Designing Health Professions Education to Engender Critical Thinking: A Review of the Literature

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Introduction

Over the past several decades, educational researchers have expended considerable effort studying the phenomenon of critical thinking, both to define it and determine how to engender its development in students (Dunne, 2015). Educators in the health professions (e.g., dentistry, nursing) are similarly interested in critical thinking, as it is a foundational component of clinical thinking, the cognitive process that effective clinical practice is based upon (Faucher, 2011). This widespread interest in critical thinking research arose simultaneously with the development of the Internet and online learning, serendipitously raising the academic question of how online instruction may be used to develop critical thinking ability (Chit Ming, 2014; Clegg et al., 2014; Cook & Triola, 2009; Forneris & Peden-McAlpine, 2007; Santiago, 2011; Wilgis & McConnell, 2008; Wyles, McLeod, & Goodfellow, 2013). Contrariwise, Postman (1999) suggested in his book *Building a Bridge to the 18th Century* that these coincidental phenomena are linked; that the rise of the Internet (with its effects on language and information perception) has in fact led to a population-wide deficiency in critical thinking, necessitating an interest in improving it (p. 56).

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In order to think critically, one must first possess knowledge to think critically *about*. Thus, in optometric education (as in the other health professions), students begin their studies by mastering a two-year basic science curriculum, which provides the foundational material--or *grammar*--for more sophisticated lessons of clinical experience (Postman, 1999, p. 163). This basic science curriculum is intensive, with course loads of more than 20 credit hours per semester, and includes courses in optics, the theory and practice of optometric clinical skills, vision science, biochemistry, gross and ocular anatomy and physiology, pharmacology, and neuroanatomy. These courses are focused primarily on the academic elements of the curriculum (i.e., knowledge acquisition, theories of clinical judgment, and general critical thinking) (Southern College of Optometry [SCO]; 2015). Patient-centric elements, such as assessment and evaluation of individual circumstances and values, can only be mastered with direct patient interaction in the clinic (Facione & Facione, 2008; Faucher, 2011; O'Neill & Dluhy, 1997).

It is an important goal in optometric education to develop critical thinking among future optometrists. The Association of Schools and Colleges of Optometry (ASCO) identifies critical thinking and its corollaries—lifelong learning and clinical thinking—as attributes every graduating optometrist should possess (2011). At SCO in Memphis, Tennessee, the administration and faculty have likewise identified these concepts as points of emphasis for its curriculum (SCO, 2009, 2013). Yet, the extensive semester load described above makes it challenging for the SCO faculty to find time for critical thinking instruction during the first two years of the program. To combat this, basic science course instructors attempt to integrate higher-order thinking into their lessons by weaving clinical discussions amid the course content, and developing examination items that require higher-order cognition. However, such elements constitute mere isolated experiences within a curriculum that, on the whole, does not support the

development of long-term critical thinking ability (Taylor, 2015; Tiruneh, Verburgh, & Elen, 2014). Large class sizes (i.e., over 130 students in each course at SCO) also make both genuine classroom discussion and thoughtful evaluation difficult to implement and maintain.

Statement of the Problem

There is a perception among optometric and health-professions educators that students' mastery of the basic science knowledge foundation often erodes significantly after their successful completion of foundational courses. Thus, students often enter the first clinical assignments of their third academic years ignorant of some important fundamentals. Worse is the perception that these students have difficulty not only recalling their grammar, but also expressing or applying what they know in a useful clinical manner. High-quality clinical ability requires high-quality critical thinking, but health professions students also tend to have difficulty developing this important skill (Niu, Behar-Horenstein, & Garavan, 2013; Taylor, 2015; Walsh & Hardy, 1999). These difficulties could prevent students from drawing appropriate and important conclusions from their inevitable clinical mistakes, partially negating the full benefit of clinical experience.

Since critical thinking (based on knowledge mastery) is vital to clinical practice in optometry, it is important that optometry students master the foundational material while simultaneously practicing and developing their critical thinking skills and dispositions, both within and apart from clinical practice. This literature review will address the problem of teaching critical thinking in pre-clinical health professions' education, with an emphasis upon optometric education. Our survey of the literature was guided by the following questions:

1. To what extent is critical thinking emphasized among optometric education in the literature?

2. Why is critical thinking development important to the optometric clinician-in-training?
3. What andragogical techniques are being developed and used to teach critical thinking to these populations?
4. To what extent have such efforts been successful?
5. How is the literature deficient on this subject?

Our findings are summarized below, organized loosely according to these topics. Due to the relatively small nature of the optometric education community, we have included illustrative papers from health professions and medical education when applicable. We conclude the paper with recommendations for future research, based upon the deficiencies noted.

Literature review: critical thinking in optometric education

The vast majority (if not totality) of literature in the field of optometric education is published in the *Optometric Education* journal (which is available online at http://journal.opted.org/) or as discrete papers or posters at the American Academy of Optometry autumn meeting (the proceedings of which are available online at http://www.aaopt.org/). Therefore, in our review of the existing literature, these sources were predominantly referred to, though traditional methods, such as *Google Scholar* and the *Encore* catalog tool, were also used to locate supporting information. The following discussion is drawn from the yield.

Optometric Education has in its archives a reasonable number of articles that directly discuss critical thinking andragogy. Denial (2008a; 2008b), Elder and Paul (2008), Facione and Facione (2008), Galvin (2008), and Hoppe (2008) all contributed to a critical thinking theme edition in 2008, while Denial and Pitcher (2007), Faucher (2011), Santiago (2011), and Wyles, McLeod, and Goodfellow (2013) published other articles that studied critical thinking.

The scientific papers and posters presented at the American Academy of Optometry meeting are predominantly clinical in their emphases, though an active optometric education section exists. Since 1993, thirty papers or posters have been presented at the meetings that referenced critical thinking in their text. Four of these were specifically about the study of critical or clinical thinking (Denial, 2007; Denial & Pitcher, 2005; Elam, 2001; Damari, Heard, & Jones, 2008).

Importance of critical thought in optometric education

Critical thinking has been extensively examined in educational literature over the past several decades. It has been defined as "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological and contextual considerations upon which judgment is based" (Facione, 1990, p. 2). In his review of theories and controversies in critical thinking, Dunne (2015) documents this phenomenon in governmental policy and higher education, summarily stating that "…critical thinking has been heralded for quite some time as being one of the most desirable outcomes of higher education" (p. 86), both for its practical occupational utility as well as its potential for driving lifelong learning. Since both of these outcomes are important in optometric practice, it is perhaps no surprise that optometric education has also resoundingly discussed and embraced the necessity of teaching and practicing critical thought (ACOE, 2011; Elder & Paul, 2008; Galvin, 2008; Hoppe, 2008).

There is considerable research available concerning the nature of critical thinking itself, for it is a broad category that houses many different mental actions. Among these are the *critical thinking skills* needed for high-quality thought: asking questions, defining terms, analysing information, identifying assumptions, reasoning verbally, inferring from inductive and deductive

reasoning, evaluating, seeing both sides of an issue, and decision making (Lai, 2011); and the *disposition* to think critically, or, as Facione (2000) puts it: "consistent internal motivations to act toward or respond to persons, events, or circumstances in habitual, yet potentially malleable ways" (p. 64). Critical thinking dispositions are naturally more developed among participants in less practical fields of study--like arts and humanities--than in practical professions (Walsh & Hardy, 1999), although an active critical thinking disposition has been linked to occupational satisfaction in nursing (Kim, Moon, Kim, Kim, & Less, 2014). In optometric education, it has been shown that critical thinking is correlated to clinical ability, though neither critical thinking skills nor dispositions improve from clinical experience or service-learning participation (Denial, 2007, 2008a, 2008b; Denial & Pitcher, 2005, 2007; Elam, 2001; Kim et al., 2014; Nokes, Nickitas, Keida, & Neville; 2005). Academically, Williams, Schmidt, Tilliss, Wilkins, and Glassnapp (2006) and Denial and Pitcher (2007) determined that critical thinking skills and dispositions were strongly predictive for performance on dental and optometric national board examinations, respectively.

Though critical thinking is widely studied and discussed in the medical and health professions' fields, *clinical thinking* is perhaps more important. Clinical thinking is a complex process that begins with recall and understanding of both a foundational body of knowledge and each individual patient's clinical presentation. The astute clinician aptly exploits this fundament to both arrive at an accurate diagnosis and decide upon the most effective treatment to pursue, a process called *clinical reasoning*. Finally, this clinical reasoning is subjected to self-review via critical thinking (Faucher, 2011). Examples of these concepts in a clinical setting are found in Table 1.

The optometrist, though a physician, is not trained as a medical doctor and, as such, is

Table 1

Example of Clinical Thinking in Clinical Practice		
History/Findings	Clinical Thinking	
A 20 year-old man presents with pain and redness left eye; he is wearing sunglasses indoors	Clinical reasoning: ● Mental representation of the clinical case by hypothesis generation	Pain, hyperemia, sensitivity to light Anterior uveitis? Corneal erosion? Contact lens related complication? Corneal ulcer? Other ocular health problem?
	Decision-making	Additional questions to ask Procedures to do: visual acuity, pupils and slit lamp examination (carefully examine cornea and look for cells and flare in anterior chamber)
	Clinical reasoning: ● Expectations	Visual acuity probably reduced; left pupil may be smaller; limbal injection, possible corneal involvement; cells and flare may be present
	Critical thinking	Do I consider all the possibilities given the available information? What if expectations are not confirmed by clinical data?

Note. Adapted from "Differentiating the Elements of Critical Thinking," by C. Faucher, 2011, *J Optometric Ed, 36*(3), p. 143. Retrieved from http://journal.opted.org/articles/Volume_36_Number_3_CriticalThinking.pdf

limited in practice to diagnosing and treating refractive error, functional disorders of the visual system, and diseases of the eye and surround. Systemic diseases are not treated by optometrists, but may be identified during the course of a routine optometric examination. A timely referral in such a situation could potentially prevent mortality or morbidity. Thus, optometry students must be able to critically evaluate their patients' clinical presentations in the context of the existing knowledge base--the grammar of gross anatomy, histology, neurophysiology, biochemistry, optics, pathophysiology, and pharmacology--to appropriately assess their patients' health and treat accordingly (Moore & Chalk, 2009). Additionally, optometry students should have the ability to discern which innovative treatments and concepts are efficacious for the treatment of their patients and which are merely novel. Critical thinking will enable them to do this, thus avoiding the use of time and resources tilting at mere windmills.

Techniques for teaching critical thought in optometric education

There are many studies and reviews published in the health professions and optometric literature reporting critical thinking improvements from novel instructional techniques (Chit Ming, 2014; Cook & Triola, 2009; Santiago, 2011; Seif, Brown, & Annan-Coultas, 2013; Wilgis & McConnell, 2008) or overarching course- or curricular-wide redesign (Damari et al., 2008; Good, Earley, & Nichols, 2011; Nehmad & Appel, 2011; Wyles et al., 2013).

Though important, there have been fewer studies on clinical thinking than critical thinking, due to its relative boutique status in health care education. Seif, Brown, and Annan-Coultas (2013) created a module on clinical reasoning for physical therapy students, which they hosted on their university's *Moodle* LMS. The module contained video footage of a mock examination, related thought questions, and Internet searches for related resources. At the end of

the module, students used what they had learned to create an appropriate exercise plan. Analyses of clinical reflection and clinical reasoning showed significant improvements in 17 of the 26 subcategories of clinical reflection and reasoning, implying that intentionally-designed lessons can have a positive effect on clinical thought.

Damari, Heard, and Jones (2008) at SCO developed a course, *Integrative Clinical Analysis*, for their second-year optometry students, to prepare them for the newly-redesigned board examinations, which emphasized clinical thinking. The course was designed around weekly facilitated small-group case-based discussions, development of literature-based diagnosis and management plans, and learning portfolios. The authors reported a general improvement in clinical thinking across the course of the semester. Nehmad and Appel (2011) developed an extended case-based effort at the State University of New York College of Optometry. This *Integrative Track* expanded the ideas of Damari et al. (2008) from a single course to several, placed across the first three years of the optometric curriculum. As of this writing, results have not been published.

Good, Early, and Nichols (2011) at The Ohio State University College of Optometry described a seven-day case-based *Keystone* course, to make first- and second-year optometry students more aware of the clinical thought processes involved in patient care. In it, students completed an introductory training session, followed by facilitated small group work to critically dissect, analyse, and manage routine clinical cases. Upon receiving a case, student teams followed problem-based learning methods in their group work, developing lists of case information points that demanded more research, summaries of existing pathology, and management plans. The students performed research outside of group time. Qualitative results gleaned from both faculty and students were overwhelmingly positive.

The division of a large class of optometry students into small, facilitated discussion groups is considerably labor intensive for the faculty who must design, grade, and facilitate discussion (Good et al., 2011). Wyles et al. (2013) of the Illinois College of Optometry attempted to mitigate this concern with a hybrid course design called *Primary Care Conference*, in which problem-based clinically-oriented learning could be held in a large class setting. At specific times throughout the third year of study, optometry students are presented with clinical cases in class. They are allotted a period of class time to evaluate the cases and answer critical-thinking questions, using whatever non-electronic references they wish to bring with them. Upon completion of the work period, work is collected for grading, and a classroom discussion is led over the material by the faculty case author. Qualitative evaluation of students indicates the conferences are considered to be useful for development of critical thought and preparation for the licensing examinations.

In their literature reviews, Chit Ming (2014) and Santiago (2008), demonstrated that visual mapping of concepts, arguments, general knowledge, and processes has been found to improve critical thinking and decision-making in a clinical context. Outside of optometric education, Wilgis and McConnell (2008) identified improvements in a pre-/post-test after using concept mapping to propagate better understanding of nursing students' thought processes in clinical scenarios. Concept maps were used to identify patients' health problems and ideal treatments. The small sample size and use of a convenience sample, however, cast some doubt on the results.

Cook and Triola (2009) describe the effects of virtual patients in clinical education, specifically their facilitation of clinical reasoning. Since this element of clinical thought is

developed naturally through multiple patient interactions, the use of well-designed virtual patients can help students improve without the use of live patients.

Deficiencies in the existing literature and possibilities for future research

Though the clinical utility of critical thinking has been demonstrated, the body of literature concerning its andragogy is suspect. Many studies and reviews report critical thinking improvements with redesign of course elements (Clegg et al., 2014; Chit Ming, 2014; Cook & Triola, 2009; Good et al., 2011; Lee et al., 2016; Yuan, Williams, & Fan., 2008), but results from these studies are often varied and not repeatable, and therefore do not clearly define an andragogical method. The variations can be explained by differences in research design, implementation of instructional interventions, durations of study, assessment measures used, and sample sizes (Behar-Horenstein & Niu, 2011; Facione, 1990; Niu et al., 2013; Yuan et al., 2008).

The literature on effective critical thinking andragogy could therefore be improved by (1) performing well-designed research with randomized selections into large treatment and control groups (or robust statistical design when randomization is not possible), (2) use of standardized assessment instruments for quantitative measures, and an (3) intervention duration of at least twelve weeks that (4) contains explicit instruction in critical thinking skills (Behar-Horenstein & Niu, 2011; Facione, 1990; Lee et al., 2016; Niu et al., 2013; Lai, 2011; Tiruneh et al., 2014; Yuan et al., 2008). Such research would benefit the optometric profession specifically by training optometrists to better diagnose and treat conditions of the eye and visual system, and the education profession and discipline at large by helping determine how to teach critical thinking in higher education effectively and efficiently (Dunne, 2015). That Lee et al.'s (2016) recent

meta-analysis of the entire health professions, dental, and medical literature found but eight examples of such robust study design reinforces the need for more high-quality work.

Conclusion

Though there is substantial research available in the optometric and health professions literature regarding teaching critical thinking, poor study design has led to questionable conclusions. Future studies should be designed to improve both the internal validity and generalizability of the results, so that andragogical methods for imparting critical thinking skills and dispositions to clinical students can be identified and implemented.

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