Educational Theories and Instructional Design Models. Their Place in Simulation.

Lyn Taylor, RN, BN, Cert Perioperative Nursing, Grad Dip Nursing (Perioperative), M Ed (AVET) MRCNA, MCN

Nursing Education and Research, Southern Health
Lyn.Taylor@southernhealth.org.au

Abstract. Simulation is a unique learning environment, as it allows participants to experience critical care interventions in a 'safe' environment. A good understanding of educational theory and instructional design is required to ensure meaningful learning is experienced. Simulation allows a variety of learning theories to be applied due to the wide variety and complexity of the clinical situations presented. Understanding how we learn allows us to tailor simulation to individuals and groups. Once a theory or theories have been chosen for the particular area of focus within the simulation environment, a structured design for the education basis must also be taken. Using an instructional design model, planning, implementation, and evaluation of courses and programs becomes more structured. Regardless of the educational theories supported by each simulation centre, instructional design models can be utilised. This paper will discuss some of the educational and instructional design theories and models suited to simulation

1. INTRODUCTION

Simulation is a unique learning environment as it allows participants to experience critical care interventions in a 'safe' environment. It is therefore important to have an understanding of a variety of educational theories and instructional design models. As there are many theories and models suited to simulation it is imperative that the right theory or model be employed for the desired learning outcome. This paper will explore some of the relevant educational theories and instructional design models best suited to the simulation environment.

2. EDUCATIONAL THEORIES

Behaviourism, constructivism and cognitivism are three of the commonly used educational theories today. Of these theories there are many exponents of each, all who have undertake extensive research and are viewed as experts in their respective field of research. Each theory has several components.

2.1 Behaviourism

Behaviourists viewed learning as a sequence of stimulus and response actions in the learner. They view the teachers or instructors role as one of modifying behaviour, by setting up situations whereby learning is reinforced by the desired responses being exhibited.

Behaviourism has it roots in the findings of the American psychologist John B. Watson in 1913 [4], [8] Watson based his studies on the works of Pavlov and his dogs in the 1890's .When a natural reflex occurs as a response to a stimulus, it is referred to as classical conditioning. Pavlov discovered during his studies that some of the more experienced dogs commencing salivation whenever they saw the person who was feeding them even if they did not arrive with any food. The younger dogs also salivated, but only when presented with food. Pavlov surmised that the older dogs had learned something that the younger ones had not They had learned to associate the sight of the person feeding them (stimulus) with the salivation (the response). [12]

The work of Watson and Pavlov were further developed by B.F Skinner in the 1930's [8]. Skinner built a 'box' in which he was able to teach animals to receive food by pecking or tapping a bar or light. He referred to this as operant conditioning. Operant conditioning occurs when a response to a stimulus is reinforced. [5], [4]. As with Skinner's animals, we can elicit a response from scenario participants by controlling manikin outcomes through an operant conditioning model. An example of this is where oxygen is applied to the manikin. If this is applied correctly and at the correct rate, the controller rewards the participant by increasing the oxygen saturations. If it is not applied correctly, the oxygen saturations are lowered further. Console controllers have been heard to say 'I'll reward that" or 'They didn't apply the correct rate so I'll drop the saturations." This is an example of operant conditioning in the simulation setting.

2.2 Cognitivism

While behaviourism was the predominant learning theory for the first half of the twentieth century, they were focused only studying observable behaviours. Thinking processes or other unobservable phenomena were not considered.[22]

Cognitivists believe that learning occurs when the learner processes information. [16] Jean Piaget began a research program in the 1920's that played a major part in the development of cognitive theories. He developed

his theory by watching and observing children. [17]. Piaget's theory used the premise that as a child develops, they build and develop cognitive structures such as mental maps or linked concepts in their response to experiences that occur within their environment. He also identified four distinct stages of development. As the child passes through these stages, they build concepts about reality and how it works through physical interaction with their environment, moving through to develop conceptual reasoning. [17]. In the development of this theory, Piaget used a standard set of questions as a starting point, then allowed questions to be flexible enough to follow a theme or train of thought to be followed to where the child wanted to go with it. He believed that spontaneous comments provided valuable clues to the thinking and understanding associated with the learning. [22]. He was not interested in a so called 'right answer' but rather the focus of the logic and thinking that the learner exhibited. For learning to occur, the individual must assimilate the learning into their existing cognitive structures.[16].

Jerome Bruner also had profound influence in the educational thinking of the late 1950's and early 1060's. He is associated with the term 'discovery learning'[5]. According to Bruner, there are three components to learning a subject. 1. Acquisition of new information; which is normally built on something that is already known, 2. Transformation of information; This is where new information is analysed and processed for use in new situations, and 3. Evaluation; where all aspects of the processing of information is evaluated to check whether it is correct.[19]

Cognitivism is suited to debriefing of scenarios. Here the debriefer asks a set of questions to the participants following a scenario. It is the learner or participant who then allows the flow of thoughts and direction that the conversation takes. It is the role of the debriefer to guide the participants to the next question and facilitate their journey to learning and reflection. It is also where new information is acquired, transformed and evaluated by the participant through being involved in the scenarios and the debriefing process.

2.3 Constructivism

Using a constructivism approach to learning, the learners ability to solve real life practical problems is emphasised. Constructivism is founded on ideas that by reflecting on our experiences, we generate our own understanding of the world. Major proponents of constructivism theory include Malcolm Knowles, Carl Rogers, and David Kolb.

Malcolm Knowles has become synonymous with adult learning theory. He used the term andragogy which had been used by Alexander Kapp to describe Plato's educational theory. [10]. Andragogy is defined as 'the art and science of helping adults learn.' While andragogy has been synonymous with adult learning, it refers to learner focused education for people of all ages.[11]. Pedagogy on the other hand refers to 'the art and science of educating children.' Pedagogy embodies teacher focused education. It is the teachers who decide what, how and when it will be learned. The teacher directs the learning.

Carl Rogers, a psychotherapist, developed an new approach that he called client centred therapy. This involved the therapist taking a 'non-directive role in which the client is encouraged to develop a deeper understanding of his or her 'self''[19].This concept led Rogers to develop a student centred approach to learning. . he also saw the teacher as the facilitator of learning, providing the resources for learning, and sharing feelings as well as knowledge with the learners.[18].

David Kolb is renowned for his work in the development of the experiential learning model or cycle. This is also become known as 'Kolb's Cycle' Kolb refers to this as 'The Lewinian Experiential Learning Model' as he believes that experiential learning is tied to the intellectual origins of Lewin and Paget. [19]

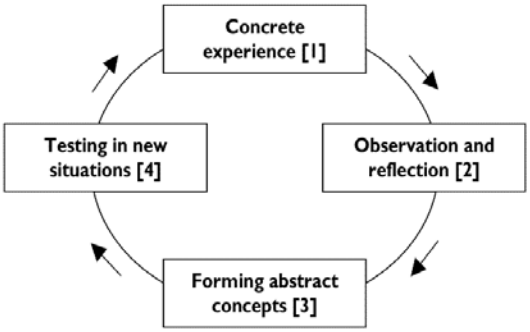

Figure 1: Kolb's Cycle of Experiential Learning [20]

While the learning cycle can begin at any point, the learning process often begins with a person carrying out a particular action and then seeing the effect of the action. The second step is to understand the effects so that if presented with the same action the learner would be able to anticipate the action that would follow. Step three involves understanding the general principles that the action involved. The last step is involved with the implementation of the action.

The way this is applied in simulation is by introducing a new skill such as difficult airway management to participants. The participant is allowed to attempt intubation or ventilation in a safe environment where actual patient safety is not compromised. The participant is allowed to experience a potentially life threatening condition that they may not yet have been exposed to in the clinical environment. They are able to visually observe what occurs to the manikin when airway oedema and laryngospasm are applied. From this there is reflection and discussion with a clinical expert on how to manage the situation. By facilitating a safe environment for the learner to try out and practice new skills, the learner is able to develop a plan of

action as to how they would manage a difficult airway situation, and be able to anticipate what their next step would be in the management of the patient in the clinical environment.

2. INSTRUCTIONAL DESIGN

Instructional design is defined by Berger and Kam [1] as 'the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the process of analysis of learning needs and goals and the development of a delivery system to meet those needs. It includes development of instructional materials and activities; and tryout and evaluation of all instruction and learner activities."

2.1 History of Instructional Design

At the time instruction design was in its infancy, the behaviourist's approach to learning was very prominent. With the advent of the Second World War, there was a great need to train hundreds of thousands of military personnel in a short space of time. Prior to this, the use of specialised teaching machines was used as a method of standardising instruction and training. This method was used in conjunction with the earlier work undertaken by Ralph Tyler on learning objectives, allowing for vast numbers of personnel to be trained in a standardised manner and in a relatively short time frame. It is thought that the heavy investment of the government into training, research and development was credited with the USA's victory in 1945. This in turn led to further research and development into the underpinnings or learning cognition and instruction. [14]

Following the post war boom, the 1950's brought about further development in theoretical models of learning. Exponents at the time included Skinner and Bloom. The general systems theory of biological interactions attributed to Ludwig von Bertalanffy, was combined together with Bloom's Taxonomy [13] and allowed for development of a systems approach to instructional and organisational development. Planners were then able to match content and delivery of instruction for organisations, individuals and groups. With the advent of the space race, the focus shifted from program development to entire curriculum development. In 1962 Robert Glaser combined the works of previous researchers and introduced the concept of instructional design. He developed a model which linked the analysis undertaken about the learner to the design and development of the required curriculum.[14].

During this time Robert Mager spent considerable time developing performance objectives that could be described in measurable terms. He suggested that they should contain the behaviour sought, the condition and limitations under which the behaviour is undertaken. This has became known as Criterion Referenced Instruction.[7] Robert Gagné further developed the work of Bloom and introduced the concept of nine events of instruction and their corresponding cognitive processes.

It is Gagné's work which has been a predominant force in instructional design.

Table 1: Gagné's Nine Instructional Events [6]

1. Gaining attention (reception)
2. Informing learners of the objectives (expectancy)
3. Stimulating recall of prior learning (retrieval)
4. Presenting the stimulus (selective perception)
5. Providing learning guidance (semantic encoding)
6. Eliciting performance (responding)
7.Providing feed back (reinforcement)
8. Assessing performance (retrieval)
9. Enhancing retention and transfer (generalisation)

David Ausubel in the 1960's also posed a theory based on how individuals learn large amounts of theory from verbal or textual presentations. According to Ausubel [20] 'the primary process in learning is subsumption in which new material is related to relevant ideas in the existing cognitive structure on a substantive, non verbal basis. Cognitive structures represent the residue of all learning experiences; forgetting occurs because certain details get integrated and lose tier individual identity.'

Since the 1950 variety of models of instructional design have been developed. These include ADDIE Dick and Carey [9]. Hannifen and Peck, Knirk and Gustafson, Jerrold Kemp,and Gerlach & Ely to name a few. [3]

2.2 Phases of Instructional Design

Although many instructional design models exist, they all contain five generic phases. These are 1. Analyse, 2. Design, 3. Develop, 4. Implement, and 5. Evaluate. These phases provide dynamic and flexible guidelines which are used for effective and efficient instruction. This is also known as the ADDIE Model [15]

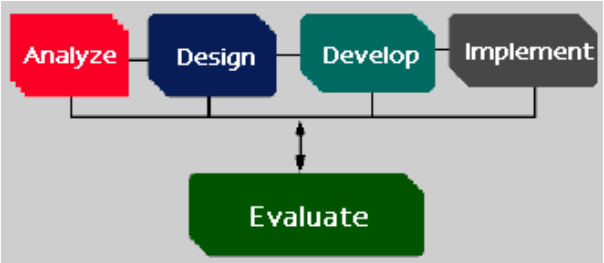

Figure 2: Instructional Design Phases [2]

Analysis is the phase where the problem is identified, defined and solutions posed.[21],[2] In the context of simulation, the purpose of this phase is to determine what the learner or participant must know or do in the clinical setting.

The design phase uses the information gleaned from analysis and allows for a plan or strategy to take place. [21],[2] It is here that the goals determined during the

analysis phase are expanded upon. The purpose of this phase is to define the information from which the instruction is developed. In other words what do we want the participant accomplish during their time in the simulator room.

Development expands upon the analysis and design stages. It is during this phase that the lesson plans and lesson materials are generated. It is here that the methods of instruction including all media which will be used are chosen. Any supporting documentation required is also generated. [21],[2] Media used may include high or low fidelity patient simulators, part task trainers software packages used for computer based instruction, audio visual media such as videos, scenarios and educational material used for handouts, training or facilitator guides.

Implementation is the actual delivery of the instruction to the learners. It is during this phase that effective and efficient delivery of the material must support the learning outcomes and promote the transfer of knowledge and associated skills to the learner or participant. [21],[2]

The final phase of the ADDIE involves evaluation. Evaluation measures the efficiency, effectiveness, value and worth of the instruction. Evaluation must also occur during the instructional design process, as well as following the implementation phase. A formative evaluation takes place between each phase and a summative evaluation measures the overall effectiveness of the instruction. The formative evaluations allow the instruction to be improved before the final version is implemented. [21],[2]

2.3 Models of Instructional Design

Many models of instructional design have been developed suitable for various instructional purposes and by differing levels of expertise of instructional designers. Each model will also be discussed for it relevance for use in simulation,

2.3.1 The Dick and Carey Design Model

Dick and Carey Model [9] involves all of the phases described previously in the ADDIE model, commencing with identification of instructional goals and finishes with summative evaluation. This model is suitable for a variety of context areas including primary and secondary schools as well as business and government uses. It is also adaptable for a variety of users ranging from novice to expert, as the step by step descriptions aid with progress through the model.

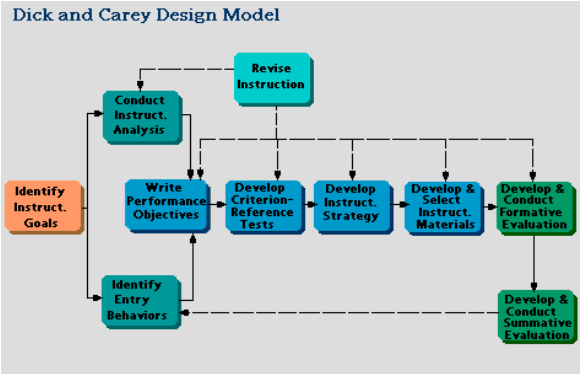

Figure 3: Dick and Cary Design Model [3]

Dick and Carey's model is one which would be suitable for use in the simulation environment. It is a straight forward linear process which allows a structured flow to the development of instruction. By identifying entry behaviours and skills of participant's detailed scenarios are able to be developed. This model does not require a formal needs analysis to be performed, but instead allows for the knowledge and skills of particular attending group to be analysed. Criterion referencing [6] allows for the instructional objectives to be developed from what is required of the participant in the clinical environment. From these, a scenario is able to be developed or modified to suit the level of expertise of the group. The type and format of the simulation is also decided upon. This can involve part task trainers, low fidelity or high fidelity patient simulators, or may even take the form or a workshop or pause and discuss scenario. The delivery method is based on the objectives and the instructional goals. Formative evaluation should be undertaken following each stage. A pilot scenario is run to ensure that the goals and objectives are met. Modifications to scenarios also take place. Summative evaluation is undertaken following the pilot and allows areas for change to be highlighted prior to the establishment of the program.

2.3.2 The Hannifen Peck Design Model

The Hannifen Peck Design Model [3] differs from that of the Dick and Carey model in that it uses a three phase approach. Phase one involves a needs assessment being performed. This is followed by a design phase, and phase three where the development and implementation of the instruction are performed. All phases include a process of evaluation.

This is suitable for simulation. The needs analysis defines the goals and objectives of the program. The design of the program is based upon the findings from the needs analysis. The development part of stage three involves how the program will be undertaken and implementation is the actual running of the program. Evaluation and revision are a continual process .This model is one that can be used by an experienced or beginning instructional designer.

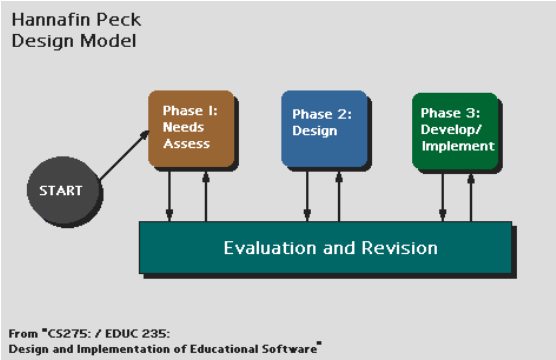

Figure 4: Hannifin Peck Design Model [3]

2.3.4 The Knirk and Gustafson Design Model

The Knirk and Gustafson Design model [3] is a three stage process which involves problem determination, design and development. Problem determination involves the identification of a problem and the setting of goals. Development of objectives and strategy specifications are included in the design stage. Development is where the materials are developed.

This model differs from the three stage Hannifin and Peck model in that there are individual processes or steps involved with each stage. This model is also good for simulation use, in particular that of scenario development as the stages lend themselves to that of software development. Again it is a model which can be used by novices or expert designers.

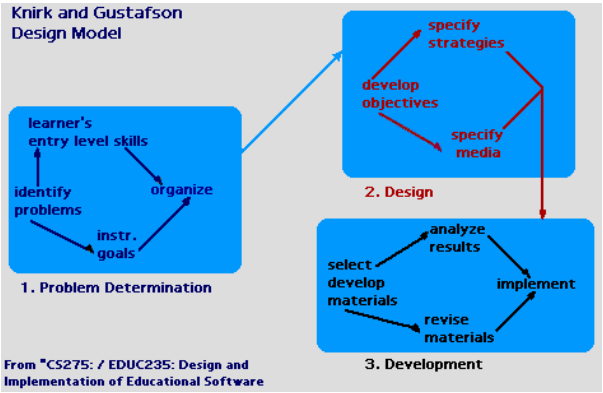

Figure 5:. Knirk and Gustafson Design Model [3]

2.3.5 Jerold Kemp Design Model

The fourth model discussed here is the Jerold Kemp Model.[3] This model takes an holistic approach to instructional design which focuses on analogies and discovery type learning. Kemp utilises all factors in the learning environment including subject analysis, the learners characteristics earning objectives teaching activities, recourses which will be utilised, support services requires as well as evaluation. This model allows for constant revision to occur.

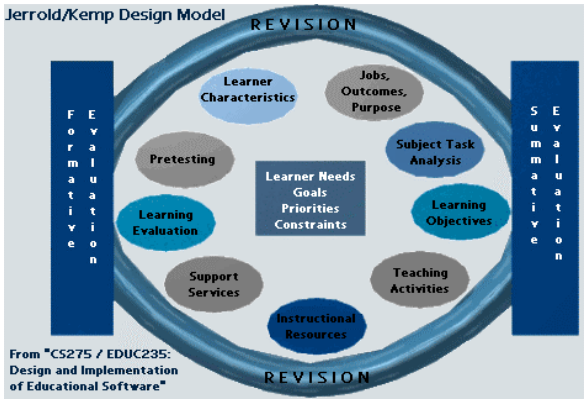

Figure 6: Jerold Kemp Design Model [3]

2.3.6 The Gerlach-Ely Design Model

The Gerlach-Ely Design Model [3] is a prescriptive model that is well suited to primary, secondary and higher education sectors. The model includes strategies for selecting and including multimedia during instruction. It is a model that is suitable for beginning instructional designers who have subject matter and expertise in a context specific area. It is prescriptive in the way that it outlines how a learning environment can be changed.

Because it is a procedural model, it is suited to simulation as it allows for focus on examples and practice to occur. This may be the way in which part task trainers are utilised within the instruction. It is also suited to small scale nodular type instruction which is also suited to the simulation environment.

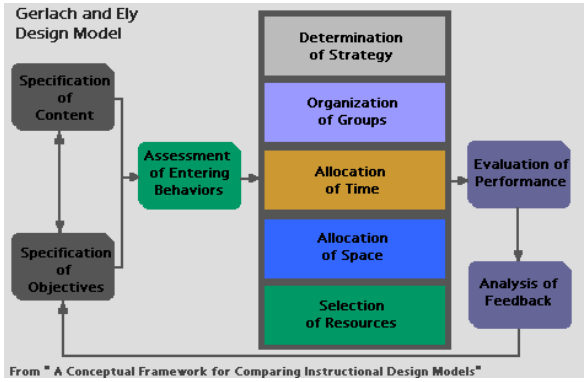

Figure 7: Gerlach-Ely Design Model [3]

4. CONCLUSION

The area of simulation is fast expanding. With this comes the need for those involved with the development of instruction in either high or low fidelity simulation to base this on sound educational and instructional theory. Some simpler clinical examples use behaviourist techniques. The more complex processes require multiple tasks and ongoing assessment. Elements of the Dick and Carey or Kemps approach may be more appropriate. The unique environment allows for students and participant to develop skills and knowledge of the clinical environment in a way that mirrors that of the clinical setting but is not only better but 'safer than the real thing.'

REFERENCES

1. Berger, C. & Kam, R. (1996) Definitions of Instructional Design. http://www.umich.edu~ed626/defin/html Accessed 28/06/2002

2. Braxton, S. General Instructional Design Phases http://www.seas.gwu/ISD/dc_design.html Accessed 20/04/2003

3. Braxton, S. Models for Instructional Design

http://www.cs.seas.gwu.edu/ISD/ge_design.html

http://www.cs.seas.gwu.edu/ISD/hp_design.html

http://www.cs.seas.gwu.edu/iSD/kg_design.html

http://www.cs.seas.gwu.edu/ISD/jk_design.html

http://www.cs.seas.gwu.edu/ISD/rp_design.html

http://www.cs.seas.gwu.edu/ISD/dc_design.html

Accessed 20/03/2004

4. Classical Conditioning http://mentalhelp.net/psyhelp/chap4/chap4d.htm Accessed 20/04/2004

5. Conway. J. (1997) Educational Technology's Effect on Models of Instruction http://www.copland.udel.edu/~jconway/EDST666.htm accessed 30/07/2003

6. Conditions of Learning (R.Gagne) http://tip.psychology.org/gagne.html accessed 04/04/2004

7. Criterion Referenced Instruction (R.Mager) http://tip.psychology.org/mager.html accessed 04/04/2004

8. DeMar, G.(1998) Behaviourism http://www.forerunner.com/forerunner/X0497_DeMar_-_Behaviourism.html accessed 28/06/2002

9. Dick, Carey, L. (1990) The Systematic Design of Instruction 3rd edition Harper Collins

10. Fidishun, D. Andragogy and Technology: Integrating Adult Learning Theory As We Teach with Technology http://www.mtsu.edu/%7Eitcinf/proceed00/fidicshun.html Accessed 28/06/2004

11. Learnativity ©1993-2002 An Introduction to Andragogy and Pedagogy http://learnativity.com/andragogoy.html accessed 30/07/2003

12. Lefrancois G. R. (1980) Psychology Wadsworth Publishing Company California. pg 181

13. Lefrancois G.R. (1991) Psychology for Teaching 7th Wadsworth , Belmont, California

14. Leigh, D A Brief History of instructional Design. http://www.pignc-ispi.com/articles/education/brief%20history.htm Accessed 18/06/2002

15. Mc Griff, S. (2001) ISD Knowledge Base/"Theoretical" Introduction http://www.personal.psu.edu/faculty/s/j/sjm256/portfolio/kbase/theories&models/theoryintro.html Accessed 12/03/2004

16. On Purpose Associates ©1998-2001 Behaviourism http://www.funderstanding.com/behaviourism.cfm Accessed 20/04/2004

17. On Purpose Associates ©1998-2001 Piaget http://www.funderstanding.com/piaget.cfm Accessed 20/04/2004

18. Open Learning Technology Corporation Limited (1996) Conditions of Learning C. Rogers http://www.educationau/edu.au/archives/cp/04d.htm Accessed 20/04/2004

19. Quinn, F.M. 2000 Principles and Practice of Nurse Education. 4th edition. Stanley Thorn (Publishers) Ltd, United Kingdom.

20. Smith, M. K. (2001) David A Kolb on experiential learning 'the encyclopaedia of informal education http://wwwlinfed.org/b-explrn.htm accessed 22/03/2004

21. Subsumption Theory (D. Ausubel) http://tip.psychology/ausubel.html_Acessed 04/04/2004 Accessed 04/04/2004

22. Yang Y.C. The basics of Cognitivism http://expert.cc.purdue.edu/~yanguc/index/theory/basic/basic_cognitivism.html accessed 28/06/2002