

## **Module 2: Theories and Foundations of Instructional Design**



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This document contains the content from the interactive instructional unit for the module.

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# Introduction

Instructional Design is “a discipline in which practitioners constantly look to the findings of other disciplines (e.g., cognitive psychology, communication) to study and improve methods of developing, delivering, and evaluating instruction and instructional practices.” (Brown & Green, 2006)

In the last module, we identified that in your future career in the field of educational technology, it is likely that you will be expected to oversee and to design online or mobile workshops, tutorials, courses, and programs. Thus, this course focuses on instructional design in distance education.

We started building a foundation of knowledge about distance education in the last module. In this module, we will continue to build foundational knowledge for this course and for your future work in ISD. We will focus on learning theories and instructional design models. Underlying every effective ISD project is a theoretical foundation, namely a learning theory, and the implementation of an ISD model (Smith & Ragan, 2005). As our text book authors imply, ignorance or lack of understanding of theory, especially human learning theory, can lead to ineffective course development and media selection; thus, hindering learning (Clark & Mayer, 2008). Theories about how humans learn and frameworks to explain how to apply these theories should guide instruction (Horton, 2007).

## Objectives

By the end of this unit, you should be able to:

### Unit Objectives:

- Explain the basic constructs of learning theories foundational to the instructional design process
- Describe your personal theoretical orientation to learning
- Apply basic constructs of learning theories to distance education instructional design
- Identify the steps of instructional design models
- Describe the role that instructional design models play in distance education instructional design

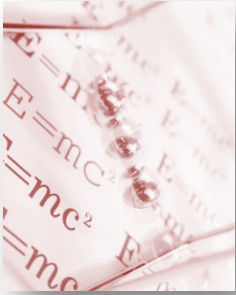
By the end of this unit, what would you like to learn? Write your personal objectives.

### Personal Objectives:

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# Theories of Learning



Learning theories provide a foundation for ISD. An instructional designer's theoretical approach to learning affects how the instruction is designed, developed, implemented, and evaluated. Most instructional designer's theoretical orientation is based upon one or the integration of three theories: behaviorism, cognitivism, and constructivism. These three theories may be familiar to you from an undergraduate psychology or education courses. They may also be familiar to you from previous courses in your program.

Although the distance education literature, particularly for higher education, purports that constructivism underlies effective distance learning, additional learning theories are also applicable. Let's briefly consider definitions of these theories and their application to distance education instructional design. Please note that in in-depth study of each of these theories is not within the scope of this course. If you would like to know more, I would encourage you to read the seminal works of some of the theorists mentioned in this discussion.

But, before we begin, reflect upon these questions:



## Reflection 2.1

What do I believe about the following...

- How does learning occur?
- What factors influence learning?
- How should instruction be structured to facilitate learning?
- Think about how you learn. When you hear, read, or see something new, does it help to talk about it and reflect on it to better understand the new information? How about research? Does it help to do some active research on this new information?

## Behaviorism



### Think About It Activity 2.1

**Yes or No:** Do you think that practice, reinforcement, and modeling are important for learning? If you said yes, your primary theoretical orientation to learning may be behaviorism.

Behaviorism focuses upon observable behaviors, and behaviorists define learning as the acquisition of new behaviors. Although behaviorists acknowledge that the mind exists, it is relatively ignored in this theoretical approach because the interworking of the mind cannot be directly observed. Well-known behavioral theorists include: Skinner, Pavlov, and Bandura.



## Behaviorism Applied to Distance Education

Davidson-Shiver and Rasmussen (2006) purport that there are several key concepts of behaviorism that have been applied to the educational environment and that you may find important in designing and implementing a distance education course or program. Please note that these are a few selected concepts; there are many more.

**Practice** – Research demonstrates that repetition via practice can strengthen learning. Providing learners with opportunities practice after the presentation of material or reading may allow learners to strengthen a specific skill. In the e-learning environment, an instructor may use Second life, a virtual world, to deliver a lecture and engage his or her students in a role-play. To read about an example of this, take a virtual trip to Innovate to Read [Educational Opportunities for Clinical Counseling Simulations in Second Life](#).

**Modeling** – Modeling is defined as a demonstration of the desired behavior or response. For example, a course designer may encourage an instructor to provide instructions for an assignment and then post exemplarily work of previous students as examples. Another example is an instructor modeling the writing of desired discussion board responses when interacting on discussion forum.

**Reinforcement** - Theorists purport that learners learn or exhibit desired behaviors when provided with positive or negative reinforcement. For example, in the e-learning environment, an e-mail from the instructor providing results and explanation of those results on an assignment may serve as a positive reinforcement. In the mobile environment a reinforcing text could be sent. (Note: For this to be a positive reinforcement the learner must view the e-mail as pleasant. When planning reinforcement, learners' characteristics should be taken into consideration).

### Positive Reinforcement: A Reinforcing e-mail or Text Message

Practice. Write a reinforcing e-mail or text message.

Dear students,

I appreciate all of your hard work on this assignment. The grades, with an average of 95%, clearly demonstrated the time and effort you put into this assignment. Please see the attached file with your grades and my notes. Keep up the great work.

Your Instructor

**Active Learning** - Behaviorist purport that learners should be active in that they should respond to stimulus in order for learning to occur. In the e-learning or mobile environment, instructors may require students to require students to answer questions in a discussion forum or via text messaging. The instructor may require learners to share documents in a collaborative workspace such as a wiki or other collaborative workspace. The purpose of this is so that instructors may observe students understanding of the material; thus, making this different than active learning described in constructivism.

## Active Learning: Assignment Instructions

Practice. Write an assignment that requires active learning.

Example: In the discussion area of the content management system, post the following assignment.

This week in class, you learned how to write a research question and hypothesis. Based on what you have earned, develop a research question and hypothesis for a research study of your choice.



### Think About It Activity 2.2

**Blog Reflection Idea:** On your blog, reflect on the following: How is behaviorism applicable to distance education environment? What concepts of behaviorism do I see as useful to distance education instructional design? What are some concrete examples (aside from the ones listed in this module?)

## Cognitive Learning Theory



### Think About It Activity 2.3

**Yes or No:** Do you think that the brain functions like a computer and reflection and processing are important for learning? If your answer is yes, your primary theoretical orientation to learning may be cognitivism.



Cognitivism emphasizes information processing, the mental processes that a learner uses as they apply skills and knowledge. In cognitive learning, the individual learns by listening, watching, touching, reading, or experiencing and then processing and remembering the information.

Cognitive learning might seem to be passive learning because there is no motor movement. However, the learner is quite active in processing and remembering newly incoming information. Cognitive theorists liken the human mind unto a computer in their explanation of learning: information comes in, is processed, and leads to certain outcomes.

### **Behaviorism vs. Cognitivism**

Behaviorists are concerned with what learners do to answer questions; whereas, cognitivists are interested in how learners explain how they arrive at an answer to a question.

"Cognitive theorists recognize that much learning involves associations established through contiguity and repetition. They also acknowledge the importance of reinforcement, although they stress its role in providing feedback about the correctness of responses over its role as a motivator. However, even while accepting such behavioristic concepts, cognitive theorists view learning as involving the acquisition or reorganization of the cognitive structures through which humans process and store information." (Good & Brophy, 1990, p. 187).

### **Cognitive Theory of Multimedia Learning**

Mayer, is well known for his cognitive theory of multimedia learning. Mayer, (2003) says the following about learner centeredness, "it is not what is done to the learner, but how the learner interprets what happens, that is, on the learner's personal experience" (p.5). His theory is based upon several primary assumptions:

- There are two separate channels (auditory and visual) for processing information
- Each channel has a finite capacity, and the learner can only process a finite amount of information in one channel at a time
- The brain does not interpret a multimedia presentation of words, pictures, and auditory information in a mutually exclusive fashion; rather, these elements are selected and organized dynamically to produce logical mental constructs.



- Learning is an active process of filtering, selecting, organizing, and integrating information based upon prior knowledge, and the learner make sense of incoming information by actively creating mental representations.

Many of the design principles are based upon this theory. We will read more about this in the upcoming weeks as we delve deeper into our text book.

## **Cognitivism Applied to Distance Education**

There are multiple key principles of cognitivism that have been applied to the educational environment and that you may find important in designing and implementing an e-learning course. Many of these, as stated earlier, are discussed in detail in your text book (Clark& Mayer, 2008); a few are identified here:

- Reflection upon content is important. In the online environment, an instructor can ask students to reflect upon the content to bring prior knowledge and experience to the forefronts of their minds.
- In order for learning to be meaningful, it should be relevant. In the online environment, an instructor or instructional designer may identify primary learner audience prior knowledge and background and relate instruction and assignments to learners' backgrounds.

### **Example: A Reflection Activity from a Grant Writing Course**

**After you have completed your tasks, reflect on the learning process and post your thoughts in your learning blog:**

Have you engaged in a previous activity that was similar to the grant writing process?

What did you learn about while completing this task that you would not have learned from simply reading about grant proposals?

What obstacles did you face in writing the grant proposal? How did you overcome the obstacles? What did you learn from the obstacles that you faced and conquered? How will this learning impact the next grant proposal you write?

How will completing this task help you in the future as a human service professional?



### **Think About It Activity 2.4**

**Blog Reflection Idea:** On your blog, reflect on the following: How is cognitive theory applicable to distance education environment? What concepts of theory do I see as useful to distance education instructional design? What are some concrete examples (aside from the ones listed in this module?)



# Constructivism



## Think About It Activity 2.5

**Yes or No:** Do you think that actively interacting with materials and peers is important to learning? If your answer is yes, your primary theoretical orientation to learning may be constructivism.

Constructivism posits that learning is an active process, and the learner is a constructor of knowledge. Learners construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. More specifically, "learners construct their own reality or at least interpret it based upon their perceptions of experiences, so an individual's knowledge is a function of one's prior experiences, mental structures, and beliefs that are used to interpret objects and events" (Good & Brophy, 1990). "What someone knows is grounded in perception of the physical and social experiences which are comprehended by the mind." (Jonasson, 1991). Driscoll (2004) suggests that the primary differences between constructivism and cognitivism is that constructivism focuses upon novel research on cognition and information processing, more upon the environmental and social aspects of learning, and more upon the adaption and management of learning.

## Constructivism Applied to Distance Education



In contrast to the traditional methods of teaching in which the teacher disseminates knowledge to be memorized by the students, who in turn recite the information back to the teacher,

constructivism promotes strategies based on active learning. Thus, the role of the teacher shifts from the "sage on the stage" to a collaborator and facilitator; scaffolding, reciprocal teaching, and guided instruction are considered primary effective teaching strategies for both the traditional and e-learning environment. This learning theory and the associated strategies are associated with effective e-learning, especially higher education e-learning.

**NOTE:** A common misunderstanding regarding constructivism is that instructors should never tell students anything directly but, instead, should always allow them to construct knowledge for themselves. This is actually confusing a theory of pedagogy (teaching) with a theory of knowing. Constructivism assumes that all knowledge is constructed from the learner's previous knowledge, regardless of how one is taught. Thus, even listening to a lecture involves active attempts to construct new knowledge.

Taken from: <http://www.learning-theories.com/constructivism.html>

- **Scaffolding** is a temporary supportive structure that the instructor uses to assist a learner to accomplish a task that they could not complete alone.
- **Reciprocal teaching** refers to a dialogue between teachers and students. The dialogue is structured through the use of four strategies: summarizing, question generating,

clarifying, and predicting. The teacher and students take turns leading the dialogue (Palincsar, 1986).

- **Guided instruction** involves the teacher and learners exploring problems and via dialogue sharing their different problem solving strategies (Hausfather, 1996).

The constructivist instructor provides tools plans problem-based learning activities so that learners can construct ideas, make inferences, draw conclusions and inferences, and discuss their knowledge in a collaborative learning environment. For example, the instructor may pose a case study based question in the discussion or provide students with a multimedia flash-based case study to discuss during a online video conferencing session. The instructor then focuses on assisting the learners. He or she may prompt each learner to reflect on and examine his or her current knowledge related to the problem and indicates to the group of learners fruitful avenues they may want to explore based on their ideas. Another well known online constructivist instructional strategies is a WebQuest. Click here to download a brief description of a WebQuest and click here to see an example [WebQuest](#). A mobile instructional strategy is the use of augmented reality. Do a web-search on “Augmented Reality in Education” to learn about the current practice and research.



### Think About It Activity 2.6

**Blog Reflection Idea:** On your blog, reflect on the following: How is cognitive theory applicable to distance education environment? What concepts of theory do I see as useful to distance education instructional design? What are some concrete examples (aside from the ones listed in this module)?

## Summary of Learning Theories

Now that we have briefly discussed the different learning theories, let's summarize them.

Learning Theory	Traditional (Behaviorism)	Traditional (Cognitivism)	Constructivism/ Social Constructivism
Theorists	Thorndike, Pavlov, Watson, Guthrie, Hull, Tolman, Skinner	Koffka, Kohler, <u>Lewin</u> , Piaget, Ausubel, Bruner, Gagne	Dewey, Vygotsky Rort, Piaget, Bruner
Theories and Instructional Models	Pavlov's Classical Conditioning Skinner's Operant Conditioning Thorndike's Laws and Connectionism Contract Learning Individualized Instruction Information Processing Model	Dual Coding Theory Elaboration Theory Schema Theory Collins & Stevens Inquiry Teaching Model Keller's ARCS Model of Motivation Merrill's Component Display Model	Situated Cognition Social-Cultural Learning Case-Based Learning Discovery Learning Distributed Learning Problem-Based Learning (PBL)
Assumptions	Knowledge is an objective reality	Knowledge is an objective	Knowledge is constructed

about Knowledge and Learning	to be obtained Learning is a change in behavior and the goal of teaching is to produce behavioral change in desired direction Emphasis is on the relationship between observable, measurable behaviors and environmental variables	reality to be obtained Learning is concerned with internal mental process (including insight, information processing, memory, perception) and results in information in an organized manner in the stored in memory	through environmental interactions and it is embedded in the context in which it is used Knowledge is collaboratively constructed and meaning is individually imposed
Locus of Learning	Stimuli in external environment	Internal cognitive structuring	Learning is in relationship between people and environment.
Educator's Role	Expert, knowledge source Arranges environment to elicit desired response	Is responsible to structures content of learning activities to assist learners in organizing information in an optimal manner for assimilation Works to establish communities of practice in which conversation and participation can occur.	Facilitator Guide Collaborator
Learner	Passive, consumer of knowledge According to behaviorism, the learner is a responder to environmental stimuli, a <i>tabula rasa</i> shaped by reinforcements	Active processor of information	Active, constructors of knowledge
Instruction and Assessment	Instruction and assessment is teacher-centered and criterion-based; The purpose of instruction is to elicit the desired response based on a stimulus (e.g., automatically performing a specified procedure) Knowledge obtainment, retention, and reproduction (recalling facts) is key.	Instruction and assessment is independent, contextual, and reflective Instructions aims to assist learners in using strategies that result in changes in thinking Instruction encourages The goal of instruction is for learners to develop capacity and skills to learn better	Instruction and assessment is student –centered, collaborative, and customized to learners' prior knowledge. Authentic assessments, portfolios, contextual, case-based projects, authentic tasks and dialogue are primarily instructional strategies. Instruction is a process of supporting knowledge construction rather than communicating knowledge for the purpose of a product.

[Also click here to visit GMU's Instructional Design Knowledge Base](#)

I highly recommend the online book entitled Theory and Practice in Online Learning edited by Terry Anderson & Fathi Elloumi. It's an excellent resource to explore even more about how these theories apply to distance education topics and is a valuable reference to have at your fingertips. You can download it at [http://cde.athabasca.ca/online\\_book/index.html](http://cde.athabasca.ca/online_book/index.html)

In addition to these classical theories, JiTT is another theory in which you may want to be familiar. If plan to work on instructional design projects with adults, then it is important that you research and understand adult learning theory. At the end of this unit, links are provided to assist you in beginning to explore adult learning theory.

## Personal Learning Theory

Now you have read about various learning theories, take time to re-reflect on these questions. Have your answers changed? Additionally, look at your Philosophy of Distance Education that you wrote for your philosophy course in this program. Do you need to make any modifications?



### Reflection 2.2

What do I believe about the following...

- How does learning occur?
- What factors influence learning?
- How should instruction be structured to facilitate learning?
- Think about how you learn. When you hear, read, or see something new, does it help to talk about it and reflect on it to better understand the new information? How about research? Does it help to do some active research on this new information?
- Do these answers differ when you consider web-based teaching and learning?
- Think about your Christian worldview. How does this impact your view of learning? Do any of the theories discuss stand in opposition to your worldview?

## Instructional Design (ISD) Models

Now that we have explored learning theories that are foundational to instructional design, we are going to consider instructional design models, these processes assist us in applying learning theories in a systematic, yet often iterative manner as we design instruction. Although there are many different approaches, most ISD models follow ADDIE: Analysis, Design, Development, Implementation, and Evaluation. The following describes each stage of ADDIE:

1. **Analysis** - The process for identifying and defining what is to be learned
2. **Design** - The process of determining how it is to be learned—based on audience need, timetable, and budget
3. **Development** - The process of authoring and producing the learning materials
4. **Implementation** - The process of installing the learning solution within the real-world business environment
5. **Evaluation** - The process of measuring the effectiveness and efficiency of the learning, based on the stated objectives; occurring in each phase of the ADDIE model and at the project end ([see http://www.crawfordinternational.com/html/cai\\_addie.asp](http://www.crawfordinternational.com/html/cai_addie.asp))



Davidson-Shivers and Rasmussen (2006) identify two type of ISD models. They say that traditional ISD models focus on planning, developing, implementing, and evaluating on a lesson of course level. The core elements of the traditional models include determining learners' needs, identifying learning goals and objectives, planning assessment and developing assessment tools, planning instructional strategies and media, pilot testing, implementing, and evaluating. The

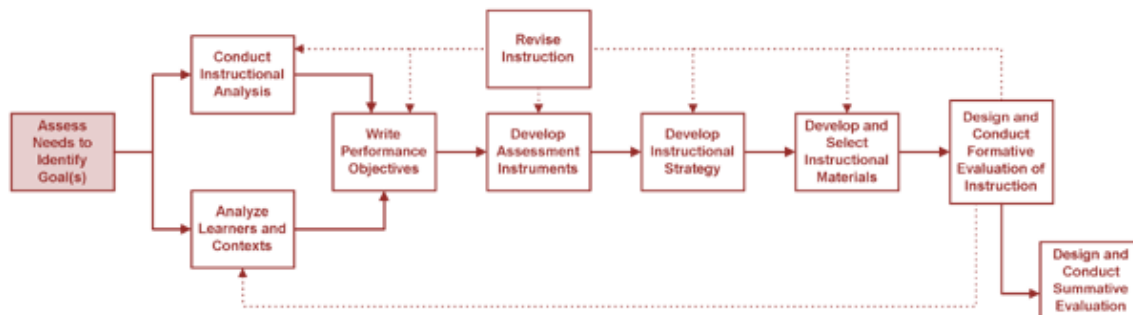
most common traditional ISD models include Gagne's (1985) Conditions of Learning and Dick, Carey, and Carey's (2005) model.

The second type of ISD model is for macro-level design. These models assist with design on a program level rather than a lesson or course level. Common ISD models for macro-level design include Reigeluth, Merrill, Wilson and Spiller's Elaboration Theory, Rapid prototyping (expeditiously developing prototypic instructional material), and Morrison, Ross and Kemp's (2004) model. In this unit, two of these models are briefly summarized: Dick, Carey, and Carey's (2005) and Morrison, Ross and Kemp's (2004) model. These are the two models upon which much of the instruction in this course is based and what you will use as a foundation to design your own instructional unit in this course. To learn more about these models and the ones mentioned above, you can use the links at the end of the unit. I would also encourage you to read some of the seminal works on the ISD models.

## Dick, Carey, and Carey's (2005) Model

This model consists of the following steps:

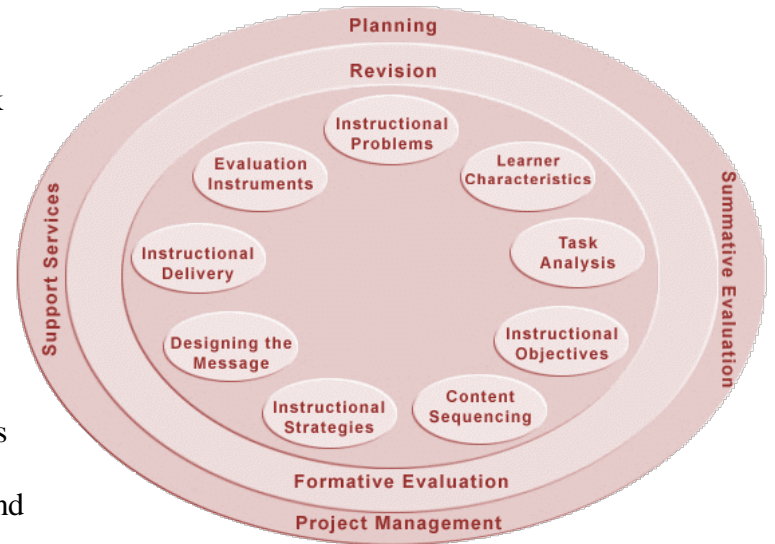
1. Needs Assessment and Goal identification
2. Instructional analysis
3. Learner and context analysis
4. Definition of objectives
5. Assessment instrument
6. Instructional strategy and Materials Development
7. Formative evaluation
8. Summative evaluation of instruction



## Morrison, Ross and Kemp's (2004) Model

Morrison, Ross, and Kemp's (2004) Nine Steps:

1. Identify instructional problems.
2. Examine learner characteristics.
3. Identify subject content and analyze task components related to stated goals and purposes.
4. State instructional objectives.
5. Sequence content within each instructional unit for logical learning.
6. Design instructional strategies.
7. Plan the instructional message and delivery.
8. Develop evaluation instruments to assess objectives.
9. Select resources to support instruction and learning activities.



### Think About It Activity 2.7

After reading about Dick, Carey, and Carey's (2005) model and Morrison, Ross and Kemp's (2004) model, answer the following questions:

How are the two models different?

*Instructors thoughts: Dick, Carey, and Carey's (2005) model demonstrates how to tackle an instructional design task systematically. Although a step by step systematic process, it takes into consideration the learners and their environments, as well as the need to constantly examine and readjust instruction to ensure improvement in the instruction itself. In contrast to the Dick and Carey model, Morrison, Ross and Kemp's (2004) model thrives on the idea of flexibility. The essential concept of this model is that any of the elements can be addressed at any time in the process, giving freedom to the designer to modify their instruction as necessary.*

What are the strengths and weaknesses that you see if you were asked to design a course or program using each model?

*Instructors thoughts: Dick, Carey, and Carey's (2005) model is detailed and enables designers to be thorough and appropriately steered through the instructional design process; however, it relies on front-end analysis, it assumes that your predictions of what will happen during the process will be correct. Being incorrect could cost a lot of time and money. Morrison, Ross and Kemp's (2004) model allows for flexibility and easy revision; however it lack a systematic, linear process.*



Now you have an overview of many of the instructional design models. In this course, you will work collaboratively to design a web-based lesson or workshop using the basic tenets of ADDIE, the Morrison, Ross and Kemp's (2004) model, the Dick, Carey, and Carey's (2005) model, and your text book. Please note, as Horton (2007), says that e-learning ISD should be an iterative process. As we survey and apply different ISD models and theories relevant to distance learning, it is important to remember to consider all of the factors that need to go into designing effective instruction and that some models are better suited to certain personalities, instructions, and situations, especially the e-learning and mobile environments.



### Think About It Activity 2.8

In closing this unit, listen to Dr. Merrill's thoughts about instructional design in an era in which online education has become popular. Identify his concerns. On your blog, reflect on the following questions: 1) Are his concerns justified? Why or why not? 2) Based on your experience, do you have additional concerns? 3) Do you think that Dr. Merrill identifies important points about instruction? Why or why not? 4) Would you add additional factors that need to be considered?

## Summary

Now you should be able to:

- Explain the basic constructs of learning theories foundational to the instructional design process
- Describe your personal theoretical orientation to learning
- Apply basic constructs of learning theories to distance education instructional design
- Identify the steps of popular instructional design models
- Describe the role that instructional design models play in distance education instructional design



Finally, have you met your personal objectives?

### Personal Objectives:

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In the next module, we will focus on the first step of the design process, analysis, and you will begin your ISD project with your ISD team.



# Links

## Links from Unit:

- [Educational Opportunities for Clinical Counseling Simulations in Second Life](#)
- [WebQuest](#)
- [GMU's Instructional Design Knowledge Base](#)
- [Theory and Practice in Online Learning](#)

## Andragogy/ Adult Learning Theory

- [Andragogy](#) (Mendelsohn)
- [Andragogy summarized](#) (Brookfield)
- [Fidishun](#) (Andragogy and Technology: Integrating Adult Learning Theory As We Teach With Technology )

## Behaviorism

- [Skinner's Programmed Instruction](#)
- [Keller's Personalized System of Instruction \(PSI\)](#)

## Cognitivism

- [Gagné's Nine Events](#)
- [Reigeluth's Elaboration Theory](#)
- [Component Display Theory \(CDT\)](#)
- [Instructional Transaction Theory \(ITT\)](#)

## Constructivism

- [Anchored Instruction](#)
- [Case-Based Reasoning](#)
- [Cognitive Flexibility Theory \(CFT\)](#)
- [Jonassen's Constructivist Learning Environments \(CLEs\)](#)
- [Mayer's SOL](#)
- [Open-Ended Learning Environments \(OELEs\)](#)
- [Perkins and Unger's Teaching and Learning for Understanding \(TfU\)](#)
- [Problem-Based Learning \(PBL\)](#)
- [Situated Learning](#)
- <http://www.papert.org/articles/SituatingConstructionism.html>

## Comparative Summaries

- [Behaviorist, Cognitivist, Constructivist](#) (Judith Boettcher)
- [Behaviorist, Constructivist](#) (University of Washington, Seattle)
- [Behaviorist, Information Processing, Constructivist](#) (Leilani Carbonell)

- [Objectivism/Behaviorism Cognitivism/Pragmatism Constructivism/Interpretivism](#) (N. Dabbagh)
- [Bruner, Ausubel, and Gagne](#) (NSW HSC, Charles Sturt Univ)

### **Dick, Carey, and Carey's (2005) model**

- [Dick and Carey Model](#) (Lee and Lee)
- [Dick and Carey Model](#) (Don Clark)

### **Engagement Theory**

- <http://home.sprynet.com/~gkearsley/engage.htm>

### **Gagne's (1985) Conditions of Learning:**

- [Gagne profile](#) (Leilani Carbonell)
- [Gagne profile](#) (Sebastian Foti)
- [Conditions of Learning](#) (Peter Patsula)
- [Conditions of Learning](#) (Stephen Bostock)
- [Conditions of Learning](#) (Kearsley)

### **JiTT**

- <http://webphysics.iupui.edu/JITT/ccjitt.html>
- <http://jittdl.physics.iupui.edu/jitt/>
- <http://serc.carleton.edu/introgeo/justintime/index.html>

### **Morrison, Ross and Kemps' (2004) model**

- [Morrison, Ross and Kemp Model](#)
- [Morrison, Ross, and Kemp Model](#)

### **Reigeluth, Merrill, Wilson and Spiller's Elaboration Theory**

- [Summary](#) (Greg Kearsley)

### **Rapid Prototyping**

- [Hoffman and Margerum-Leys](#) (Rapid Prototyping as an instructional design)
- [Rieber](#) (Understanding Rapid Prototyping by Analogy: Making Paper Planes)
- [Rapid Prototyping](#) (Strickland)
- [Rapid Prototyping](#) (WikiBooks)