to teach'. Content is closely linked to the goal of the instruction, with defined outcomes to be achieved and identified skills to be mastered. Curriculum theory explores areas such as the social construction of knowledge, the influence of technology on learning and the effect of politics on curricula. It examines ideological orientations towards the curriculum and provides guidelines for curriculum design and development. Curriculum theory implies interaction with and influences on a range of factors,

> The character of curriculum shapes and is shaped by its external relationships with knowledge, perspectives, and practices in other educational domains: administration, supervision, foundations, policy studies, evaluation, research methodology, subject areas, educational levels, teaching or instruction, special education, educational psychology, and so on. (Schubert, 1986, p. 35)

2.5 Instructional Design Theory

Instructional-Design Theory

The centrality of adapted and customised instruction is clear from Reigeluth's statement,

> An instructional design theory is a theory that offers explicit guidance on how to better help people learn and develop. The kinds of learning and development may include cognitive, emotional, social, physical, and spiritual learning.
> (Reigeluth, 1999, p. 5)

Instructional design theories are goal-oriented and identify methods of instruction for specific situations. These methods have sets of components, which makes them flexible and adaptable, as noted by Gros,

> Instructional design models have the ambition to provide a link between learning theories and the practice of building instructional systems. (Gros et al. from de Lisle, 1997, online).

Some instructional design theories are:

Cognitive Education, Multiple Approaches to Understanding, Teaching and Learning for Understanding, Open Learning Environments, Constructivist Learning, Learning by Doing, Collaborative Problem Solving, Problem-based Learning (PBL) and Merrill's First Principles of Instruction.

These theories are not mutually exclusive, but overlap and often have a number of common elements. Merrill's Model of Instructional Design was used for the Anthropometry tutorial, the subject of this study, and will be discussed in detail below.

2.5.1 Merrill's Model

One of the major theorists in the Instructional Design field is M. David Merrill, Professor in the Department of Instructional Technology at Utah State University (Viljoen, 2002, online).

Merrill divides the instructional event into four phases which he calls **Activation**, **Demonstration**, **Application** and **Integration**. Central to this instructional model is a real-life **Problem**.

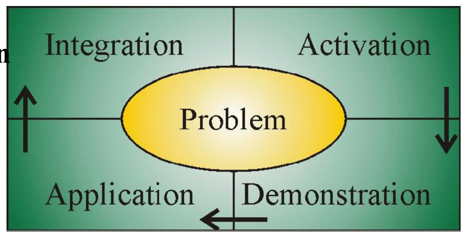
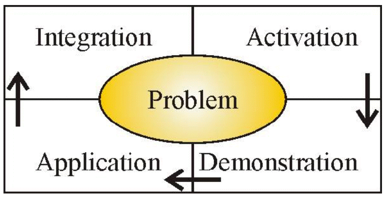


Figure 2.2 - Merrill's Model

Merrill's Model is consistent with the six principles from the biology of learning (Kovalik & McGeehan - 1999, as quoted by Merrill, 1997, p. 1),

1. Emotions are the gatekeepers to learning.
2. Intelligence is a function of experience.
3. Humans in all cultures use multiple intelligences to solve problems and to create products.
4. The brain's search for meaning is a search for meaningful patterns.
5. Learning is the acquisition of useful mental programs.
6. Personality – one's basic temperament – affects how a learner takes in information, organizes and uses it, makes decisions about it, and orients him / herself with respect to the world and other learners.

a. Problem



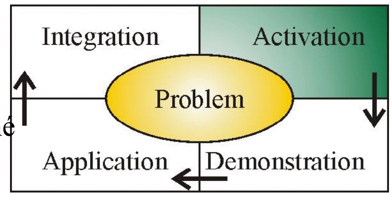
Problem-based learning (PBL) is perceived by some as the most exciting approach to education and learning, which has been developed in the last thirty years. The term PBL is used to describe a variety of projects, from research and solving case studies, to guided design and engineering design projects. Noteworthy is the fact that

> PBL is both a curriculum and a process. The curriculum consists of carefully selected and designed problems that demand from the learner acquisition of critical knowledge, problem solving proficiency, self-directed learning strategies, and team participation skills. The process replicates the commonly used systemic approach to resolving problems or meeting challenges that are encountered in life and career.
> (Maricopa Centre for Learning and Instruction, 2001, online)

Recent research in cognitive psychology has shown that learners who are actively involved in solving real-life, authentic problems learn better. Confronting learners with a real-life problem should activate several cognitive processes, one of which is the search for relevant information and concepts in their long-term memories, i.e. existing knowledge is activated. Merrill explores several elements in the process of PBL,

> Learning to solve problems involves four levels of instruction: the action-level, the operation-level, the task-level and the problem-level. Too much instruction is limited to the action or operation level and does not involve the student in the more integrative task or problem levels. (Merrill, 2001, p. 5)

b. Activation



The importance of activation of existing knowledge has been addressed by a number of educational psychologists. During Merrill's **Activation** phase prior knowledge (or experience) is recalled and emotions are triggered. This corresponds to Gagné first three events of instruction: stimulating to gain attention, informing learners of the objectives of the instruction and reminding learners of relevant previously learned material.

Not only pre-knowledge should be activated during this phase, but mental models as well. If these mental models consist of misconceptions, the instructional process could modify them.

The activation of existing knowledge takes place in a number of different ways. These depend on the instructional approach, the cultural background of the learners, their emotional state and the planned outcomes of the instructional event.

Knowledge and understanding

Knowledge exists in three major forms: images, concepts and prepositions, according to Dills & Romiszowski (1997, p. 664). Knowledge can be activated by external stimuli or internally by mental operations or self-instructions. Reigeluth points out that

> Understanding a topic is a matter of being able to think and act creatively and competently with what one knows about the topic. (Reigeluth, 1999, p. 97)

The learners in any classroom or instructional situation have a wide variety of past experiences. They also have different attitudes towards the instructional and learning process; some learners expect to be taught, while others are willing to direct their own learning.

Ausubel confirms the importance of Merrill's emphasis on pre-knowledge,

> If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.
> (Ausubel in Dills & Romiszowski, 1997, p. 403)

This is also confirmed by Anderson, Adams & Bruce and Rummelhart & Ortony,

> Research on human learning indicates that students will learn more if they can relate new information to what they already know.
> (as quoted in Alessi & Trollip, 1997, p. 22)

It is therefore important to activate the student's relevant existing knowledge. This can be done in a number of different ways: using an introduction or providing learning objectives, giving a pretest or confronting the learner with a problem to be solved.

Introduction and learning objectives or outcomes

Learning objectives, goals or outcomes can be used to challenge, motivate and guide learners and to assist them to structure their own learning experience. They also provide the opportunity to activate the existing knowledge and set the scene for the instruction that is to follow. Hajre-Chapman sees a broader application of the learning objectives,

> I use them for accountability for myself, and for focussing, orientating, motivation and interest. (Hajre-Chapman, ITFORUM, 19 Feb. 2001)

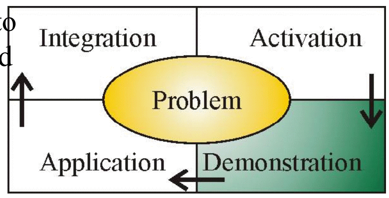
Research has shown, however, that introductions and learning objectives are seldom read by learners if they are not forced to do so, as documented by Alan Carr,

> In my own work, I have found that undergraduate students ignore the objectives page, and jump straight in to the assignments. Even at the end of the course, less than 5% of these students had looked at the objectives.
> (Carr, ITFORUM, 16 Feb. 2001)

Pretest

Pretests are used to determine the readiness of a learners for the instruction that is to follow and can be useful to prevent the learners repeating an instructional sequence of material they already know. As for computer-based tutorials, Alessi cautions, "it is not good for a pretest to be built **into** a tutorial. It is better for a pretest to be in a separate program" (Alessi & Trollip, 1997, p. 22). Pretests should therefore be used with care since they can negatively influence the attitude of the learners towards the new material.

c. Demonstration



The main goal of any instructional event is to expose learners to new knowledge and skills and to "bring about new learning and new capabilities" (Lefrancois, 1997, p. 193).

During the **Demonstration** phase the instructor presents new material and demonstrates new skills.

Reigeluth defines a demonstration as

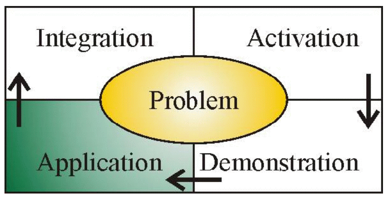
> a carefully prepared presentation that shows how to perform an act or use a procedure; accompanied by appropriate oral and visual explanations and illustrations; frequently accompanied by questions. (Reigeluth, 1999, p. 97)

Demonstration focuses the learner's attention on relevant information and promotes the development of appropriate mental models; it shows actions in a certain sequence, can simplify complex tasks and facilitate learning.

According to Merrill learning is facilitated when

> the learner is shown rather than told, is shown multiple representations and is directed to explicitly compare alternative representations. (Merrill, 2001, p. 6)

d. Application



The purpose of a practice phase in the instructional event is to provide an opportunity for learners to develop proficiency and become experts. Merrill's application phase combines Gagné's elicit learner performance that uses new learning and provide feedback about learning events.

During the **Application** phase cognitive processes come into play; there is a search for meaningful patterns and mental programmes are formed. The link between recalled learning and repeat experiences is clear,

> The only way we remember what we learned is by having similar experiences that trigger our memories. (Schank et al. in Reigeluth, 1999, p.166)

The importance of guided problem solving

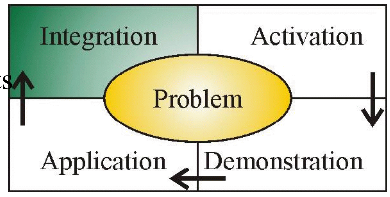
Woods outlines the process of skills development,

> To develop skill requires that the educator explicitly takes the skill apart, asks the learners to try it, figuratively holds up a mirror so that the learners can see how they did the skill, describe potential target skills, and then give them practice + feedback, practice + feedback until they know they have the skill.
> (Woods, 1994, p. 2)

Merrill points out that the process of skills acquisition involves error recognition,

> Making errors is a natural consequence of problem solving. Most learners learn from the errors they make, especially when they are shown how to recognize the error, how to recover from the error, and how to avoid the error in the future.
> (Merrill, 2001, p. 7)

e. Integration



Most instructional events end with an assessment phase. During this phase learners have to prove that they have acquired new knowledge and skills. Gagné's assessment events are, evaluate the learner's performance and arrange for future practice to aid retention and generalisation. Merrill calls this the **Integration** phase during which the learner gets the opportunity to prove new capabilities and show newly acquired skills. The integration phase uses the higher order thinking skills in Bloom's Taxonomy, Analysis, Synthesis and Evaluation.

f. Summary of Merrill's Model

Merrill says that

> Learning is facilitated when the learner is engaged in a real-world problem, when new knowledge (and skills) build on the learner's exciting knowledge (and skills), when new knowledge is demonstrated to the learner, when new knowledge is applied by the learner and when new knowledge is integrated into the learner's world. (Merrill, 2001, p. 3)

2.6 Instructional Design Process

The instructional design process is concerned with the processes used to design or plan the instruction. There are a number of instructional design models, some more flexible than others. In all models evaluation plays an important role, but in some it only occurs at the end. Others place more emphasis on continuous evaluation and use it at every stage of the developmental process.

Design models include:

2.6.1 The ADDIE design model

The most familiar design model is the Analysis, Design, Development, Implementation and Evaluation (ADDIE) model.

Depending on the situation, the five steps of this model are reduced to three or even expanded to seventeen.

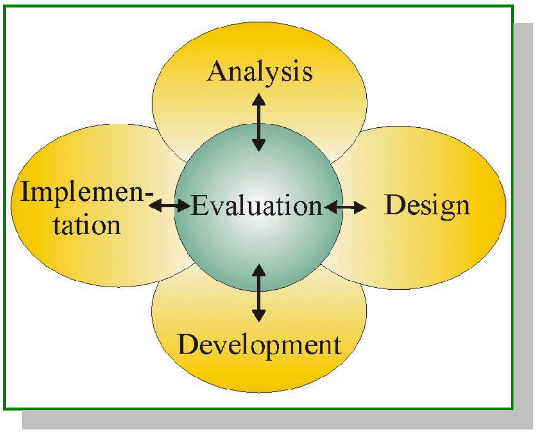


Figure 2.2 - ADDIE model

2.6.2 The DADI model

The DADI (Definition, Architecture, Design and Implementation) design model is similar to the waterfall model (discussed below), but differs in that

> You cannot proceed to the next step until the previous step is understood. You may however, return to the previous section whenever changes require. (Shorts, 1996, online)

The phases in the DADI model are:

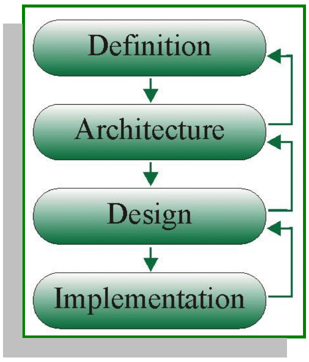


Figure 2.3 - DADI model

Definition

During the definition phase, objectives are defined, logistics examined and the scope and depth, the budget and time frame are determined.

Architecture

During the architecture phase, the major content areas are identified and decisions about navigation and media types are made.

Design

The design phase determines what the product will actually look like.

Implementation

In the implementation phase, content is subjugated to a process, as stated by Pajak, "This stage is strictly: Build, Test, Fix, Repeat."

(Pajak, accessed 2002, online)

2.6.3 The object-oriented model

Shorts explains the origins of this model, "This model comes from the push in the software industry to move away from older coding approaches towards an object-oriented approach." (Shorts, 1996, online)

The phases in the object-oriented model are:

Object-oriented analysis

Its presence in the model preempts an object- oriented perspective.

User and Task Analysis

The user and the task are analysed and the scope of the project is determined.

Design User's Conceptional Model

The concepts required during the use of the program are developed.

Design Information Presentation

During this phase the manner in which information will be presented is decided.

Design Interaction and Control Mechanisms

The controls for the program are developed during this phase.

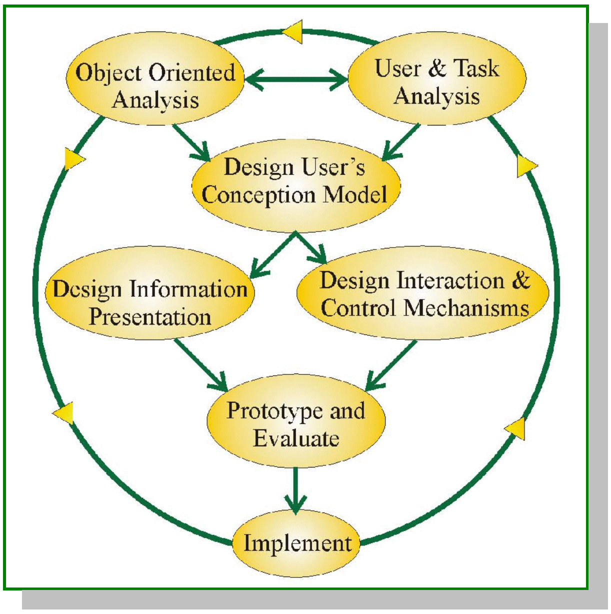


Figure 2.4 - Object-oriented model

Prototype and Evaluate

The prototype is developed and tested during this phase.

Implement

The developed and tested object piece is combined with the rest of the program.

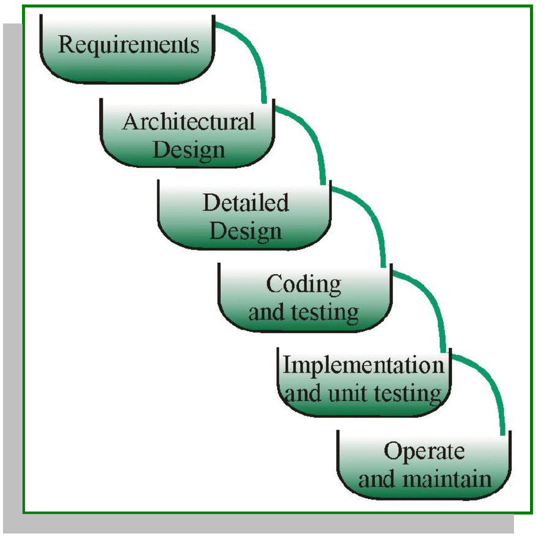


Figure 2.5 - Waterfall design model

2.6.4 The waterfall model

The waterfall model was derived from an engineering model and makes use of a strictly linear approach. The idea is that the outputs of one stage flow into the next stage. This implies that each step has to be completed before the next step can be started. The rigidity of this model is not suited to all applications, but it is easier to manage than more flexible models.

Some developers add continuous evaluation to this model, using it like the "snakes and ladders" in the game, either to skip steps or slide back to the start.

2.7 Conclusion

This chapter reviewed the difference between instructional design theory, learning theory, the instructional design process and curriculum theory. Some instructional design process models and their components were briefly discussed.

Instructional design theories are not discrete, isolated theories. It is clear that they overlap and some are more suitable for a specific course than others. They are also strongly influenced by learning and curriculum theories. Before deciding on the application of a specific design theory, instructional designers have to become familiar with the curriculum of the course and decide which learning theories will be most appropriate for the planned instructional event. Reigeluth (Reigeluth, p. 55) proposes that the following elements should be considered before deciding on an instructional design model:

- Focus of learning (interdisciplinary, topic, domain or problem)
- Type of learning (memorisation, comprehending, skills application)
- Control of learning (educator-centred or learner-centred)
- Grouping for learning (individual, pairs, teams or larger groups)
- Interactions for learning (learner-educator, learner-learner, learner-tools, learner information, learner-environment)
- Support for learning (cognitive and/or emotional)

Merrill's Model was found to be suitable for the Anthropometry tutorial, since the focus of learning is on problem solving and students should understand and practise skills application. The support for learning is cognitive rather than emotional, students will learn individually and control of learning will be shared between educator and student.

Once an instructional model has been chosen, the designer has to decide on the most suitable design process model. The ADDIE model was used for the development of the Anthropometry tutorial, since this is the model used by Telematic Learning and Education Innovation at the University of Pretoria.