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Evidence-Based Teaching Guidelines

Transforming Knowledge Into Practice for Better Outcomes in Healthcare

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Educational change is necessary to meet the demands of the current healthcare environment. An outcome-based approach to healthcare education is optimal to support organizational change. Learning objectives should focus on the best practice outcomes and should emphasize what the healthcare provider is expected to do after the educational activity is over. Regulating agencies and consumers hold healthcare accountable for providing high-quality, safe patient care. Educational activities should provide the skills and knowledge that enable nurses to meet this goal. **Key words:** *activating prior knowledge*, *cognitive load*, *educational outcomes*, *learning approaches*, *modes*, *media*, *modality principle*, *teaching methods*

DID learning take place? Outcome-based education is a paradigm shift from passive traditional learning to an active, learner-centered, result-oriented approach to learning. The learner and instructor focus on the desired results. The practice-based outcome concentrates on what the learner will be able to do following the educational activity, and what they will contribute to the practice of critical care nursing. Educators need to create a learning environment that is interesting, challenging, motivating, guiding, and supporting. But, what teaching strategies are best? How do we know that education led to desired practice? The science of learning provides guidelines to address optimal ways to integrate knowledge and skills into clinical practice.

Recently, there has been increased attention on establishing the effectiveness of educational activities has come to the forefront. Clinical performance is examined as a means to evaluate quality and safe patient care. Traditionally, it was enough to attend continuing education activities, if only to meet the relicensure/recertification requirements of the nurse. There were few stated expectations that the education would be applied to clinical practice. Today, quality improvement initiatives, evidence-based practice, professional accountability, and public expectations dictate the importance of demonstrating educational outcomes. There is increased attention to choosing teaching methods that will facilitate the achievement of these outcomes. Judicial use of educational resources, cost, the needs of the learner, outcome goals, and the proliferation of technology are all considered in selecting appropriate teaching methodologies.

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LOW-, MEDIUM-, AND HIGH-LEVEL LEARNERS

The psychological process for learning uses 2 memory systems: short-term or working memory and long-term memory. These

systems are involved in the active transformation of content from the environment into new knowledge and skills that can be accessed when needed. Short-term memory is distinguished by its capacity limits, processing power and separate storage for visual and verbal information. Miller[1] explained that working memory holds only 4 to 5 "chunks" of information when active. It is crucial that educators keep working memory from becoming overloaded and allow working memory to be dedicated to key content.

Educational activities are developed to help learners build the best mental models or memory structures known as schemas. In time, the nurse activates the schemas to intervene appropriately in the clinical arena. Working memory and long-term memory work together. It is interesting that the more knowledge stored in long-term memory, the more information working memory can hold. This helps to explain why experienced nurses can process more efficiently than novice nurses. The expert nurse can distinguish patterns in content from previous mental models. Still another advantage of the expert nurse is automaticity. Skills become automatic due to daily repetitions like running a code or calculating a vasoactive drug. Automaticity permits the expert nurse to bypass the limited capacity of working memory. These concepts are important for the educator because the low-ability learner is at risk for cognitive overload. The majority of this article will discuss methodologies that pertain to the low-ability and medium-ability learner. Expert nurses (high-level learners) have the ability to gage their learning and make adjustments. High-level learners have ample mental models to support their cognitive processes and, therefore, requiring little or no instructional support.[2]

CHOOSING EDUCATIONAL TOPICS

The delivery of education begins with determining the need for training, always with the end result or outcome in mind. Is there a patient safety issue, a new process or procedure, or a new patient population? Ever since the of the Institute of Medicine[3] published *To Err Is Human*, which attributed 44 000 to 88 000 deaths to preventable hospital medical errors in 1997, hospitals are being held accountable for meeting patient safety goals. Improvement, change, and learning are deeply united.[4] Reasons for providing educational activities include patient safety issues, emerging service lines, change in organizational goals, evidence-based research, quality data initiatives, priorities of regulatory agencies, on boarding of new staff, and specialty training.

PURPOSE

An educational program must address the goals and values of the activity. A purpose statement should address what knowledge, technical competency, professional standards, and/or beliefs the nurse should take away and utilize following the activity. What is the goal? What are we trying to accomplish? What methods are most appropriate to achieve the chosen goals? It is important to determine if the outcome goal is to:

1. inform (communicate information)
2. perform procedure (build procedural skills that can be applied to the work environment)
3. synthesize data/problem solve (build critical-thinking skills/clinical judgment)

Finally, the purpose serves to motivate the learner by identifying how this educational activity improves their professional practice through the attainment of new skills and knowledge.

DELIVERING THE CONTENT

In 1947, the US Army conducted a study that proved that type of media (books, lecture, video, etc) made no difference in learning outcomes.[5] Research continues to

confirm similar outcomes even when including electronic learning; the bottom line is that well-designed and well-implemented educational programs determine the effectiveness.[6] Clark[2] looked at 50 years of comparative media research and concluded that it is instructional modes, methods, and design that most directly influence learning. Modes refer to the sensory channels (visual, auditory) that are used by learners to process information. Learners use independent sensory channels to process visually represented material and auditory represented material. Instructional scientists have proven over and over again that audio descriptions of complex visuals are more effective in managing cognitive load. This is known as the "modality principle."[7] For example, reading text and seeing a complex picture presented to a learner overloads the mind in processing 2 items using 1 sensory channel.[8] It would be better to provide audio while viewing the complex visual picture, processing the information using 2 different sensory channels. This basic principle prevents cognitive overload.

LEARNING APPROACH

The educational literature recognizes 4 approaches to learning: receptive, directive, guided discovery, and exploratory. Each has its merits, depending on the intended instructional outcome. The oldest and most traditional approach to learning is receptive. In this means of delivering content, the learner is passive. An analogy is that the instructor opens up the head of the learner, pours in the content, and hopes the brain absorbs it like a sponge. Examples include traditional lecture, a video, or a textbook. Although receptive learning environments do not provide active engagement with the content, they can still promote learning. For example, this approach can be used to provide updates to current employees, present basic orientation information to new hires, or provide additional knowledge to the high-level learner.[2] In the directive approach, learners gradually build skills and knowledge by progressing from basic to advanced skills. The leaner responds to questions, and the instructors provide corrective feedback. This approach can be use to teach procedural skills. Guided discovery learning allows for the development of knowledge and skills through real work-related experiences. Instructors provide relevant problems, resources, and guidance. Examples of this approach are problem- or case-based studies. Guided discovery is best used for the experienced learner that already has relevant content knowledge. Exploratory approaches incorporate a collaborative structure whereby learners can exchange ideas and resources with other clinicians with respect to a common outcome goal. Examples of this include use of the Internet to explore current research and evidence-based practice. Many educational activities are a combination of one or more of these approaches. The best approach needs to match the instructional goals and the learner's level of knowledge and skill. As the instructional planner, it is import to select the best mix of modes, methods, and learning approaches to achieve the intended educational outcome. Table 1 summarizes the instructional design of educational activities.

METHODS

The best methodology often depends on the learner's background knowledge as well as the intended learning outcome[9] Method refers to the techniques used to promote learning. Well-designed lessons support the psychological processes that promote the transformation of lesson content into practical work-related applications. Much of learning, however, is at the surface level. Surface-level learning is rote memory without understanding. Conversely, deep learning requires comprehension, understanding, and reflection to promote active integration into memory. Marzano et al[10] reviewed decades of educational literature that addressed high-quality instructional techniques. They

Table 1. Instructional design for learning

Media	Mode	Method	Learning approach
Books	Audio	Practice sessions	Receptive information acquisition
Classroom Instruction	Text	Analogies	Directive perform procedure
Self Study	Graphic	Case studies	Guided discovery problem solving
Electronic learning	Visual	Inductive/deductive	Exploratory

advocate the use of an instructional framework. This framework incorporates teaching strategies that yield research proven results. The focus is on input strategies that assess previous knowledge about the content, provide links to that knowledge, and suggest organizational frameworks for the content.

Marzano et al[10] identified 9 strategies that have the highest probability of learner achievement. The 9 strategies are identifying similarities and differences, summarizing and note taking, reinforcing effort and providing recognition, homework and practice, nonlinguistic representations (mental images, pictures graphs, models, acting out content) cooperative learning, setting objectives, providing feedback, generating, testing hypotheses, and lastly, questions, cues, and advance organizers (activating prior knowledge). Teaching for transferring the performance (ideas into action) requires a combination of principles as well as the ability to recognize and respond when a particular problem should arise. This is more difficult to do than training of procedural tasks. The instructional method must tap on the learner's higher cognitive thoughts. Using the following instructional principles helps the learner to achieve a higher level of cognitive thinking.

IDENTIFYING SIMILARITIES AND DIFFERENCES

One research principle is to engage the learner in a comparison of 2 or more case studies, ideas or problems that share a similar concept. This requires the synthesis and analysis of information to identify the concept being learned. The instructor uses inductive techniques. Table 2 lists the steps for inductive learning. For example, the learner compares causes of acute renal failure, or various presentations of chest pain or abdominal pain. What particular characteristics are similar and different? Still another teaching methodology is using analogies to denote similarities. Analogies are helpful in creating mental models to make associations. The analogies need to be of a different domain of thinking. For example, comparing peristalsis with squeezing a tube of toothpaste would be an effective method to show similarities. The concepts are similar—sustained pressure to move material through an expandable tube. Two different domains were used: the gastrointestinal tract and a tube of toothpaste. Conversely, describing an arterial venous malformation like a varicose vein might lead to skewing the mental model, making it an ineffective analogy.

Table 2. Inductive learning steps

Examine the clinical data/look up unfamiliar terms or data
Make connections between clinical data/group clinical data and label
Identify critical relationships, cause/effect relationships, make predictions or generalizations
Apply learning to a new and different context to demonstrate understanding
Self-reflect on performance or knowledge and the learning process

The concepts between the two are unrelated. The varicose vein forms from a weak valve where as the arterial venous malformation is from an abnormal connection between the vein and artery. The same domain was used, anatomy of vessels. Also, effective analogies must successfully draw on knowledge familiar to the learner.[11] As illustrated, analogies can produce mixed educational outcomes if not applied correctly.

SUMMARIZING AND NOTE TAKING

Anderson and Hidi[12] provide useful information on summarizing and note taking. Three generalizations can be made from their meta-analysis. To effectively summarize, the learner must delete some information (trivial and redundant), substitute some information, and keep some information. This requires the learner to analyze the information at a fairly deep level. The following example shows how an instructor might use this technique. An article is provided on ventilator modes for novice nurses in the intensive care unit. The instructor then guides the learner in summarizing.

The summary might look like this:

Indications

1. Ventilatory pump failure
2. Inefficient pulmonary gas exchange

Modes of Ventilation

1. Volume constant example: synchronized intermittent mechanical ventilation (SIMV) or assist control (AC)
2. Pressure constant example: pressure control ventilation (PCV)
3. Hybrid example: pressure control volume regulated (PCRV)

Breath Type

1. All breaths controlled by the ventilator: assist control (AC)
2. All breaths spontaneous: continuous positive airway pressure (CPAP)
3. Mix of spontaneous and controlled breaths: (SIMV)

The instructor demonstrates in detail to the learner how to summarize an article using the principles of deleting, substituting, and keeping important information or concepts.

Research has shown that taking notes from instructor-led lectures does not improve higher learning in adults. Note taking requires the learner to divide his/her attention to 2 or more processing channels. Time would be better spent listening and processing the content.[13] Instructional researchers recommend providing learners with complete notes that serve as references. Reading, note taking, and summarizing the content in your own words promotes deeper encoding and better understanding of the content.[14] Summarizing and note taking are often seen as basic study skills, but they are two of the most powerful skills a leaner can develop to improve learning outcomes.

REINFORCING EFFORT AND PROVIDING RECOGNITION

Recognition and praise are essential components for a healthy classroom and workplace environment. As humans, we possess the need to be recognized and feel a sense of accomplishment. Effective recognition needs to be positive and sincere in nature, immediately connected to performance, and specific about what is being praised. Importantly, coworkers know the particulars of a job and they notice excellence. Peer praise is important and effective. Therefore, the best praise and recognition may not necessarily come from the top down. Recognition of effort feeds motivation. Studies[15–17] have shown students who believe that the amount of effort put into a task increases their achievement actually do better. Rath and Cliton[18] identify that recognition and praise are incredibly powerful. They identified 4 critical outcomes related to praise and recognition: employee retention, customer satisfaction, productivity, and profitability. Our health system uses "Mission Moments" to praise and recognize healthcare practitioners who demonstrate best practices. Reinforcing effort and providing recognition can positively influence the learner's

knowledge, skill, and continued desired behavior if done correctly.

PRACTICE SESSION/HOMEWORK

Practice is important to retain and apply knowledge and skill. Swell and Cooper[19] demonstrated that learning occurs faster and better when educators replace some practice with worked examples. Worked examples initially provide detailed explanations. As the lessons progress, the learner gradually completes more of the steps themselves. Eventually, the learner completes all the steps on his/her own. Homework and practice provide opportunities for students to practice, review, and apply knowledge. Practice should be job relevant. Research referenced in Marzano et al[10] shows that students need to practice a skill 24 times to reach 80% competency, with the first 4 practices yielding the greatest effect. Researchers have shown many times there is a strong correlation between the amount of time spent on homework and learner achievement.[20] However, learner achievement was more profound when the educator provided in-depth explanatory feedback.[10]

"Practice makes perfect," the old axiom goes, but time spent does not necessarily equate to better performance.[21] Ericsson[22] refers to intentional or deliberate practice that leads to improved performance. Deliberate practice entails concentrating on critical aspects and gradually refining performance through instructor explanatory feedback and repetition.[22] Supporting deliberate practice with feedback informs learners not only of the correctness of their response but the reason behind a correct or incorrect response. Some examples of this include the use of the audience response systems, electronic learning, and case scenarios, all coupled with feedback. The use of drill and practice may be beneficial when fast, error-free responses are needed, as in mock code scenarios or quickly setting up a chest tube or ventriculostomy system. Provide simulations for tasks that are unsafe or impractical to practice on the job. Simulations should model real-world situations or processes to promote clinical application. The learner needs to demonstrate and practice on the real equipment or close simulation to incorporate enough similar elements to enable transfer to the unit.[2] Importantly, practice exercises are best given throughout the instructional activity rather than lumping them together in one place.[2]

NONLINGUISTIC REPRESENTATIONS

Marcus et al[23] showed in their research that learners following text instructions took longer to complete a task than when using diagrams. Many products, for example, intravenous tubing, come with pictorial instructions. A good picture is worth a thousand words. Mayer and Gallini[24] demonstrated that novice learners showed greater improvement when using text and illustrations than from words alone, while experts learned well from either approach. Novice students also learn better from audiovisual explanations of concepts. Adding a relevant audiovisual to text improves learning by providing 2 memory traces.[25]

COOPERATIVE LEARNING

Research findings support that organizing learners into cooperative groups produces a positive effect on overall learning. Students can learn more together than individually.[26] Johnson and Johnson[27] identified 5 key elements of cooperative learning:

1. positive interdependence (a sense of sink or swim together)
2. face-to face promotive interaction (helping each other learn, applauding success and effort)
3. individual and group accountability
4. interpersonal and small group skills (communication, decision making, conflict resolution)
5. group processing (reflecting on how well the team is functioning and how to function even better)

From the vigorous research on cooperative learning 3 generalizations can be made. Lou et al[28] find that medium- and high-level learners benefit from grouping of either similar (homogeneous) or different (heterogeneous) ability levels. However, learners of low ability perform worse when they are placed in heterogeneous groups with medium and high-level learners. When low-ability learners were placed with other low ability learners, learning occurred more easily. The greatest benefit, however, was demonstrated when medium-level learners were grouped with other medium-level learners or high-level learners. Grouping high-level learners with other high-level learners produced a less drastic but still positive increase in learning. Lastly, cooperative learning should be applied to meet the learning goals and should not be overused. Cooperative learning offers a powerful, flexible strategy for improving learning outcomes. However, the instructor must be mindful of the effects of homogenous and heterogeneous grouping.

SETTING GOALS/OBJECTIVES

Objectives need to be directed to the overall desired outcome. They are the stepping-stones in obtaining the outcomes. Establishing outcome goals and feedback in a specific manner to enhance learning is what researchers and educational theorists term metacognitive skills. More specifically, metacognitive skills are the learner's own awareness and control over his/her learning or thinking processes including goal setting, monitoring progress, and adjusting strategies as needed.[2] This skill, mastered by successful learners, is crucial for reaching both short- and long-term goals. Marzano and colleagues[10] review of the research on goal setting came to 3 conclusions. First, negative outcomes were found when the objectives pointed to an exact learning focus. In essence, the educator has the learner focus so narrowly on the objective that the learner ignores other important content in the lesson. The second conclusion is that instructional goals should not be too specific. Third, learners should establish personal goals and objectives.[29] Setting goals/objectives that utilize these research findings promote favorable learner outcomes, particularly if there is learner involvement.

FEEDBACK

Research shows that feedback, if done correctly, generally produces good performance outcomes. The primary purpose of feedback is to provide insight to the learner so he/she can attain the desired skills, attitudes, and behaviors. Feedback guides future performance. Instructors provide feedback to help assess a learner's performance, identify areas where they doing well, and provide them with explanatory feedback on what they can do to improve. The best feedback occurs on a frequent basis, not just at the end of an educational activity. Good feedback is timely and specific. Moreno and Mayer[30] showed that explanatory feedback results in much better learning than corrective feedback. Explanatory feedback helps the learner understand the concepts, thereby creating mental models. Without timely, specific feedback, mistakes go uncorrected, good performance is not reinforced, and clinical competence could potentially be substandard. Feedback is focused on the behavior, not the individual. The instructor needs to make sure the learner understands the feedback and follow up with a plan to monitor and assist the learner in improving on the areas of weakness. Feedback given at an inappropriate time may be harmful. When a poor performance or outcome is occurring, the learners may be working through their own emotions of inadequacy. Brief feedback and emotional support are necessary, later followed by a more detailed feedback session in private. As the old saying goes, "praise in public and criticize (or preferably critique) in private."When done skillfully, feedback can be another powerful learning strategy to provide critical information on performance and set the stage for improvement.

Table 3. Inductive exercises

Unknown (volume)	Unknown (pressure)	Unknown (combination of (pressure and volume)
Synchronized intermittent Mechanical ventilation assist control	Pressure control pressure support Positive end-expiratory pressure Continuous positive airway pressure	Pressure control volume regulated bilevel

GENERATING AND TESTING HYPOTHESES

Hypothesis generation and testing are comprised of experimental inquiry (inductive and deductive thinking), decision making, and problem solving. In inductive learning, the learner makes observations and analyzes data, looking for patterns so that they may infer larger concepts. The inductive approach may cause the leaner to draw other meanings from the data that was not intended and erroneous. Additionally, the inductive approach may take a longer time for the learner; therefore, it may be less efficient than a deductive approach. Contrarily, in the deductive learning approach, the learner has the general concepts and then figures out the issue, problem, consequences, and examples from those concepts. The deductive approach is more structured. Certain concepts may not lend themselves easily to inductive techniques, for example teaching the clotting cascade. However, the deductive approach also has its tradeoffs; it may be too inflexible, not allowing one to reason, creatively think, or problem solve. Marzano et al[10] note that thinking in real life is never purely inductive or deductive. They relate that thinking is often more "messy" and nonlinear than earlier definitions proposed.

Because inductive instruction is less familiar to many educators, the following illustration is offered. The educator may ask the learner to list all the modes of ventilation. As the learners list the modes of ventilation, the educator specifically groups them in a certain way for all to see. Table 3 provides an example. After responses have filled all 3 columns, the educator asks, "What is the basis for the grouping?" Record all the suggestions from the class. In this case, the concepts are different modes of ventilation. The goal is to look for similarities and make a generalization that is supported by the examples.

In other examples, the nurse educator asks questions like: What if the physician asks you to ___? In what situations may it be permissible to do something and in what situations may it not? Why? The patient has stopped making urine, what could be the possible causes? What data would support this? Educators should ask learners to clearly explain their hypothesis and how they came to their conclusion. Providing the learner with this type of framework facilitates the most powerful and analytic of cognitive operations, generating and testing hypotheses. This aspect of instructional methodology aligns to promote deeper cognitive learning.

ACTIVATING PRIOR KNOWLEDGE

An instructional strategy that helps the learner retrieve what they already know about a topic is called *activating prior knowledge*. Cues, questions, and advance organizers serve to activate a learner's prior knowledge. Prior knowledge has a large influence on student performance, explaining up to 81% of variance in posttest scores.[2(p139)] Questions and cues (hints) are similar. The instructor gives a cue when explaining that today's sepsis lecture reviews the pathophysiology of sepsis, (content they already know), and then

Table 4. Advance organizers

Cardiovascular drugs that bind to SNS receptors	
Drug	**Receptor(s) affected**
Dobutamine	B_1, fewer B_2 effects, slight alpha stimulation
Dopamine (dose related)	
• <3 μ g/kg/min	• Renal, brain, mesenteric stimulation
• 3–10 μg/kg/min	• B_1, DA, fewer B_2 stimulation
• 10–20 μg/kg/min	• Alpha, B_1, DA, fewer B_2 stimulation
Epinephrine	Alpha, B_1, B_2 effects most prominent at lower doses (stimulation)
Isoproterenol	B_1, B_2 stimulation
Metoprolol	B_1 only (cardioselective β-blockade)
Norepinephrine (Levophed, Levarterenol)	Alpha, fewer B_1 effects
Phentolamine (Regitine)	Alpha (blockade)
Phenylephrine (Neo-Synephrine)	Alpha stimulation
Propranolol	B_1, B_2 blockade

additional information will be provided on the sepsis resuscitation bundle. The instructor has activated prior knowledge plus sets expectations to learn new information.

Questions work similarly. Educators' questions should focus on what is most important. When asking questions, allow a brief pause of 3 to 5 seconds to allow the student to think about the question and formulate an answer. Analytical questions challenge the student's minds allowing for deeper cognitive processes to occur. Other methods of activating prior knowledge include group discussion of a problem related to the content, prework assignments with questions, or the use of advance organizers. Mayer and Wittrock describe an advance organizer as "material presented before a lesson that is intended to promote learning by helping the leaner relate the new material to existing knowledge."[31(p293)] Research educators appreciate the importance of activating prior knowledge in discovering, making connections, and constructing explanatory answers to new concepts.[32] Advance organizers serve to organize and highlight the essential content to be learned. An example of an advance organizer is shown in Table 4, which can be reviewed before an educational activity on hemodynamics and pharmacology. Kloster and Winne[33] reported if an advance organizer is to be effective, it must tap in to the prior knowledge and be processed by the learner.

Sometimes, teachers inadvertently activate prior knowledge by adding interesting stories that are not directly relevant to building knowledge and skills. Information added to content to stimulate emotional interest has been shown to have harmful effects on learning.[2] When emotional details are omitted, retention and transfer are significantly higher.[2] It is believed that these "seductive details" distract the learner by drawing attention away from the important content.

GOOD ANALYTICAL QUESTIONS

There is a skill in asking the "right questions" to improve higher-level thinking. "How" and "why" questions usually require more analysis than "who," "what," "when," or "where" questions.[34] Table 5 provides examples of questions that draw on higher levels of cognitive processing. When questioning the learner, the instructor draws attention to patterns, connections, contradictions, dilemmas,

Table 5. Analytical questions

Abstracting	What is the general pattern underlying this information? To what other situation do these apply?
Analyzing errors	What were the processes that led to the error? How could it be corrected or improved? How is____misleading? (The physician order, communication, etc). What are the issues/conflicts, the intended or desired outcomes? What are alternative strategies or responses?
Analyzing perspectives	What is the reasoning behind his or her perspective? What is an alternative perspective and the reasoning behind it? What are the pros and cons?
Classifying	What are the clinical presentation, laboratory values, and presenting s/s that would lead you to believe this is happening? What is the classification of this drug? What are the defining characteristics of this drug classification?
Comparing	How are these things alike/different? Analogies or metaphors
Constructing support	What are some of the limitations of this argument? What evidence-based research would support this argument? What makes your action unacceptable/undesirable? What actions should have been taken?
Deductive reasoning	Based on the following clinical problems or information, what orders would you predict or what conclusions can you draw?
Inductive reasoning	Based on the following information, what complications could occur? What clinical data would lead you to believe this? Why are these particular interventions relevant for this patient? What clinical data would indicate the patient needs immediate intervention? Why? (Prepares the nurse to anticipate changes in patient condition)

and problems. The instructor requires the learner to make interferences about presented information. What clinical data would lead you to believe this to be the problem? How should the nurse and physician manage this? What orders would you expect? Require the learner to respond to self-explanation questions (questions that require the learner to review the necessary steps and identify the underlying concepts behind them). But, where should questions be placed in the education activity? Research conducted by Van den Broek et al[35] concluded that, for adult learners, distributing questions throughout the lesson proved beneficial in drawing attention to specific content and prompting learners to make specific connections. We have found that audience response technology provides the learner and nurse educator with immediate feedback on information on how well the learner is acquiring the relevant content.

Focusing on effective teaching principles improves learning outcomes. Nursing practice requires a level of mastery that goes beyond the simple recall of facts to more complex levels of learning, such as clinical problem-solving skills. Table 6 summarizes methods that can be used to manage cognitive load, direct attention to relevant content, and activate prior knowledge to foster the best educational outcomes.

USING TECHNOLOGY TO LEVERAGE KNOWLEDGE/SKILL INTO PRACTICE

As nurse educators, the application of the information to real clinical settings is crucial. Education is a process. It takes time for

Table 6. Effective learning outcomes[a]

Managing cognitive load (Ruth Colvin Clark)
Methods to bypass working memory
Job aids
Reference-based training
Memory aids in the training interface
Drill and practice
Methods to minimize content
Concise writing
Eliminate unnecessary audio
Cut unrelated stories and visuals
Avoid redundant modes
Minimize animations
Methods to impose content gradually
Teach relevant concepts before steps or stages
Segment lessons into bite sizes
Allow learners to control their pace
Methods to minimize unproductive mental work
Replace some practice with worked examples
Represent spatial content with visuals
Methods to maximize working memory capacity
Describe visuals with audio narration
Graphs
Graphics are relevant to the instructional purpose
Moving picture are limited and used to illustrate content that cannot as readily be shown with a series of static graphics
Simple graphics are used, rather than complex
Graphics and the related text are presented simultaneously, by printing the text near the picture

[a]Reprinted with permission from John Wiley & Sons, Inc.[2]

nurses, especially new nurses, to integrate new knowledge and new skills into practice. Some transfer of new skills and knowledge requires little judgment, and job success depends on consistent, accurate application. Transfer of more complex skills and knowledge require sound clinical judgment and problem-solving skills. Well-designed computer technology can promote the transfer of knowledge and skills.

Clinical applications that require little judgment need operational simulations that require deliberate repetitive practice. The technology of Heart Code basic life support, which utilizes a computer and interactive mannequin, is one example of deliberate objective performance. The mannequin is hooked up to a computer that assesses the performance. The skill is performed until it is mastered, with the learner getting feedback from the computer program "That's right, you are doing well," or "Your compressions are not deep enough." According to Health Stream[36] standardized its basic life support with the Heart Code program and boasts of a significant decrease in the cost of training and that they nearly doubled their successful resuscitation outcomes. Repetitive, deliberate practice eventually leads to automaticity, freeing working memory capacity to allow for better clinical judgment and problem solving.

Another exciting technology is the electronic intensive care unit (e-ICU). A group of ICU nurses and intensivists remotely monitor

patients and interact with the facility ICU staff. In addition to monitoring patients, e-ICU staff can focus on the educational growth of a nurse. The technology can help the both the novice nurse and the seasoned nurse. The e-ICU practitioner can communicate with the nurse, asking her/him what is going on with the patient, and assess if the nurse grasps the clinical picture. Through video and voice technology, they can perform a neurological assessment together, score the Braden scale, or analyze hemodynamic parameters. Implementation of evidence-based practice and standards of nursing care practice can be facilitated through the technology of the e-ICU.

LEARNING OUTCOME/APPLICATION FAILURE

Clark[2] identifies 4 reasons why knowledge and skill do not transfer to the job. First, there is poor organizational support. The supervisor needs to ensure that the learner will apply the skills and knowledge soon after the training. Providing resources and peer coaching is effective.[37] The teaching principles provided here foster peer coaching to assist the transfer of new skills from the staff development classroom into clinical practice. Feedback, discussion, and recognition need to be given when learner applies the new skill. It is important to model the desired skills, attitude or knowledge at all levels in the organization. The second reason for failure occurs when the transfer skills taught were too general and not specific for what is needed in the job situation. It is important to remember that skills can fail to transfer if they are out of the context of the job domain. Generic skills do not transfer over to the work environment. Training should teach skills in the same context the learner encounters on the job. The third reason for failure is that the learner is taught how, but not why. Understanding supports building mental models that enhance the learner's ability to apply the information on the job and adapt to new situations. The fourth reason is the failure to apply a skill from one context to a different context. Learning is context specific. Instructional researchers and educators agree that the aim of learning is to apply what we learn and to extend the learning to new situations. They also suggest that this seldom occurs.[38] Thirty years of research suggests that intelligence and talent provide initial advantages, but that high levels of expertise are due primarily to sustained, systematic effort on the part of the learner.[2] Ability alone is not sufficient for high levels of expertise. Ability and sustained practice are ideal.[39] Educators should teach skills in the same context as they will be encountered on the job.

OUTCOMES

Do learners know what they know? A learner's perspective of their own knowledge and skill is not always accurate.[40] Self-assessment of performance remains a poor predictor of actual performance.[40] Also, a learner's preferences and judgments may not be good indicators of the way they actually learn best.[41]

Health institutions are moving toward more definitive measures of desired outcomes and performance. The impetus to put quality patient care in the forefront has created healthcare culture changes. Dashboards, monitoring, report cards, metrics, physician satisfaction, nursing satisfaction, retention, basic knowledge assessment tests, and key performance indicators will measure progress toward the expected outcomes. The complexities of health make training and education a necessity. The discussed instructional guidelines provide evidence-based training methods that can lead to competence and hopefully, in time, expertise.

CONCLUSION

In today's healthcare environment, with fiscal restraints, staffing shortages, complex patient care needs, and the individuals' own personal goals and motivation, assuring outcomes becomes a challenge for nurse educators. In outcome-based education, the

outcomes determine the instructional design. Performance outcomes also provide criteria for instructional evaluation. "If desired change is to prevail, a conducive educational culture which values learning as well as evaluation, review and enhancement must be engendered."[4(pii38)] All of us have a leadership role in education. The goals of implementing best clinical practice are intimately united with outcomes. The educational research presents essential, effective guidelines for instructional programming that support providing competent health professionals and meeting organizational goals. It is my hope that this article will evoke emotions and memories of both effective and ineffective instruction. This article encourages you to reflect on your instructional practice so that you may be inspired to amend your teaching methodologies and base it on the science of learning.

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