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Is Educational Theory of Use in Optometric Education?

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Abstract

It is incumbent upon optometric education programs to design curriculum elements based on theoretical perspectives as it gives instructors a framework for understanding the rationale for the teaching and assessment methods. Design and delivery of programs should be based upon theories of how optimal learning is achieved. It behooves us as optometric educators to challenge ourselves to become familiar with the relevant theories of education, apply them in our work, and study the results. This moves us toward the important goal of creating a culture of using theory-informed approaches in optometric education.

Key Words: *curriculum design, learning, education theory, teaching method, healthcare education*

Introduction

Healthcare education is carried out primarily by instructors repeating the way in which they were taught.[1-7] There is a sense that teaching is an art where only content knowledge and natural talent are needed to excel.[3] New trends, such as the "flipped classroom," may be applied without an understanding of the principles behind the educational strategy.[1] If the method fails to achieve desired results, blame is placed on the method.[1] Without an understanding of the theory that underlies newer teaching methods, instructors risk misapplying strategies, which can result in a lack of successful implementation for both teachers and learners.[1,3] It is reasonable to believe that optometric education has similar challenges.

Theory is a conceptual understanding of how things work.[2] The usefulness of theory may be more readily understood from an example from the ocular disease literature. Glaucoma is a common eye disease that can result in permanent vision loss. While the pathogenesis is incompletely understood, a number of theories exist. Theories include vascular (insufficient blood supply due to increased intraocular pressure [IOP]), biomechanical (increased IOP leading to strain of the lamina cribrosa) and biochemical (neurodegeneration from biochemical mechanisms).[8] As well, the role of cerebrospinal fluid is seen as potentially important.[8] These theories were built from an impressive amount of quantitative and qualitative research. The vascular and biomechanical theories are applied by treating glaucoma with IOP reduction. In addition, theories drive research and are modified based on the results of the studies. Challenging the existing paradigm is how progress is made. The same principles apply to optometric education.

When research is not based in theory, the results can be misleading. To make a point about the dangers of post hoc analysis of data, Emily Chew performed an analysis of the age-related macular degeneration data from the Age Related Eye Disease Study to show that vitamin and mineral supplementation effectiveness depended upon the zodiac sign of the subject.[9] This was intended to be an obviously incorrect result because zodiac sign is not included in the theories of the pathogenesis of age-related

macular degeneration. Similarly, if optometric education research is carried out without attention to underlying educational theory, the results may not have merit.

How people learn is also incompletely understood. There are many theories (based on extensive research) of how people learn and they may be grouped by discipline, such as bioscience, education/learning or sociocultural perspectives.[2] Each theory in itself is only a partial explanation of how learning occurs and many have overlapping concepts.[2] Therefore, when creating an optometric educational plan it is necessary to look to multiple disciplines and their theories to illuminate each aspect of the plan and focus on what is likely to be useful. Theory helps form a scaffold upon which good instruction can be built and allows instructors to understand why and under what circumstances certain practices are successful.[3] The informed optometric instructor, therefore, is less likely to deviate from the model. Also, teaching based in theory, as in the ocular disease example, can be studied, which leads to modifications in the theory and enhanced educational outcomes.[3]

This paper examines some of the theories of learning that might be useful to optometric educators and shows how they can be applied to designing a skills curriculum.

Theories of How Learning Occurs

Theories that aim to explain how learning occurs include the following.

Theories in bioscience focus on how the brain learns.[2] Because discovery comes from science, it is sometimes easy to forget that these are theories and not truth.[2] Neuroscience studies learning and memory formation looking at structure and molecular and cellular function of the brain and has used functional magnetic resonance imaging studies to understand cognition in humans.[10,11] This research has allowed for some general principles to be developed that can be applied in optometric education. These include:[11]

- allow for repetition of material from varying perspectives
- go deeper rather than touching superficially on many topics
- reward and reinforce (this is vital)
- actively engage the learner
- create a moderate stress level for the learner
- allow for adequate rest
- integrate multimodal (auditory and visual input) information rather than expect multitasking

Motor control theories are useful in learning skills such as automaticity and skill expertise (performance is automatized with practice allowing for attention to other factors), deliberate practice (deliberate practice is needed to achieve excellence), and challenge-point framework (learning is maximized when the task is within the ability of the learner and complexity is gradually increased with experience).[2,12]

Education/learning theories can be categorized into five additional orientations: behaviorist, cognitivist, humanist, constructivist and social theories of learning.[13] In the behaviorist view, learners are passive and a stimulus produces a reaction in the learner.[13] Therefore, giving people feedback to allow them to change their behavior is central in this theory.[13] In the cognitive view, learners think about the information, process it and act upon it in different ways depending on the situation.[14] This orientation has produced theories of clinical reasoning, theories on the development of expertise and cognitive load theory.[14] In the humanist perspective people try to achieve their maximal potential.[13] The concepts of self-regulation, self-directed learning and self-assessment align with this orientation.[13] Constructivist learning theory is a refinement of cognitive learning theory and is derived from constructivist epistemology where the “focus is on the mental representation of information by the learner.”[15] The learner reconstructs long-term memory representations to be consistent with new information from the

environment and experience.[15] For this to occur, learners must process the new material and integrate it with existing understandings to form a new cognitive structure that is unique to them based upon their own process of learning.[16]

Social cognitive theory was formed by blending the behaviorist approach, which emphasizes the importance of the environment on behavior, with the cognitive approach, which emphasizes the importance of cognition on learning and functioning.[13] Learning is seen as a social process with reciprocal interaction between environmental, personal and behavioral determinants.[13] Each of these determinants influences the others with varying outcomes depending on the dominant factor.[13] In this theory humans have five capabilities:[17]

- *symbolizing capability* allows us to use symbols internally to represent actions so we don't have to carry out each action to determine the outcome
- in *forethought capability* we can anticipate the likely outcomes of our behavior so we can plan for those outcomes
- *vicarious capability* allows us to learn by observing others
- *self-regulatory capability* allows us to regulate our behavior by our internal standards
- *self-reflective capability* allows us to look critically at our experiences and think about our thought processes[17]

In situated learning theory, learning is seen as a socio-cultural process tied to context with its social relations and practices.[13] The term *communities of practice* describes the activities of a group of people with a shared interest.[13] In *legitimate peripheral participation*, learners start at the periphery of the community by observing and performing simple tasks and then gradually move more centrally assuming the roles, skills, norms and values of the culture as an active participant.[13] Learning occurs in the workplace from an individual and social perspective.[13] In the related concept of experiential learning, learning occurs through reflection on experience in practice.[13] Reflection is an important concept that is seen in multiple theories of learning.[13]

Application to a Curriculum Element

How can any of these theories be applied in optometric education? As an example, optometric educators may be tasked with reviewing the psychomotor skills curriculum of their school or college. It would behoove them to look to best practices in healthcare education and understand the theoretical underpinnings when designing the program. **Table 1** summarizes the design elements that could be used to develop a procedural skills stream in the curriculum renewal process. The theoretical basis supporting the design element is given as is an example of how it can be operationalized. Assessment methods are also reviewed.

Table 1. Click to enlarge

Development of clear outcomes or goals enhances learning by allowing the learner to develop strategies to reach the goal and is based in social cognitive theory.[18] In social cognitive theory, learners are active agents and learning is influenced by their personal goals, values, attitudes, knowledge and experience.[18] Once the goals are articulated to them, learners are able to take on the goals and monitor their progress towards the goals.[13] Humans are able to anticipate the likely outcomes of actions, and this forethought, as a capability, helps in achievement of goals under this theory.[17] Teachers need to support learners in regulating their own learning.[3] This is operationalized by writing learning objectives.[17] Learning objectives are clear statements of what ability the learner will have at the end of the educational session. For example, "At the end of this course the student will be able to perform retinoscopy on a normal adult

person and obtain a result within the repeatability of the technique."

Demonstration of the skill and providing task-relevant knowledge gives learners the foundation for building their abilities and increases self-efficacy. In social cognitive theory, as described by Kaufman and Mann, learners construct meaning by observing others in a social context.[17] This produces a standard of performance against which they can judge their own performance. They need to understand the task and build on prior knowledge, which has a constructivist underpinning. However, they may need help in activating that prior knowledge and relating it to the new learning.[17] Operationalization can be using online learning methods to allow for developing task-relevant knowledge without using allocated lab time. Peyton's Four-Step Approach to teaching a skill has been shown to produce higher ratings on a global rating scale for a skill assessment than the standard approach of demonstration with explanation followed by answering questions.[19] In this approach the instructor first demonstrates the skill without comment, which decreases cognitive load. Next, the instructor demonstrates the skill while describing the skill in detail. This is followed by the student talking the instructor through the skill. Finally, the student performs the skill on his/her own.[19] Step 3 has the most impact on learning the skill.[20]

Longitudinal, repetitive, progressive skill development is based on bioscience theory of motor control such as the Fitts and Posner model of automaticity in which well-learned skills become automatic with practice.[2] Ericsson's idea of deliberate practice to develop expertise requires lengthy, repetitive and dispersed domain-specific practice.[12] Challenge-point framework states that an optimal challenge point exists when learning is maximized and detriment to performance is minimized.[2] That is, the difficulty of the task is matched to the learner's abilities.[2] To operationalize these concepts, skill training should start in a laboratory setting where the students practice on themselves. Ideally, the sessions should be timed to one or two hours and repeated frequently. Introduction to more complex scenarios would occur during clinic rotations in primary care and then in specialty care settings.

Guided practice with distributed feedback is based upon the aspects of social cognitive theory that state that individuals develop positive self-efficacy through practice with positive feedback. The feedback should be constructive because without it performance achievement is reduced. Feedback is also helpful because it provides information the individual can use in reflective practice.[17] This aspect is vital to the learning process. Indeed, the ability to self-assess is tied to the ability to reflect on practice.[13] As described by Mann, to operationalize this the learner should be provided with immediate error correction while performing the procedure but limited verbal guidance and coaching. This is because the coaching takes the learner's attention away from the task, overloads working memory and the learner may become reliant on the educator to compete the task. Then, at the end of the skill performance, feedback is provided. According to Nicholls et al., "Feedback is the single most influential teaching practice to promote motor learning."[21] Feedback should continue to occur in the clinical setting and be based on direct observation.[22]

The elements of *transfer of skills to a clinical setting* with a cultural milieu consistent with real practice and gradual transition to independent practice with initial observation are grounded in the concepts of situated learning, communities of practice and legitimate peripheral participation.[13] Inherent in these concepts is the idea that learning is tied to its context, social relations and practice.[13] The community of practice is a group of people who pursue a shared enterprise.[13] Initially novices participate peripherally (for example by observation) and then gradually move more centrally when they gain the skills, norms, values and culture of the community.[13] To operationalize this theory optometric students should be observing in clinic during early years of optometric education. Then they may progress to assist with skills such as pre-testing and subsequently move on to assisting with examinations before they are competent enough to conduct skills independently. This can happen concurrently with laboratory practice.

Assessment



Figure 1. Miller's pyramid of clinical assessment.[23]
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Assessment should be aligned with the learning objectives of the procedural skills training program. Learning objectives are what the learner is to achieve, while learning outcomes are what the learner did achieve. Miller's framework (pyramid) for clinical assessment **(Figure 1)** describes four levels of ability: knows (knowledge), knows how (competence), shows how (performance), does (action).[23] Consistent with Miller's pyramid, a system of assessment should be in place that addresses each level in the pyramid.[23] Written examinations such as multiple-choice questions or long-answer questions can be used to assess the concepts behind the procedures for the "knows" and "knows how" components.[24] Direct observation of the procedures using checklists as the procedures are performed in the lab and a summative pre-clinical competency examination are at the level of "shows how."[24] Direct observation of optometric skills in clinic can be used for the "does" level.[24] In addition, students should be encouraged to keep logbooks for procedures and write reflective e-portfolios to encourage self-assessment and self-directed learning.

Conclusion

This paper presents a variety of theories as lenses through which to view optometric education. Each theory illustrates an aspect and allows us to focus on a goal in education to address it more effectively. Some theories are more relevant to a particular educational problem than others. The theories in this paper are not exhaustive of those in the literature; they represent only a sample. Ultimately, theories are challenged through research, which allows for development and improvement over time. An example from general education is the popular theory of learning styles has been disproven through research in application of the theory to teaching and learning.[25] A research question pertaining to the skills training example could be "Does using Peyton's Four-Step Approach to teaching a skill improve performance on skills assessment?" This could be studied using a randomized controlled trial design in which traditional teaching is done in one lab section, Peyton's approach is done in another, and the skills assessment results are compared.[26]

Educational theory allows both educators and learners to develop a perspective and discourse around best practices. The discourse of a discipline provides a language for representing its work and allows for discussion and reflection.[13] It behooves us as optometric educators to challenge ourselves to become familiar with the relevant theories of healthcare education, to apply them in our work and study the results. This will move us toward the important goal of creating a culture of using theory-informed approaches in optometric education.

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