SIMulation Based on Language and Learning (SIMBaLL): The Model

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Abstract

The purpose of this paper was to elucidate the crucial importance of using a learning theory to develop simulation as well as to assess student learning outcomes from and during simulation. The authors designed a simulation model based on language learning called SIMBaLL, SIMulation Based on Language and Learning that was evolved from Arwood's Neurosemantic Language Learning Theory. This model provides a hierarchical framework to assess and measure conceptual learning outcomes.

KEYWORDS: simulation, learning theory, learning, conceptual learning

It is limiting to hold only the perspective that simulation is a teaching strategy or technique. Seeing simulation as a teaching strategy places the emphasis of focus on the "faculty doing" and not on "student learning." In deciding whether simulation is an effective nurse educator technique, most simulation studies focus on nursing students' perceptions of the benefits of simulation, especially as measured by self-efficacy (Kaakinen & Arwood, in press). A few studies examine whether students show an increase in actual skills through engaging in a simulation unit (Lasater, 2007; Wong & Chung, 2002). However, the process of learning skills is not the same as the process of acquiring concepts for higher-order thinking or problem-solving.

More college learners today experience difficulty with higher-order thinking skills (Young, 2007). Because students are having more difficulty with concept development, it becomes even more imperative to base learning on a theory of student learning that focuses on concept acquisition rather than the repetition or practice of skills. It is the higher-order thinking or conceptual knowledge that demonstrates students' understanding and that provides the opportunity for students to use simulation to better learn concepts. Understanding how students learn concepts allows for designing and implementing effective simulation units. Learning concepts parallels how a person thinks.

Of today's learners, 60-90% think with mental visual concepts (Arwood, 1991; Arwood, Kaakinen, & Wynne, 2002). However, Unites States education focuses on auditory teaching strategies. As a result of the mismatch between the way students think and the way educators teach, students experience difficulty with higher-order thinking skills. Focus on student learning necessitates using a learning theory model so that teaching methods match the way students acquire concepts. Because concepts are acquired neurobiologically, the **Sim**ulation **Ba**sed on **L**anguage **L**earning (SIMBaLL) Model uses a knowledge base grounded in neurobiological learning systems theory and not learning styles.

Learning systems represent what happens in the central nervous system when a person learns a new concept. Learning styles refer to ways individuals believe they learn best. Learning styles are based on observable data that a person may be educated into believing; however, styles may not match what is happening in the learning system of the brain. The SIMBaLL model uses what is known about the learning system process of acquiring concepts. Concept acquisition increases in complexity; therefore, the complexity of concept acquisition is parallel to developmental cognitive stages (e.g., Piaget, 1971; Vygotsky, 1934/1962).

Because the learning of concepts requires greater understanding of the simulation than understanding teaching skills through modeling or imitation, it is important to use a learning theory to plan, design, and implement simulation for concept learning. The SIMBaLL Model considers not only the developmental level of the learner and of the simulation but the way in which most learners process information for thinking or conceptualization. Therefore, use of clinical simulation to establish clinical competency in both nursing education and practice settings requires faculty to be knowledgeable in how students learn new concepts for higher order thinking.

NEUROSEMANTIC LANGUAGE LEARNING THEORY

The Neurosemantic Language Learning Theory (Arwood, 1991) parallels current neuroscience research (e.g., Bookheimer, 2004; Calvin, 1996; Carruthers, 1997; Damasio, 1986, 2003; Gazzaniga, 2005; Goldberg, 2001; Goldblum, 2001; Sylwester, 1995, 2003; Wallace, Ramachandran, & Stein, 2004) on how the human body turns physical input into thinking (Begley, 2007). Some background in this will prove helpful.

The first stage of learning focuses on the physiological ability of the human body to receive sensory information through the receptors; eyes, ears, nose, skin, and mouth (Wilson, 2007). Each receptor receives specific types of input. Because the eyes and ears inherently provide for messages from a distance, they are the typical modalities used to teach college students. The eyes record the position of the reflection of light (Logothetis, 2007) and the body moves to expand the number of light points. For example, the head turns to see more information, as when a nurse conducts a physical assessment. The ears receive the semantic features of the sound wave which includes pitch (frequency), loudness, and duration. In this way, sensory reception of light and sound is the first level of Neurosemantic Language Learning (Arwood, 1991). The eye and ear receptors change the physical input to chemical/electrical impulses that go through the cranial nerves to the midbrain. In the midbrain, the sensory input overlaps to form recognizable patterns. These patterns are meaningful to the learner and constitute the second level of learning.

At this level, learning is only perceptual in nature, which allows for the recognition of sensory inputs (such as the imitation of someone’s speech), replication of skills (modeling what someone else did), or the repetition of a task as in practicing. Thus, this second level of learning is limited to imitation, replication, and practice without an understanding of the conceptual components of the task; in essence, the learning is doing without thinking. For example, when

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a student learns psychomotor skills in the simulation lab, such as taking vital signs, transfer and ambulation skills, or drawing up medication into a syringe, the student is doing a task based on patterns but not necessarily based on concepts.

Current learning theories based on neuroscience (e.g., Bookheimer, 2004; Damasio, 2003; Merzenich et al., 1996) typically include these first two levels of learning, sensory input and perceptual patterns. In general, these theories separate the brain from the mind and use a Theory of the Mind (e.g., Carruthers, 1997) approach to ideas not explained by the neuroscience. Arwood (1991) recognized and identified two additional layers of neurobiological learning: the conceptual and language levels.

Systems of concepts are both broad in quantity and deep in quality because they evolve in complexity across time and space. Concepts are organized in sets that are related to one another and not in isolation and also are hierarchical in development. Therefore, simulation designed to develop a student's acquisition of concepts must arrange for both the breadth of concept development as well as the hierarchy of concept acquisition. For example, instead of one simulation to teach students the psychomotor skill of taking vital signs and the interpretation of normal ranges of vitals, nurse educators would need a hierarchy of simulation about taking and interpreting vital signs under various conditions to develop higher understanding of these concepts, such as interpreting vital signs or correlating vital signs with patients' differing medical conditions.

The fourth stage of Arwood's (1991) Neurosemantic Language Learning Theory identifies language as a representation of conceptual learning. For example, nursing students are first able to recognize what a nurse is doing (sensory to perceptual development). Then the student nurse learns definitions of terms, such as blood pressure, hypertension, and hypotension. At this level, they can regurgitate the definitions as patterns. Then they learn the "why" or pathophysiology across various situations, which means they are beginning to conceptualize the terms. At the fourth stage of learning, the students demonstrate accurate understanding of these concepts by how they talk or write about the concepts. In essence, their language demonstrates what they know or understand. And, since concepts increase in meaning over time, the language will also change to represent the students' knowledge with increased learning.

Cognitive Development

At the cognitive, conceptual level, a person is able to consciously think about an idea. Figure 1 shows the stair-step development of cognition. At each level, the learner outcomes become more complex: 1) The learner is unaware of the meaning of a concept; 2) the learner knows the meaning of the concept in relationship to himself; 3) the learner shares the meaning with others and in relationship to what others know; and 4) the learner uses language symbols for safe and effective representation of nursing concepts.

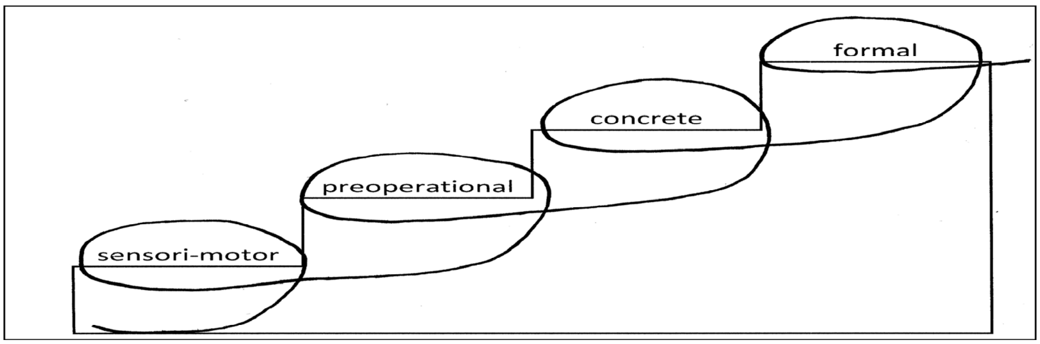

Figure 1. The stages of cognitive development.

Cognitive stages show a stair-step progression of the development of ideas or concepts. But, the learner's underlying conceptual development spirals in depth and breadth as learners acquire new information with new recognizable patterns. In other words, concepts develop through this spiral learning process over time, increasing the knowledge base, not just the ability to perform a task, see Figure 2.

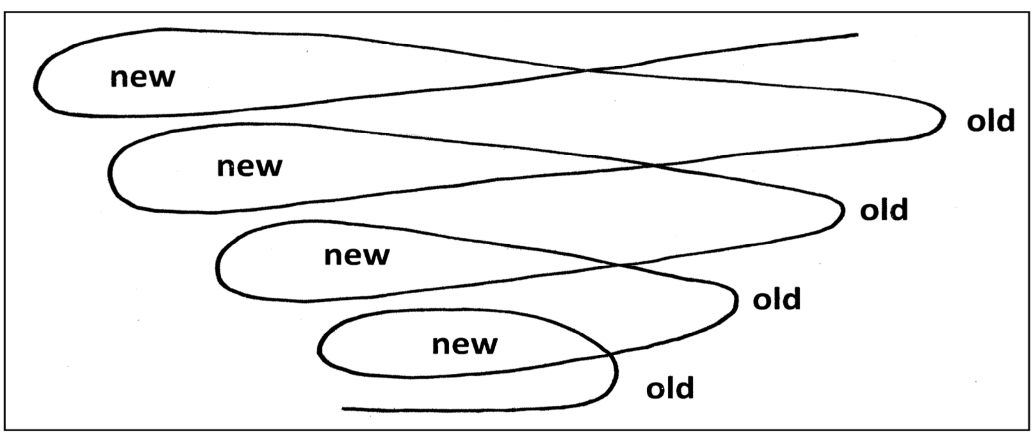

Figure 2. The spiral process of learning concepts.

The learning spiral of a concept represents, at each cognitive stage, how new information is brought into the old concept, creating the depth of a concept's

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meaning. All new concepts become accessible at a preoperational level, but the concept is not fully developed at this level. The learner recognizes the name of the concept and can respond to another person's use of the concept. Since language represents what the student knows, the student, at this level, might say, "I know what that means … it is on the tip of my tongue but I just can't remember." Through additional experiences, the learning system continues to acquire new information related to the concept. As information about a concept increases, the spiral of information moves forward; eventually, the concept's level of meaning moves up to the next level. For example, beginning nursing students may know how to take vital signs based on imitation (preoperational level). But vital signs are more difficult to take on some patients. At first, taking vital signs on a difficult patient brings in new information. This new information conflicts with how the student nurse took the vital signs before; but as the student nurse acquires information about different types of patients, then s/he begins to use rules to think about how to take vital signs (preoperational to concrete level). But, taking vital signs also requires interpretation of the data. What the patient brings to the setting may conflict with what the student knew before the patient was assigned to the student (concrete). Finally, the student begins to incorporate not only the vital signs but why the vital signs are taken and what to do with the data. At this level, the nursing student is beginning to use more of a formal understanding of the concept "vital signs."

This learning spiral shows the scaffolding (Bruner, 1978) of conceptual knowledge. In other words, concepts are acquired over time and then refined through the conflict of new information with old information. With each refinement of conceptual meaning, there is a reorganization of the learner's understanding of the concept. Since language represents a person's underlying conceptual development, as a concept increases in complexity so does the learner's ability to "talk" about the concept, what s/he knows or is thinking about relative to the concept. Figure 3 shows the interaction between development and learning.

Simulation can be designed, planned, and implemented to follow this spiral process so that there are conceptual expectations based on the cognitive level of the learner. Furthermore, the complexity of the simulation can be arranged to meet a student's level of need. The student's learning about a concept can also be increased through discussion with the nurse educator at the end of a simulation designed to increase conceptual learning or during the simulation, if the nurse educator is able to assign meaning through language to what the student nurse is doing. Assessment of the learner's knowledge can be determined through the use of language; therefore, simulations can be used to determine competency of conceptual knowledge, such as graded simulation.

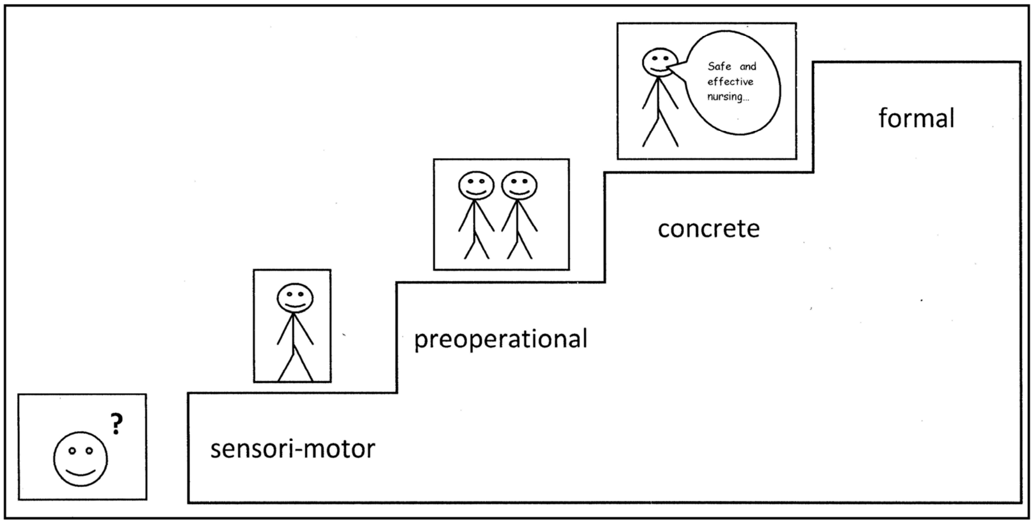

Figure 3. Learning concepts develop the outcomes.

APPLICATION

The SIMBaLL model refers to **Sim**ulation **Ba**sed on **L**anguage **L**earning, which derives from the Neurosemantic Language Learning Theory (Arwood, 1991). The SIMBaLL model has four components. 1) Simulation lessons can be arranged to follow a hierarchy of concept development. 2) Since language represents concept development, nurse educators may use language to determine the student's conceptual understanding during the simulation. 3) In this way, nursing faculty can adjust their language to assist in the student's conceptual learning from the simulation lesson. 4) And, finally, the student's understanding of the concepts underlying the simulation activity may be assessed by quickly analyzing his/her use of language to fundamental questions about the simulation.

Hierarchy of Lessons and Conceptual Level of Student

Since concepts are acquired through the language learning system, the lowest level of conceptual development occurs as a set of recognizable patterns. Examples of pattern tasks include imitation, copying a model, performing a skill, and replicating a procedure. These types of simulation, which are appropriate to

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offer first, can indicate that a student is able to perform a psychomotor task but without the student necessarily understanding why or how s/he performs the task. This is very limited cognitive learning and does not provide flexibility in performing tasks with a real patient.

Following such basic psychomotor replication of patterns, a student begins to acquire a preoperational understanding of the task. This is the first real level of conceptual knowledge. The student is able to think about oneself as a person performing a task. Since 60-90% of all nursing students think in a graphic visual form of cognition (Arwood et al., 2002), the nursing student is able to think of self in his or her own picture performing the task. Preoperational simulation lessons provide a situation that is routine for the student to show what s/he knows to do. Whether the patient responds to the student's actions is not important, since this level is about the learner, not the patient. This is an important point! At a preoperational level of learning, the learner is concentrating on what s/he knows, not on the patient's needs.

Furthermore, at the preoperational level, students think about what they know. Self-efficacy simulation activities ask students if they thought the simulation made them feel more comfortable. Any type of lesson asking students what they believe or think is at a preoperational level. Again, the preoperational level is the lowest level of learning concepts; it does not provide learning concepts at a higher order.

At the concrete or third stage of cognitive development, the patient must be central to the nurse's actions and words. Therefore, the simulation patient must be able to respond to the nurse's actions and words. The student then responds to the patient. If the student responds in a routine manner, ignoring specific details or cues that the patient provides, then the student is responding at a preoperational level. But if the student panics and cannot respond, then the student has dropped cognition to a sensory level and is no longer able to think through his or her actions. On the other hand, if the student responds to the details of the patient and provides safe and accurate care to the patient based on those specific details, then the student is functioning at the concrete conceptual level for a concrete simulation task. Ideally, the purpose of a simulation designed to provide concrete tasks would expect the student to respond at the concrete level of conceptual learning.

The concrete level of simulation provides not only a complex case scenario but also expects students to explain why they performed specific actions during the simulation process based on a more complex understanding of the concept. The students' answers determine the level of their understanding. For example, if a student says, "I saw the patient's oxygen saturation was below 92%, so I gave them oxygen per the PRN order." This explanation indicates that the student did (put oxygen on the patient) what the student needed to do based on a rule. Rules are concrete in nature; the conceptual rule is when oxygen level is below 92%, the patient needs oxygen. The student's language tells the nurse educator that the student knows the rule about oxygen administration, which shows that the student has a concrete level of understanding. But stating the rule does not mean the student knows why, in this specific patient situation, the oxygen level was low and what else s/he might need to know or look for in the patient, a formal and higher level of conceptual knowledge.

At the formal level, the student is able to explain why the patient's specific data related to the intervention of providing oxygen in a particular way. In this situation, a student who is at the formal conceptual knowledge level is able to explain that "the oxygen level was low in this patient because I saw that the patient had 300 mls of blood in the NG container. The patient is in the hospital because of a peptic ulcer and the patient's oxygen saturation level dropped because it is likely there is internal bleeding and the beginning of hypovolemic shock."

A formal level of understanding shows more than rule-based thinking. The formal thinker is able to analyze the situation and apply theoretical constructs to the situation through synthesis of information. At the formal level of conceptual language, the student is able to explain "why" decisions are made.

SIMULATIONS FOR LEARNING

When the purpose of the simulation is to assist students' conceptual learning, the nurse educator can tailor verbal prompts, cues, and/or questions to guide or scaffold the students' thinking through language into a higher level of cognitive functioning. The students' use of words parallels their cognitive understanding.

Learning is both a social and a cognitive function of the learning system. Socially, how students respond to others as well as how they use language determines their cognitive level. Grading the student, on what the student understands or knows, is therefore based on the student's words and acts that demonstrate socially and cognitively how well the student is learning concepts. In this way, the student learns to construct meaning (Cooper & Kiger, 2003) to become literate in a given content area.

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The following tables provide examples of how students interact with simulation and how their language provides the nurse educator with insight into their cognitive level of understanding. For each level of functioning, examples of behavior and faculty assistance to learning is provided. Table 1 shows the lowest level of cognitive interaction. At this level, the student responds to sensory input and can only act with a motor response.

Table 1

Sensori-motor Level of Development

Social Development	Others must engage with student. Student is unable to function as an agent.
Language Development	Cannot explain at the moment; student is in crisis. After some time, may be able to say he or she was afraid and did not know what to do. Language comes to a halt.
Behaviour Examples	Student becomes immobilized. *Example 1.* Student did not hand in clinical reflection journals. When asked why the student did not hand in her journals, she said, "I was afraid after I blew it last time, so I just did not know what to do, so I did not do anything." *Example 2.* During medication administration, a student who is afraid of needles accidentally sticks himself. The student stares at the hand that was stuck and starts to shake and cry uncontrollably. Faculty has to guide student to sit down.

By understanding how behavior and/or language reflect a student's level of thinking or cognition, faculty members can customize feedback to help a student learn. As the student's learning increases, so does the student's cognitive functioning. The SIMBaLL model provides an understanding of how to use simulation, not just for assessment of what the student knows, but also as a form of learning. In sensori-motor cases (Table 1) where students are immobilized and unable to conceptualize and therefore act, the following teaching strategies help faculty intervene to assist the student in functioning at a higher cognitive level.

Faculty take over simulation because all conceptual learning has stopped at the sensori-motor level. By watching the faculty member, the student begins to function at a higher level. The simulation could be redesigned into a series of smaller simulations allowing the student to experience smaller steps of success. Faculty should provide prescriptive guidance for the simulation now and in the next simulation until the student is able to function at a higher level. After the student gets control or can focus, then the situation can be debriefed with clear expectations of behaviors and options for the future.

It should be noted that when students are functioning at this level, they do not mentally see themselves doing the simulation. So, each student should be asked to draw out the simulation by beginning with the drawing of the student on the paper. The faculty can draw this as a stick figure and label it with the student's name so the student can begin to see self in the simulation. The whole purpose of intervening or assisting a student at this level is to help the student begin to once again think or conceptualize about the simulation activity. This pre-operational level of cognitive development is depicted in Table 2.

Table 2

Pre-operational Level of Cognitive Development

Social Development	• Agency is "I"-based; the problem is external to the person or "other"-based. • What do I get out of the relationship? • We learn from what we see. • Lack of verbal communication. • Feels like a "victim".
Language Development	• Can relate to others but not with others. • Rules are specific to own needs. • Blame others, tell what he or she did but not in relationship to the patient or to other sources of information such as the text or the professor. • Demonstrates marketplace morality: "I am sorry."

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Table 2 (continued).

Behavior Examples	Examples of the language at a pre-operational level: • You didn't teach me how to do it. • I'm not sure how to do it. • I can't find the answer in the book. • I'm not sure what you want. • You confused me. • Nobody in the class gets it. • None of us are getting it. • I do it exactly as in the book in this order so I get an "A." *Simulation example of pre-operational level*: Student breaks sterile technique during testing. When confronted, the student says, "I did what my lab instructor told me to do." Or, "I followed the check list exactly…" *Simulation clinical example*: During a simulation to test medication administration, a student enters the patient's room to give an IV medication. The patient says to the student, "I am not supposed to get that medication and I just went to the bathroom so I don't need that medication." The student says, "I need to give you this medication because there is an order for it." This conversation continues for a while, until the faculty says to the student, "What is the medication order?" Upon checking, the student finds there is no order to give that medication to that patient. The student assumed there was an order because there had been one the time before. *Clinical explanation*: At this level, the students are confused by different steps to complete a procedure as they do not see multiple options or solutions for action with a particular patient. For example, if the simulation is for the same action as in the book but the patients have presenting differences, the student at this level may not recognize the similarities. The students may also be confused by different explanations or different people using different words.

New concepts begin their development at this preoperational level. Student learners at this level see themselves but not necessarily the patient or others. During simulation, teaching strategies that help students move from the preoperational to concrete thinking level, follow. Faculty work from what students say they know. Thus, by taking a student's words, the faculty member refines student knowledge and adds information to what the student knows. Faculty give feedback to what the student does, so the student is able to add this new information to the level of what the student knows. Faculty could ask the student about multiple ways that the new information added to old information and how it might be used. Faculty provide additional simulations for similar use of concepts to assist the student in progressing from the preoperational to concrete level of understanding.

For most nursing students who are working with nurse preceptors, the level of the student's learning is concrete (Table 3). Simulations designed to help this level student develop the concrete understanding of skills, might be arranged to include any or all of the following ideas. At this level the student must be challenged to explain why he or she showed specific actions. Rules are acceptable. The student should be asked to think about multiple reasons why one action was chosen over another. Rules are used in multiple situations. The student can answer why and how questions about complex possible actions for a case and provide a rationale for the chosen action. The rationale is rule-based or presented as a right or wrong notion. The student can teach the rule(s) to others. A concrete-level thinker is able to delegate based on rules of delegation in non-crisis situations.

Most expert levels of learning are formal in nature (Table 4). Formal cognition suggests that not only is the learner able to perform a task but to do so using language that will explain one's thinking for complex cases or multiple tasks. If a learner is able to demonstrate any of the following, the learner is functioning at the formal level. The following types of tasks may also be used in simulation to help learners develop a formal understanding. Ask the student to explain how to manage multiple patients with multiple needs using complex language to explain how systems, theory, and knowledge interact. Have the student explain to multiple members of families what the process is for managing the care of their loved one. Use time-based, simultaneous actions….multi-tasking priorities. Ask the student to explain how to delegate tasks while prioritizing actions to others during a crisis.

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Table 3

Concrete Level of Cognitive Development

Social Development	Agency is “we”-based…what do we get by being in a relationship with others. “I use the rules to determine what to do with which patient.” Different patients have different needs and there are rules or protocols for dealing with different patients. But the rules pertain to the different patients so that how the rules integrate may not be understood.
Language Development	Ideas are about rules, examples, others’ ideas, right/wrong morality, right and wrong way to approach specific situations.
Behavior Examples	Contractual behavior, shared responsibility, friendship is what we are both getting. A patient with multiple needs is the basis to this concrete lesson. The student addresses the patient’s needs in a rule-based process. *Simulation example*: The patient complains of pain to the student. The student asks the patient to rate the pain on the pain scale. The patient rates the pain at 7 out of 10. Without further assessment, the student tells the patient that S/he will go get the pain medication right away and the student leaves the room. This is preoperational because the student does not think about leaving the patient alone and does not do further assessment of the pain. At a concrete level, the student calls for help and/or asks someone to stay with patient while the student goes to get the medication, after further assessment. *Clinical example*: A cancer patient develops a fever 12 hours after administration of a chemotherapy agent. The student gives the patient an antipyretic medication but does not tell the nurse about the situation until the end of the shift. This is a preoperational level of understanding. At the concrete level, the student would confer with an in charge nurse to determine if an antipyretic medication is warranted.

Table 4

Formal Level of Cognitive Development

Social Development	Symbolic agency…I can walk in another's shoes and take another's perspective. Emotions are formal - remorse is felt and expressed in multiple ways.
Language Development	Ideas are principled, mores are ethical, rules are not needed… formal morality, what is good for all people even at the expense of personal gain.
Behavior Examples	• Student can safely and appropriately manage a patient with complex needs in crucial situations. • Student can monitor the work of multiple patients with multiple needs at the same time. • Student explains the rationale for multiple types of treatments with effective language for lay people. • Student can resource in time beyond the here and now; evidences effective, organized time-management skills. • Student is able to delegate based on what the patient needs, not on what the student or the nurse needs. *Simulation and clinical example*: In a hypovolemic shock situation, the student completes assessments, prioritizes, and initiates actions of intervention; informs others; anticipates what will happen next; and delegates to others during crisis so that multiple actions can be done simultaneously. During the reflection session, the student demonstrates formal conceptual knowledge of complex pathophysiology specific to this patient's presentation. The student knew what was happening, why it was happening, and could anticipate others' actions (e.g., the physician). The student may be able to do meet both the patient's physiological needs and psychosocial needs.

The purpose of understanding how students' actions and language represent their conceptualization of thinking, helps the nurse educator arrange simulation activities to not only meet the student learner's level of development

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but also to use simulation for helping the student increase own level of conceptual learning.

SIMULATIONS FOR EVALUATION OF KNOWLEDGE

Using the hierarchy of lessons against how the student responds provides an evaluation process. For example, if a student is given a preoperational simulation, then the student is expected to perform at a preoperational level. If the student is unable to perform at this level, then the student fails the simulation and teaching strategies are implemented to assist the student in another simulation at that level. Since preoperational lessons are about the student, not the patient, the importance also is related to the student's needs. At this level, nursing faculty may want to provide a student with multiple attempts to pass the simulation.

However, at the concrete level of simulation, the stakes are higher because the patient is central to the simulation, for example, the patient's needs, care, and medication. At this concrete level, faculty should use specific strategies and multiple similar simulation situations to assist the student in conceptual learning. Concrete conceptual knowledge is assessed by a pass/fail or graded simulation at that concrete level. Continual failed attempts mean that the student requires a learning intervention in a different way than the faculty is providing (as shown in the following section on language organization).

Once a nursing student is able to provide multiple concrete levels of rule-based responses to multiple patients, then the student begins to demonstrate a more formal language response to questions about why specific actions are performed under a variety of conditions. Students at the formal level of knowledge may be able to provide safe, efficient, and prioritized care to one seriously ill patient who is relatively stable. However, they may experience difficulty functioning at the formal conceptual level as the patient becomes progressively worse or moves quickly into crisis. Likewise, the same student may have difficulty at the formal level when responsible for caring for multiple patients. Multiple patients require the student to think about a variety of rules being applied in different ways to different conditions in different patients.

During the simulation or immediately following, the period of debriefing allows faculty to check on conceptual understanding as well as to help the student refine own thinking. Some nurse educators report that there are certain students who repeatedly fail a particular type of simulation task. This failure suggests that the feedback during or after simulation occurs in a form that does not help the student learn the concept that the stimulation was providing. When students continue to demonstrate difficulty learning or do not pass graded simulations, the designed learning activity (input) does not match the way the learner is processing information. Nurse educators can change the input to match the student's neurobiological learning system and language processing in addition to providing students with strategies for better thinking in a way for them to learn best.

Language Processing

Language represents conceptual knowledge and provides insight into what the student knows and also the way the student learns new concepts. The majority of students learn to conceptualize their knowledge as visual concepts. In this way, the student may not be helped by a faculty who talks a lot to help the student learn during simulation. Instead, the faculty member would do better to draw the patient on a white board and then draw what is occurring in the patient and what the student was or was not doing. Then the faculty member draws how the student's actions affect the patient. For example, a student who continued to break the sterile barrier during simulation did so because he could not mentally see that when he used gloved hands to place the under sheet, he was touching the table with hands that had sterile gloves. By touching the table with sterile gloves, the student broke the sterile field. It was not helpful to this student, who has a visual learning system, to tell him that he broke the sterile field after each simulation. Because he had no mental picture for what he did that broke the sterile field, he continued to fail the skills test. A different strategy would be to stop the student when the error occurs and ask him to look and see what he is doing and how his action breaks the sterile field. By showing the student that the back of his hand touched the table, he could see what the educator's words meant. This strategy would give the student a mental picture of what he was doing. In addition to showing the action of what the student did, the faculty member could also change any spoken words from talking about a rule separate from the action, to more visual language at the time of the error, such as "Your hands have on sterile gloves so you do not want your sterile gloves touching anything. When you reach down to place the under sheet, your sterile glove is touching the table even though you cannot see your hand. When your hand with the sterile glove on it touches the table, then your glove is no longer sterile." The next step would be to have the student explain what he did and why he should not touch the table even though he cannot see his hand touching.

This means that faculty engaged in simulation designed to help conceptual learning must also understand that most students think in the mental pictures or graphics of concepts that they can picture. Invisible concerns such as bacteria, staph, and viruses, for example, may not provide the visuals that students need to

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conceptually understand what they can see and what they cannot. For example, a beginning nurse attempted to catheterize a patient without first washing her hands. The nurse had just finished changing the bandage of a person with staph. The parent of the patient was watching and asked the young nurse to please wash her hands. The nurse said that she did not get her hands dirty and therefore, did not need to wash her hands. The mother of the patient continued to insist that the nurse wash her hands between patients. Finally, after three insistent remarks, the nurse rinsed her hands, at which point the parent insisted on soap and lather and time for washing. The parent later realized that the reason the nurse had not washed her hands was that she did not see dirt on them. Somehow, the nurse did not make the cognitive connection between all of the pathophysiology and communicable disease studies in college and what the actual microbes look like on hands. Likewise, nurses who insist that they have gloves on from one patient to another do not realize that the gloves are not just to protect them but also to protect their patients. In both of these examples, the nurses are not learning the material at a formal level and are learning to execute psychomotor skills at a preoperational to concrete, rule-governed lower level of thinking. In order to provide safe and effective nursing to patients, simulation designed and implemented at a formal level would benefit nurses and their patients.

SUMMARY

Simulation is more than just a tool for teaching skills or analyzing student self-efficacy. Simulation can be designed and implemented across conceptual levels to facilitate students' learning at increasingly higher levels of conceptualization. In order to design and implement simulation at an appropriate student level and then be able to move students' conceptualization to the next cognitive level, the faculty must understand the learning relationship between cognition and language. Language represents cognition and can be used to understand what the student knows, as well as to help the student learn concepts at a higher level.

To evaluate the use of the model, faculty can compare student performance in both the didactic and clinical setting with student performance in a graded simulation. One of the primary ways to evaluate the use of the model is to analyze students' written reflections of their thinking after the simulation is complete. The model can be used to identify the cognitive developmental level of at risk students in the clinical setting, which has been validated when students were required to remediate in the clinical simulation laboratory (see Table 5).

Table 5

The SIMBaLL Model: Simulation Based on Language Learning

Cognitive Level	Social Level	Language Level	Simulation Type	Faculty Strategies
Sensori-motor	Dependent	Not able to use language	Psychomotor, imitation, modeling of skills	Faculty takes over; repeat sim in smaller steps; prescriptive guidance.
Pre-operational	I am in my picture. Patient is in his/her own picture.	"I know" what I do and if I can't do something it is your fault.	I perform skills based on what I know, separate from patient needs	Faculty refines student words to match what student knows through feedback; add multiple examples of sims for similar use of concepts.
Concrete	Patient is in my picture, and I relate to the patient and the patient's needs.	I learn based on what we know about the topic; rule-governed.	Complex single-patient care	Students required to explain rationale for actions; students can teach rules to others; sim designed to have student delegate in non-crisis situation; ask students to describe how rule(s) can apply in multiple situations.
Formal	I can take another person's perspective, I can walk in someone else's shoes.	I learn from the analysis and synthesis of complex concepts.	Simultaneous, multiple complex patients; supervision and evaluation.	Provide sims to manage patient and family teaching at multiple levels that require multi-tasking priorities and delegation during crisis.

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Faculty would do well to base simulation on foundational learning theories, such as the Neurosemantic Language Learning Theory (Arwood, 1991), in order to use the knowledge of language as the basis for simulation assessment, grading, and determination of competency. It is crucial for faculty to understand that doing an action does not always equate with "knowing" why that action was the correct one or the best one for that patient in that situation. Faculty must also understand that there exists a hierarchy of conceptual learning from the preoperational to formal cognitive levels of development that they can use to tailor student learning needs. The SIMBaLL Model presented in this article offers nurse educators a theoretical framework for designing, assessing, and facilitating learning through simulation. Table 5 summarizes the model.

REFERENCES

Arwood, E. L. (1991). *Semantic and pragmatic language disorders* (2nd ed.). Rockville, MD: Aspen Publishers, Inc.

Arwood, E., Kaakinen, J., & Wynne, A. (2002). *Nurse educators: Using visual language.* Portland, OR: APRICOT.

Begley, S. (2007). *Train your mind, change your brain.* New York: Ballantine Books.

Bookheimer, S. (2004). Overview on Learning and Memory: Insights from Functional Brain Imaging. *Learning Brain Expo Conference Proceedings*. San Diego, CA: Brain Store.

Bruner, J. (1978). The role of dialogue in language acquisition. In A. Sinclair, R. Jarvella, & W. Levelt (Eds.), *The child's conception of language* (pp. 241-256). New York: Springer-Verlag.

Calvin, W. H. (1996). *How Brains Think: Evolving intelligence then and now.* New York: Basic Books.

Carruthers, S. A. (1997). *Language, thought, and consciousness: An essay in philosophical psychology.* Cambridge, UK: Cambridge University Press. Cooper, J. D., & Kiger, N. D. (2003). *Literacy: Helping children construct meaning*. New York: Houghton Mifflin.

Damasio, A. (1986, November). *Learning and Language*. Presentation for the Institute for Science, Engineering, and Public Policy, Portland, OR.

Damasio, A. (2003). *Looking for Spinoza: Joy, sorrow, and the feeling brain.* New York: Harcourt Brace.

Gazzaniga, M. S. (2005). *The ethical brain.* New York: Dana Press. Goldberg, E. (2001). *The executive brain: Frontal lobes and the civilized mind.* New York: Oxford University Press.

Goldblum, N. (2001). *The brain-shaped mind: What the brain can tell us about the mind.* Cambridge, UK: Cambridge University Press.

Kaakinen, J. R., & Arwood, E. (in press). Systematic review of nursing simulation literature. *International Journal of Nursing Education.*

Lasater, K. (2007). Clinical judgment development: Using simulation to crease an assessment rubric. *Journal of Nursing Education, 46*, 496-503.

Logothetis, N. K. (2007). Vision: A window on consciousness. In F. E. Bloom (Ed.), *Best of the brain from Scientific American* (pp. 78-89). New York: Dana Foundation.

Merzenich, M. M., Jenkins, W. M., Johnston, P., Schreiner, C., Miller, S. L., & Tallal, P. (1996). Temporal processing deficits of language-learning impaired children ameliorated by training. *Science*, *271*(5245), 77-81.

Piaget, J. (1971). *The language and thought of the child.* New York: Humanities Press.

Sylwester, R. (1995). *A celebration of neurons*. Alexandria, VA: Association for Supervision and Curriculum Design.

Sylwester, R. (2003). *A biological brain in a cultural classroom: Enhancing cognitive and social development through collaborative classroom management*. Thousand Oaks, CA: Corwin Press.

Vygotsky, L. S. (1962) *Thought and language.* Cambridge, MA: MIT Press. (Original work published 1934)

Wallace, M. T., Ramachandran, R., & Stein, B. E. (2004). A revised view of sensory cortical parcellation. *Proceedings of the National Academy of Sciences (USA), 101*(7), 2167-2172.

Wilson, D. (2007, February). *Vision and the brain*. Oregon Health & Science University (OHSU) Brain Awareness Lecture Series, Portland, OR.

Wong, T., & Chung, J. (2002). Diagnostic reasoning processes using patient simulation in different learning environments. *Journal of Clinical Nursing, 11*, 65-72.

Young, R. V. (2007). The university possessed. *Intercollegiate Review, 42*(1), 3-9.

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