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ScienceDirect

Currents in Pharmacy Teaching and Learning 8 (2016) 271–278

Currents in Pharmacy Teaching & Learning

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Research article

Assessing development in critical thinking: One institution's experience ☆

Michael J. Peeters, PharmD, MEd, FCCP, BCPS*, Sai H.S. Boddu, PhD

University of Toledo College of Pharmacy and Pharmaceutical Sciences, Toledo, OH

Abstract

Objective: Enhancing critical and moral thinking are goals of higher education. We sought to examine thinking development within a Doctor of Pharmacy (Pharm.D.) program.

Methods: The California Critical Thinking Skills Test (CCTST), Health Sciences Reasoning Test (HSRT), and the Defining Issues Test (DIT2) were administered to Pharm.D. students over four sessions throughout their didactic studies. Students took tests in their P1 Fall, P1 Spring, P2 Spring, and P3 Spring. While CCTST and HSRT are similar for assessing foundational critical thinking, the DIT2 assesses complex moral thinking. Each thinking test was correlated with academic success by undergraduate and graduate grade-point averages (GPAs).

Results: The CCTST was administered in P1 Fall (20.1 ± 5.0). For HSRT, mean ± S.D. was P1 Spring: 22.7 ± 3.5, P2 Spring: 22.6 ± 4.8, and P3 Spring: 23.8 ± 4.5. After converting P1-CCTST and P2-HSRT scores using user-manual interpretations, there was no difference on paired comparison ($P = 0.22$, 0.1 Cohen's d). There was a small difference between P1-HSRT and P3-HSRT ($P < 0.01$, 0.2 Cohen's d). Also administered each time, the DIT2 was P1 Fall: 40.4 ± 12.6, P1 Spring: 36.3 ± 13.7, P2 Spring: 44.9 ± 13.6, and P3 Spring: 43.4 ± 15.4. For DIT2, both P1 Fall to P2 Spring and P1 Spring to P3 Spring were significant with small and medium effect-sizes (both $P < 0.01$, 0.4 and 0.5 Cohen's d respectively). Importantly, multiple HSRT, and DIT2 assessments correlated with undergraduate and graduate GPAs.

Conclusions: During a Pharm.D. program of study, students developed substantially in moral reasoning though minimally in foundational critical thinking. Both foundational and moral reasoning correlated with academic success. Showing responsiveness to change, the DIT2 appears helpful as a measure of cognitive development for pharmacy education.

Keywords: Critical thinking; California critical thinking skills test; Health sciences reasoning test; Defining issues test; Assessment; Measurement

Introduction

Development of critical thinking has been adopted universally as an important goal of higher education.[1–4] However, it has also been recognized that there can be considerable variation and confusion in definitions of "critical thinking,"[4] including from pharmacy education.[5,6] While expanded background for thinking definitions and measurement instruments has been recently reviewed for pharmacy education,[6,7] the following is a short summary. There appear to be two major, though different, constructs described as "critical thinking" that have each been studied with promise in pharmacy education[6,7] and other health professions[8]—foundational critical thinking and complex thinking/reasoning, as shown in Figure. Decades ago, these

☆University of Toledo College of Pharmacy and Pharmaceutical Sciences funded the administration of these assessments.

* Corresponding author: Michael J. Peeters, PharmD, MEd, BCPS, FCCP, University of Toledo College of Pharmacy and Pharmaceutical Sciences, 3000 Arlington Ave, Mail Stop 1013, Toledo, OH 43614.

E-mail: michael.peeters@utoledo.edu

http://dx.doi.org/10.1016/j.cptl.2016.02.007

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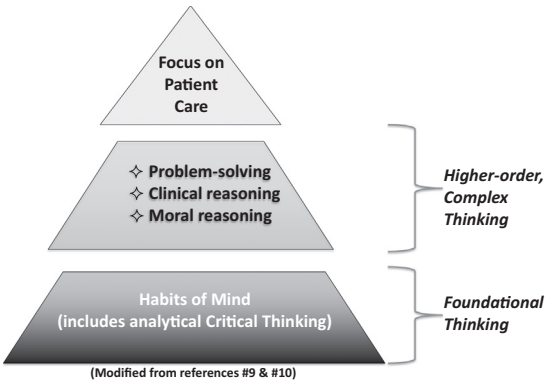

Fig. A cognitive framework for critical and complex thinking[6].

forms of thinking had been described in education with Marzano's Dimensions of Learning model.[9,10]

"Habits of mind" is terminology used within the Center for the Advancement of Pharmacy Education (CAPE) 2013 Educational Outcomes,[11] referring readers to Costa's work for further insight. Costa notes that "critical thinking," while not mention specifically within his habits of mind, coincides with his framework[12]; both Marzano et al.[9] and Costa and Kallick[12] agree that critical thinking is foundational. As a "habit of mind," foundational critical thinking is analytical and involves interpretation or analysis followed by evaluation or judgment.[4] Meanwhile, complex thinking may better be termed problem-solving or clinical reasoning. Following the American Philosophical Association's definition of critical thinking,[13] the California Critical Thinking Skills Test (CCTST) and its more recent extension, the Health Sciences Reasoning Test (HSRT), quantify one conception of foundational critical thinking.

While there is a foundational need for critical thinking, sound thinkers require more complex thinking as well. The Defining Issues Test version 2 (DIT2) quantifies a complex, cognitive-moral perspective to thinking.[14] Importantly, the DIT2 has also been associated with physician and pharmacist professionalism[15,16]; its use in assessment has been recommended for pharmacy education at multiple times.[16–18]

Methods

Setting

The University of Toledo is a comprehensive public institution and includes an academic medical center. The college of pharmacy is a 2 + 4 Doctor of Pharmacy (Pharm.D.) program, where the first two years of the Pharm.D. are considered undergraduate coursework while the remaining two years are graduate-level coursework. While undergoing future changes, at the time of this investigation the curriculum was mainly separate lecture-based basic science and therapeutic course-blocks, with some case-based coursework. This study followed students from the 2015 and 2016 Pharm.D. classes through their didactic first- to third-years. This investigation received the University of Toledo's IRB approval.

Because one of the cognitive development instruments used in this study (i.e., DIT2) is a measure of ethical reasoning, brief mention of that ethics curriculum is needed; this content is explained in more detail elsewhere.[19] In short, "professionalism and ethics" is a longitudinal module throughout the first- to third-year of professional study. Each semester, students build on content from prior material. Ethics, introduced as the four biomedical principles,[20] is a framework to approach pharmacy practice ethical issues. Students reflected on and discussed a number of ethical applications to pharmacy practice. The majority of these are within students' first-year of Pharm.D. study. Within the module, there is no explicit mention or discussion of Kohlberg's model of moral reasoning (which was foundational for initial development of the DIT2 instrument[21]).

Design

This was a longitudinal cohort research study design that followed two class years of Pharm.D. students from their first through third professional years (P1–P3). To measure change, a longitudinal research study design has been championed.[22] The large Wabash National Study assessed thinking development (foundational critical thinking and complex thinking) among numerous undergraduates at liberal arts colleges; it used a longitudinal research study design.[22] Each entering Pharm.D. class was randomly divided into a Group A and a Group B. The randomization first stratified students into sections based on introductory pharmacy practice experiences scheduling, pharmacy practice experience, and future practice setting interests; second was to alternate between tests in each lab section wherein an equal number of students took each test.

Group A took the CCTST in Fall semester of their first-year, the DIT2 in spring semester of their first-year, the HSRT in spring of their second year, and the DIT2 in the spring of their third year (Table 1). At the same time, Group B did almost the opposite (Table 1). Given that there were roughly two years between repeat administrations of any single version of thinking test used in this study, a student's recall of any instrument's specific content seemed very

Table 1
Critical thinking assessment administration design overview for each Pharm.D. class

Group	P1 Fall	P1 Spring	P2 Spring	P3 Spring
A (half of class)	CCTST	DIT2	HSRT	DIT2
B (half of class)	DIT2	HSRT	DIT2	HSRT

CCTST, California Critical Thinking Skills Test; DIT2, Defining Issues Test, Version 2; HSRT, Health Sciences Reasoning Test.

Note: Only paired significance testing was done (Group A or Group B); cross-sectional testing between groups was avoided (Group A vs. Group B).