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ARTICLE

The Validation of the Active Learning in Health Professions Scale

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There is a need for an assessment tool for evaluating the effectiveness of active learning strategies such as problem-based learning in promoting deep learning and clinical reasoning skills within the dual environments of didactic and clinical settings in health professions education. The Active Learning in Health Professions Scale (ALPHS) instrument captures three elements of active learning: activities that have elements of novel access to information, observing or participating in experiences focused on learning, and reflective practices about the learning process. In order to assess the criterion-related validity of the ALHPS, a Structural Regression Model was created in which the latent variable of Active Learning was placed as a predictor of graduating seniors' critical thinking. The strong psychometric properties of the ALHPS instrument indicate that it is possible to reliably assess students' perceptions of the frequency with which they experience active learning pedagogy within doctoral health professions education, and that such strategies are predictive directly of academic engagement and indirectly of increases in students' critical thinking skills.

Keywords: health professions education, active learning, assessment, problem-based learning, structural equation modeling, confirmatory factor analysis, academic engagement, critical thinking

Introduction

Graduating health professions students are expected to have gained critical thinking skills, cultural competency, self-directed learning, and other lifelong professional characteristics. The complexity in health care delivery and the need for fewer medical errors have increased pressure on educators to equip their graduates with the level of critical thinking and reasoning skills necessary to meet these increasing demands. With professional accreditation bodies calling for evidence of graduates' learning and reasoning skills, teaching and learning methods have come under increased scrutiny. Specifically, the traditional passive learning environments often found in a lecture-dominated curriculum may not support the development of these higher-order thinking skills (Lizzio & Wilson, 2007).

The structure of most full-time doctoral-level health professions programs consists of didactic basic science courses (e.g., anatomy, pathology, microbiology) in the first one or two years of the program, with a transition to clinical courses and interactions in the third and/or final year. Lectures dominate the course format and are often accompanied by laboratory sections. Within medical school and other health professions, this structure of coursework has been criticized for potentially obstructing student ability to reason and apply basic science within clinical contexts (GPEP, 1984; Graffam, 2007; Willis & Hurst, 2004).

Problem-based learning (PBL) is a specific form of active learning instruction that could be a solution to this gap in basic science learning and clinical reasoning as PBL is aimed at three major goals: to help students integrate basic science and clinical knowledge, to facilitate the development of clinical-reasoning skills, and to help students develop lifelong learning skills (Barrows, 1986). The PBL framework referenced in this study is based on the scholarship of Barrows and colleagues at McMaster University in the 1960s. PBL is an active learning method that incorporates complicated, ill-structured problems that stimulate learning in a collaborative format (Barrows, 2000). The problems do not have one singular solution, nor is the goal of the learning to diagnose the disease state in medical problems. The goal is to understand the complex relationships within the factors of the problem through a series of steps that include independent self-inquiry followed by facilitator-guided learning. Learners

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are required to discuss and reason between alternative explanations and to provide a reasonable argument to support their proposed explanations.

The collaboration, self-direction, and deep processing required in PBL has been related to outcomes such as self-awareness, higher-order thinking, engagement, and critical thinking (Evenson & Hmelo, 2000; Hacker & Dunlosky, 2003; Knowlton, 2003). Scholarship of PBL indicates that medical students from PBL curricula are better able to apply knowledge and demonstrate more effective self-directed learning strategies than students from traditional curricula (Hmelo, 1998; Hmelo & Lin, 2000; Schmidt et al., 1996).

Today, some programs claim to follow the original principles of McMaster University, but most often, only certain elements of the pioneer programs can be found embedded in hybrid versions of PBL throughout higher education (Evenson & Hmelo, 2000).

PBL has been integrated into numerous areas within health professions, including medicine, nursing, dentistry, pharmacy, and optometry (Lohman & Finkelstein, 2000). Assessing the impact of hybrid versions of PBL and how students are learning within those environments can be challenging. In fact, a broader term for learning experiences, active learning, is often used widely in both higher education and health professions literature to describe teaching that actively involves students in the learning process. Bonwell and Eison (1991) described active learning as pedagogical strategies that "involve students doing things and thinking about the things they are doing" (p. 2) within the classroom setting. Such learning stands in sharp contrast to passive listening that occurs in most lectures.

Though the broad definition of active learning has been related to the promotion of higher-order thinking and meaning making (Bonwell & Eison, 1991; Braxton, Milem, & Sullivan, 2000; Kuh, 2002), this type of teaching is implemented infrequently in the curriculum of doctoral-level health professions (Graffam, 2007; Willis & Hurst, 2004). The reasons for infrequent use are primarily the result of habitual behaviors. Medical educators tend to teach in ways they were taught (Graffam, 2007). As physicians usually have little training in teaching, the assumption that effective teaching results only from the teacher's in-depth knowledge of a topic is prevalent (Fang, 1996). Other reasons for passive teaching and learning tend to include high cost of education delivery and uncertainty over its advantages to lecture-based teaching (Graffam & Fang, 1996).

The current study was part of a larger investigation that examined learning factors that significantly contributed to the variation in graduates' critical thinking in four doctoral health professions programs, after controlling for levels of critical thinking at entrance. The institution selected for the study was composed of several doctoral-level health professions programs in which didactic and clinical education were classically structured with basic and clinical science education, but that included variations of teaching strategies that varied between passive and active learning environments. In an attempt to more broadly categorize teaching strategies or pedagogy used beyond that of passive learning, active learning will be used to describe variations of PBL, other collaborative learning pedagogy such as team-based learning, or pedagogy that incorporates some form of inquiry and problem solving.

Active Learning in Health Professions

Graduates of health professions programs need to demonstrate strong critical thinking skills, as critical thinking impacts clinical reasoning and patient health outcomes. The ability to identify and assess the teaching strategies within health professions education is important for guiding or designing curricula toward a culture shift. Teaching that is characterized by PBL and active learning in general can result in many benefits, one of which is critical thinking as part of a lifelong skill set (Bonwell & Eison, 1991; Braxton, Milem, & Sullivan, 2000; Kuh, 2002). This culture shift toward active learning represents a philosophical move from an instructional paradigm through teacher-centered curriculum to a learning-centered education where lifelong learning skills are parallel in value to traditional clinical skills outcomes.

Despite the advantages of active learning strategies in promoting educational goals that are important in doctoral health professions education, there is not currently a method of assessing the extent to which faculty engage in teaching practices that encourage active learning. Most of the assessment tools focus on student engagement in particular activities or behaviors, rather than on teaching methods or how courses are structured across a curriculum. In addition, many of these tools are focused primarily on the undergraduate student. The purpose of this study is to validate a new assessment tool for active learning strategies among health professions educators that is predictive of increased critical thinking and clinical reasoning skills.

Conceptual Framework of Active Learning

The conceptual framework used to design this instrument is based on Bonwell and Eison's (1991) seminal conceptualization of active learning, as expanded by Fink (2013). Bonwell and Eison described active learning as interacting with information directly or indirectly by observing and then reflecting on that learning process using such higher-order skills as analysis, synthesis, and evaluation. Fink expanded the definition to include three components: acquiring information and ideas, experiences, and reflection. Each of these components is thus integrated into the assessment tool.

Acquiring Information and Ideas

One of the active learning components that Fink (2013) promotes is the concept of students becoming self-directed learners by accessing content and data by direct measurement or by reading credible sources before or during the classroom learning activities. This direct access to information implies less reliance on the instructor or lecture-based format for the supply of knowledge. Instead, the instructor can act as a guide for students as they learn how to access reliable information on their own.

Student ability and interest in accessing information directly has high relevance in health professions education, as evidence-based practice is a modern imperative. Evidence-based practice is the careful use of best evidence in making decisions about the care of individual patients (Sackett, 1996). It requires both high-quality evidence and sound reasoning. High-quality evidence includes clinically relevant research from the basic sciences, patient-centered research about current and accurate diagnostic testing, as well as treatment efficacy. Evidence used well can replace less efficacious testing and treatments with care plans that are safer, more accurate, and more powerful (Sackett, 1996).

Another direct form of information access common to health professions education occurs in patient care experiences within clinical education. Whether simulating patient care or in direct provision of care, assessment, or information gathering occurs by listening, observing, documenting patient history, performing testing, and gathering diagnostic data pertinent to addressing the patients' chief complaint (Alfaro-LeFevre, 2004; Halapy & Kertland, 2012).

Experiences

Experiences categorized by Fink (2013) as direct and indirect activities include students engaging in some type of action with the learning material. According to Fink, observation of experiences can also provide meaningful learning. For health professions, these experiences can be in the form of structured pedagogy or as separate creative activities in the didactic or clinical setting. Observing experiences are most easily recognized in health professions when a faculty member demonstrates a clinical skill or students observe upperclass students performing clinical examinations on patients. These types of experiences are described differently and occur at different times in each health profession program, but are usually part of every program (Dornan, 2012). Dornan (2012) has described the term for learning from direct patient care as *workplace learning*, a concept originating in 1910 that "exists in medical curricula in many different guises: early clinical experience, clerkships, residency, and continuing medical education" (p. 16).

Reflection

Once students have obtained new information and have participated in experiences, reflection is the third component of active learning that can support making meaning of the new learning. There are typically two types of activities that support reflection on content: participating in discussion or writing about the information (Fink, 2013). Within the health professions setting, debriefing a case in clinical education is a common form of reflecting on patient care learning. Another, less common type of reflection occurs when students are encouraged to consider the learning process itself, including (a) how well they are reasoning about the topic (e.g., connecting concepts, thinking logically), (b) how the knowledge may relate to them personally, and (c) what type of action they may take as a result of the learning. Enacting this type of reflection could include requiring students to make regular journal entries or create an electronic learning portfolio (Fink, 2013). The scholarship about strategies that effectively foster reflection and reflective practice in health professionals is still early in development, but one review of the literature (Mann et al., 2007) in health professions identified 29 studies that provide evidence about reflective practices and their utilization. Mann et al. concluded that reflective practice can be used by clinicians to inform their decision-making, but that it is a complex process not uniformly exercised. In students, reflection can be demonstrated in different ways and at different levels, but that the deeper levels appeared most difficult to achieve. Professional and clinical practice requires doctors to have self-reflective capacity, especially when faced with illogical reasoning or when conflicted by personal beliefs. Metacognition, in particular, is a critical aspect of the transformation of graduates as they learn to think about their own thinking; it is also essential for reasoning in patient care, for using evidence-based approaches, and for a strong foundation of excellent clinical practice (Facione & Facione, 2008).

Fink (2013) has suggested that a learning activity that incorporates all of the aspects of active learning creates a holistic approach to learning and is more meaningful than if each aspect of active learning is addressed separately in separate teaching activities. Certain teaching activities, such as clinical rotations or direct patient care settings, are experiential in nature and more easily support all three elements of active learning. Within the classroom or didactic setting, collaborative learning pedagogies such as PBL are also highly effective methods of combining all three aspects of active learning.

Assessing Active Learning

How courses or pedagogy actually support learning outcomes such as self-directed learning, lifelong learning, and critical thinking depends on the level of impact of the teaching itself (Barr & Tagg, 2010). In order to explore these relationships of teaching and learning outcomes, instruments are needed to assess active learning, including hybrid versions of PBL, and particularly within health professions curriculum with its dual nature of didactic and clinical environments. A few instruments exist to assess active learning in the classroom or didactic environment, but no instruments assess both the didactic and clinical environments.

For example, Popkess (2010) developed an active learning instrument within the health professions as she studied undergraduate nursing students. Active learning was conceptually defined as "the involvement of students in learning strategies that encourage students to take responsibility for learning" (p. 31), and was operationally defined as "activities such as students' participation in presentations, cooperative learning groups, experiential learning, peer evaluation, writing in class, computer-based instruction, role playing, simulations games, peer teaching, and small discussion groups in the classroom environment" (p. 31). This definition of active learning was more aligned with approaches of assessing students' involvement in activities in and out of class (Carini, Kuh, & Klein, 2006; Kuh, 2002; Umbach & Kuh, 2006), rather than with Bonwell and Eison's (1991) definition focused on pedagogy.

This lack of distinction between how the student responds (i.e., engagement) and the pedagogical approach chosen by the faculty (i.e., active learning) may result in an unclear understanding of how active learning impacts learning gains. Learning environments and pedagogical approaches, such as problem-based learning (PBL), model many of the significant teaching practices of active learning. Given the importance of active learning's impact on health professions students' graduating level of professional attributes and skills, improving strategies to assess teaching methods and corresponding outcomes when using active pedagogy such as PBL is crucial.

In order to capture the level of active learning in both the didactic setting and the clinical setting within health profession education, we designed and tested the Active Learning Health Professions Survey (ALHPS) with doctoral level health professions students. Active learning was defined as faculty teaching activities that required students to seek information, do something actively with the content, and reflect on their learning (Bonwell & Eison, 1991; Fink, 2013). Because the instrument was developed to understand the practices of faculty, scores did not depend on whether students fully participated in the activities or found them engaging, but rather whether the activities occurred at all. The research question that guided our study was: To what extent is the Active Learning Health Professions Survey a reliable and valid measure of active learning pedagogy? Our hypotheses were that the instrument would be internally consistent, as measured by coefficient alpha reliability estimates, and would demonstrate both construct- and criterion-related validity, as evidenced by confirmatory factor analysis and a structural equation model in which scores on the instrument were predictive of students' psychological engagement in learning as well as their critical thinking skills at graduation.

Methods

Participants

This study validating the ALHPS was part of a larger study conducted in a private, post-baccalaureate health professions university in the western United States. The university is comprised of nine colleges with eight doctoral-level professional programs (podiatry, pharmacy, physical therapy, dental medicine, optometry, medicine, veterinary medicine, and graduate nursing). The colleges selected for participation included professional doctoral degree programs in which the structures were similar to each other as containing both didactic and clinical teaching. The programs selected also had administered a critical thinking test to all students at the beginning of their program (in 2009 or 2010): optometry, medicine, dental, physical therapy, and podiatry. The five doctoral professional programs that met both criteria were four years in length, with the exception of the doctor of physical therapy program (three years).

Though five colleges were identified and invited to participate, only four participated to a level that represented their respective program (> 10% response rate) with 182 of the 463 graduating doctoral students participating: Optometry (n = 69), Podiatry (n = 21), Dental (n = 52), and Physical Therapy (n = 40). The demographic characteristics of the sample are outlined in Table 1.

Instruments

The primary criterion variable in the study was critical thinking skills, as measured by scores on the Health Sciences Reasoning Test (HSRT; Facione & Facione, 2013). The HSRT is a 33-item multiple choice instrument that uses the language of health care and is based on the California Critical Thinking Skills Test. The instrument provides a total score for critical thinking skills as well as five subscale scores. These subscale scores measure the constructs of analysis, evaluation, inference, deductive reasoning, and inductive reasoning. The HSRT has been used in undergraduate and graduate health professions programs including nursing, dentistry,

Table 1. Demographic characteristics of participants (N = 182)

Characteristic	N	%
Age		
18–22	1	0.5
23–27	84	46.2
28–32	79	43.4
>32	18	9.9
Gender		
Female	102	56.4
Male	79	43.6
English as First Language		
Yes	113	62.1
No	69	37.9
College Grades		
Mostly A's	23	12.6
A's and B's	95	52.2
Mostly B's	40	22.0
B's and C's	24	13.2
Race/Ethnicity		
African-American	3	1.6
Asian American/Pacific Islander	77	42.3
Caucasian/White	72	39.6
Latino	10	5.5
Multiracial	3	1.6
Prefer not to respond or Other	17	9.3
Health Profession Grades		
Mostly A's	23	12.6
A's and B's	92	50.5
Mostly B's	39	21.4
B's and C's	26	14.3
Mostly C's	2	1.1

occupational therapy, medicine, and pharmacy (D'Antoni, 2009; Huhn, Black, Jensen, & Deutsch, 2011; Inda, 2007; Pardamean, 2007; Sorensen & Yankech, 2008). HSRT normative data was established at the initial development of the instrument when N. Facione and Facione (2006) sampled 3,800 health science students in both undergraduate and graduate level programs. High levels of reliability and internal consistency were reported using Kuder-Richardson-20 (KR-20) calculation for dichotomous multidimensional scales estimated at 0.81 for the total score and KR-20 values ranging from .52 to .77 for the subscale scores. Factor loadings for items in each subscale range from .30 to .77 (N. Facione & Facione, 2006). Construct validity was demonstrated for the HSRT by successfully discriminating between expert and novice critical thinking skills in a graduate physical therapy program (Huhn et al., 2011).

A second criterion variable that was placed in the structural model as a mediating variable between active learning pedagogy and critical thinking skills was students' psychological engagement in learning, as assessed by the Engaged Learning Index (ELI; Schreiner & Louis, 2011). The ELI is a 10-item measure of both psychological and behavioral aspects of academic engagement that explains significant variation in students' self-reported learning gains, interaction and satisfaction with faculty, overall satisfaction with their college experience, and to a lesser degree, their grades. Engaged Learning is a reliable (α = .85) second-order construct comprised of three subscales: Meaningful Processing, Focused Attention, and Active Participation. Schreiner and Louis (2011) used confirmatory factor analysis with a sample of 1,747 undergraduate students. Items used a 6-point Likert scale with responses ranging from *strongly agree* to *strongly disagree*. A 3-factor, 10-item model was verified using confirmatory factor analysis (Meaningful Processing, Focused Attention, and Active Participation) with a second-order construct of Engaged Learning. The 3-factor model with engaged learning as a higher-order construct provided an excellent fit, with χ^2 (32) = 471.91, $p < .001$, CFI = .98, and RMSEA = .046 with 90% confidence intervals of .042 to .049 (Schreiner & Louis, 2011). Variable loading was strong, with β ranges from .61 to .82.

Early Development of the ALHPS

A pilot study that designed and tested reliability and validity of the Active Learning in Health Professions Scale (ALPHS) instrument was initiated in January 2013 prior to the larger study outlined earlier. A draft of items was established and then reviewed with four health professions education experts at each of the colleges in the current study. The representatives suggested changes in wording to several items on the ALPHS instrument, or suggested new items based on the type of active learning that occurred in each of the programs that was not represented on the existing instrument. Examples of additions specific to programs included items about service learning or collaborative learning experiences in the didactic environment. The initial 32 items used a 6-point Likert scale (e.g., ordinal data) with responses ranging from *almost never* to *almost always*. Items were framed within two sections of the survey instrument, with instructions guiding participants to consider teaching environments of didactic (classroom) instruction, as well as the clinical environment involving direct patient care. The items were grouped to form two factors named Didactic Active Learning and Clinical Active Learning. This early pilot version of the instrument was tested with a sample of 108 optometry students within first- through third-year classes (from one of the programs in the final study, but not the same class year of students). After deleting response sets with large numbers of missing items, outliers, and incomplete responses, 93 responses were analyzed. Some of the items had very low communalities, and after deleting two, Cronbach's alpha for the remaining 30 items was .905. A focus group comprised of representatives from each class year (6 total students, 2 per class year) met one month after the survey and the volunteer participants were given instructions to review the items and recomplete the survey on paper so that items could be discussed. The major theme discussed by the focus group was the perception of the purpose and intent of items. Some students perceived that the survey was aimed at determining how they individually participate in activities (engagement) instead of the intended purpose of reporting how faculty used teaching strategies to engage all students. Feedback from the group influenced a change in the stem of the items so that the items emphasized student responses about faculty practices in each learning environment and not about their own level of participation in those practices. In addition to the change in the stem, certain items were revised or omitted based on redundancy or lack of clarity. This process resulted in 25 useable items. Also, each section (clinic or didactic) had a separate stem to introduce which environment was under consideration. The clinical environment was, straightforward, to describe, so the ALHPS began with clinical introduction: "to what extent did faculty expect the following of students in DIRECT PATIENT CARE SETTINGS (e.g., internal clinics, external clinics)". The section was then followed by the didactic setting introduction: "Now think about all other learning experiences OUTSIDE OF DIRECT PATIENT CARE (e.g., classroom, labs, small groups)". In order to explore wording one additional time, but considering time constraints of student schedules at that time of year, the 25 items were piloted online to third-year optometry students only (see Table 1). Forty-three out of 85 students responded to the survey, and although the sample was too small for adequate factor analysis, initial results indicated strong findings. A principal components analysis was conducted utilizing a varimax rotation. The 25 items resulted in a 5-factor solution with Cronbach's alpha of .907. In order to achieve parsimony and reduce the survey to a smaller instrument, several criteria (eigenvalue, variance, and residuals) were used to remove items. The final resulting instrument included 13 items as a 3-factor solution. Each of the scales demonstrated internal reliability through Cronbach alpha values that exceeded the .70 threshold. The total instrument estimate of reliability was high at .881 with 67.0% of the total variance of active learning explained by the three factors. The coefficients of each item of all the scales also had high values (> .40) and also added to the understanding of how well the items within each scale correlated to one another. The resulting ALHPS was a 3-factor instrument with neatly fitting items, and the stem of each item did in fact conceptually fit in that factor (see Table 2). The first component accounted for 42.3% of the total variance in the original variables, while the second component accounted for 15.0%, and the third component accounted for 9.7%. Table 3 presents the loadings for each component with the resultant 13 variables. Component 1 consisted of 4 of the 13 variables. These variables had positive loadings and were labeled as Clinical Teaching. The second component included 4 of the 13 variables with positive loadings. The second component addressed Didactic Reasoning. The third and final component included the remaining 5 of the 13 variables and was labeled Didactic Strategies. The didactic items did correspond with the instructions guiding students to consider learning experiences outside of direct patient care (e.g., classroom, labs, small groups).

The final result was a 13-item instrument that demonstrated internal consistency as measured by a Cronbach's coefficient alpha of .88. The items clustered on three scales that explained 67% of the variance in active learning: Clinical Teaching (4 items; α = .79), Didactic Reasoning (4 items; α = .68), and Didactic Strategies (5 items; α = .87; see Table 3).

Procedures

After approval by the Institutional Review Board, two surveys (the HSRT and a supplemental survey that included the ALHPS, the ELI, and demographic items) were administered to all graduating doctoral students in four of the colleges in a private, doctoral-granting health professions university in the western United States. This survey was administered in-person or online depending on the arrangements made with each college representative. Students' HSRT scores were matched to their ALHPS scores through the use of their student IDs, with the assistance of the Institutional Research Office.

Within the context of the larger study, Structural Equation Modeling (SEM) was selected as the statistical procedure to explore the use of active learning for teaching critical thinking. SEM provides a framework for both theory development and theory testing by using a measurement model and then a structural model. The measurement model uses both Confirmatory Factor Analysis (CFA) and Exploratory Analysis to show relationships between the latent variables (e.g., active learning) and their indicators (each of the items in the instrument). The structural model uses path diagrams in a Structural Regression Model (SRM) to demonstrate potential causal relationships between variables (e.g., active

Table 2. Active learning health professions scale (13 items).

Factors	Definition
Clinical Teaching	Four items measure clinical teaching; *This set of questions is aimed at understanding how **faculty** have used <u>teaching strategies.</u> To what extent did faculty expect the following of students in direct patient care settings (e.g., internal clinics, external clinics) (1) Faculty provided opportunities for observing or practicing complex clinical skills (ALC1); (2) Faculty guided students in debriefing activities that enabled students to evaluate and judge the quality of their thinking (ALC2); (3) Faculty demonstrated good thinking out loud (ALC3); (4) Faculty expected students to acknowledge and improve areas of weakness in skills and knowledge (ALC4).* Each item is measured on a 6-point scale: 1 = Almost Never, 6 = Almost Always.
Didactic Reasoning	Four items measure didactic reasoning; *Now think about all other learning experiences outside of direct patient care (e.g., classrooms, labs, small groups). (1) Faculty expected students to read textbooks or journals before class/small groups (ALD1)*: (2) *Faculty expected students to search for and find relevant information to answer questions or solve problems (ALD4); (3) Faculty expected students to think about how information or concepts are connected to each other (ALD5)*; *(4) Faculty expected students to integrate learning from several courses to solve problems (ALD6).* Each item is measured on a 6-point scale: 1 = Almost Never, 6 = Almost Always.
Didactic Strategies	Five items measure didactic strategies; *Now think about all other learning experiences outside of direct patient care (e.g., classrooms, labs, small groups). (1) Faculty used technology or web-based activities to promote complex thinking (e.g., Discussion boards, role-playing games) (ALD2); (2) Faculty used small groups to promote problem-solving (ALD3); (3) Faculty used interactive methods while lecturing to stimulate discussion about information and concepts (ALD7); (4) Faculty used activities to promote the connection of information to students' prior knowledge (ALD8); (5) Faculty used community service projects to engage students in collaborative learning experiences (e.g. service-learning) (ALD9).* Each item is measured on a 6-point scale: 1 = Almost Never, 6 = Almost Always.

Table 3. Principal components analysis factor loadings and reliability of ALHPS subscales.

Factor and Survey Items	Factor Loading	Internal Consistency (α)
Clinical Teaching		.786
ALC1: Complex Skills	.846	
ALC2: Debriefing	.735	
ALC3: Faculty Think	.798	
ALC4: Self Aware	.644	
Didactic Reasoning		.684
ALD1: Prior Reading	.850	
ALD4: Search to Solve	.683	
ALD5: Connect Concepts	.877	
ALD6: Integrate Across Courses	.740	
Didactic Strategies		.871
ALD2: Technology	.525	
ALD3: Small Groups	.768	
ALD7: Interactive Lecture	.807	
ALD8: Connect Prior Knowledge	.710	
ALD9: Service Learning	.559	

learning, engaged learning, and critical thinking). SEM models allow complex exploration between latent and observed variables, including both direct and indirect effects. The benefit of such a method is that all the relationships between the variables can be tested simultaneously while removing any measurement error (Tabachnick & Fidell, 2007). Analysis for SEM, including both the CFA and SRM, used AMOS software (PASW Version 18.0) to estimate the direct, indirect, and total effects of these relationships, and to estimate a path model that explains the development of students' critical thinking skills. Active learning, as measured using the ALHPS, and Engaged Learning, as measured by the ELI, were both used as latent variables in the SEM model. Critical Thinking as measured by the HSRT was the outcome or dependent variable. As Confirmatory Factor Analysis (CFA) is used to assess the measurement fit of each latent variable within SEM, the CFA step is described in detail in this paper as the methodology to provide the criterion-related validity of the ALHPS.

Confirmatory Factor Analysis

A Confirmatory Factor Analysis (CFA) was conducted on the ordinal data from 182 graduating doctoral health professions students within 4 programs, and the degree to which the items on the instrument were adequately described by the latent variable labeled Active Learning was determined. The goodness of fit tests used included the Comparative Fit Index (CFI; Bentler, 1990) and the Root Mean Square Error of Approximation (RMSEA; Browne & Cudeck, 1993). CFI values can range from 0 to 1, with 1 indicating a perfect fit. Values greater than .95 are considered to represent a well-fitting model (Thompson, 2004). In contrast to the CFI, lower RMSEA levels are indicative of a better fit, with values closer to 0 being more desirable. A commonly accepted standard is that RMSEA values of less than .06 represent a well-fitting model (Thompson, 2004). In addition to these indicators, the χ^2/df was used to relate the findings to sample size; as a rule of thumb when using ordinal data, values of 3.0 or less signify a good fit of the model (Kline, 2011).

The data were screened for missing values, univariate and multivariate outliers, and normality. Missing data from individual items in the data set were less than 5% and were replaced using single-imputation methods that replace each missing score with a single calculated mean score (Kline, 2011). There were no univariate or multivariate outliers identified.

Results

Confirmatory factor analysis (CFA) indicated that the proposed 13-item, 3-factor model was a poor fit to this new sample ($\chi^2(62) = 136.07$ $p < .001$, CFI = .950, RMSEA = .081, CMIN/DF = 2.195) until appropriate covariances of error terms were added ($\chi^2(56) = 81.61$, $p < .05$, CFI = .983, RMSEA = .050, CMIN/DF = 1.46).

In examining R^2 or squared multiple correlations of each indicator (see Table 4), it was noted that the R^2 of three items (*ALD1, ALD2, ALD9*) was significantly below the recommended 0.50 level (Kline, 2011). One item was related to faculty expectations of students to read texts or journals before class, one inquired about faculty use of technology or web-based activities to promote complex thinking, and one item inquired about the use of community service projects to engage students in collaborative learning. Each of these concepts may not have been integral to the curriculum of the programs in the study or with this particular group of graduating students, but they may be useful in a different sample.

In order to test a more parsimonious model for this particular sample and study, and for the purpose of optimizing the latent variables in the measurement step of SEM, a 10-item, 2-factor model seemed to fit the data well. The first factor was related to the clinical teaching environment and was named Clinical Teaching, with four observed variables measuring this latent construct. The remaining six items in the ALHPS were related to the didactic or classroom environment and were named Didactic Teaching (see Figure 1). The resultant fit of the two-factor model was good (χ^2 (29) = 42.07, p =.055, CFI = .989, RMSEA = .050, CMIN/DF =

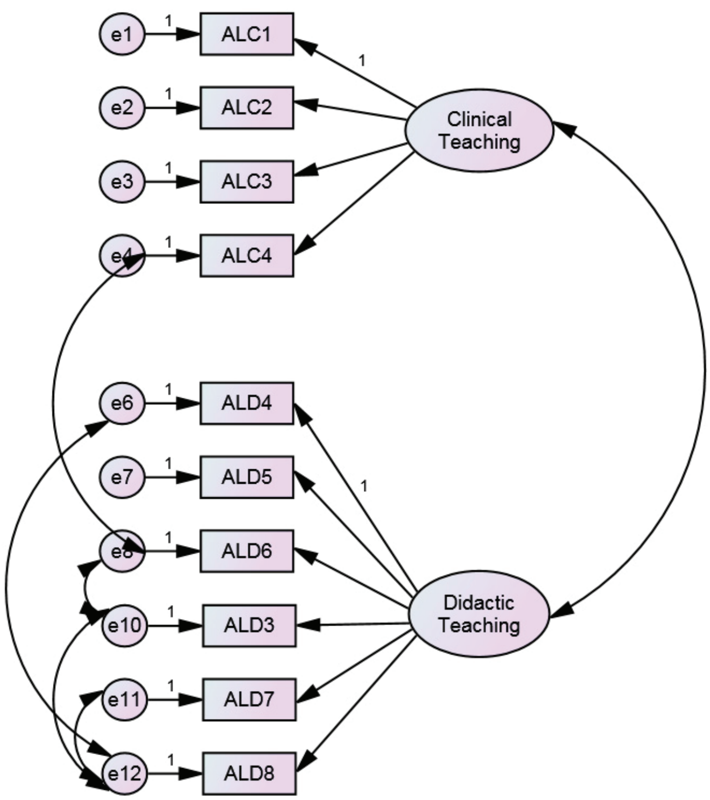

Figure 1. CFA two-factor 10-item structure of the ALHPS.

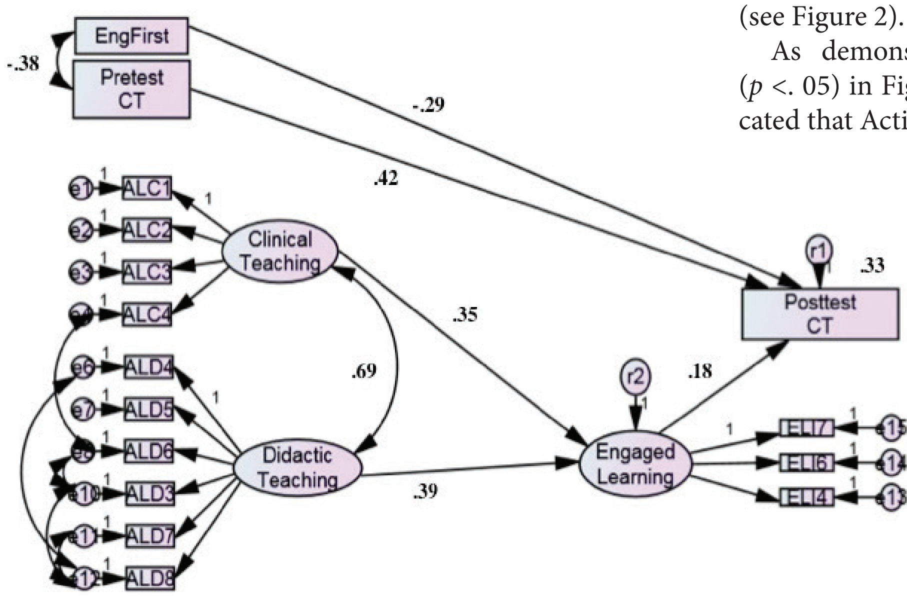

Figure 2. Final critical thinking model.

1.45). Cronbach's alpha for the instrument demonstrated excellent internal consistency (α = .92). The Clinical Teaching factor reliability was α = .88, and the reliability of the Didactic Teaching factor was α = .91. Squared correlations for the 10-item ALHPS can be viewed in Table 4.

Structural Regression Model

In order to assess the criterion-related validity of the ALHPS, a Structural Regression Model was created in which the latent variable of Active Learning, as represented by the ALHPS scores, was placed as a predictor of graduating seniors' critical thinking, as measured by the post-HSRT. Students' academic engagement, as represented by their Engaged Learning Index scores, was placed as a mediating variable between Active Learning and Critical Thinking. The hypothesis was that active learning pedagogy would contribute both directly to critical thinking skills and indirectly to those skills through engagement in learning, after controlling for students' demographic characteristics at entry and their levels of critical thinking when they began their doctoral program. The student entry characteristics of college grades, race, age, and gender were eliminated from the model, as they did not contribute significantly to the variation in critical thinking skills at graduation. In addition, two factors on the Engaged Learning Index (Active Participation and Focused Attention) did not contribute to the Structural Regression Model. After removing each factor sequentially, Meaningful Processing remained as explaining a significant contributor to the variance in students' HSRT scores at graduation. This model provided an excellent fit to the sample data ($\chi^2(96) = 124.28$, $p = .028$, CFI = .982, RMSEA = .040, CMIN/DF = 1.30), explaining 33% of the variance in posttest HSRT scores (see Figure 2).

As demonstrated by significant parameter estimates ($p < .05$) in Figure 2, the Structural Regression Model indicated that Active Learning, as represented by ALHPS scores,

Table 4. Confirmatory factor analysis results for the two-factor ALHPS.

Variable		Item	Squared Multiple Correlations (R^2)
Clinical Teaching			
	ALC1	Faculty provided opportunities for observing or practicing complex clinical skills	.64
	ALC2	Faculty guided students in debriefing activities that enabled students to evaluate and judge the quality of their thinking	.78
	ALC3	Faculty demonstrated good thinking out loud	.66
	ALC4	Faculty expected students to acknowledge and improve areas of weakness in skills and knowledge	.54
Didactic Teaching			
	ALD4	Faculty expected students to search for and find relevant information to answer questions or solve problems	.67
	ALD5	Faculty expected students to think about how information or concepts are connected to each other	.76
	ALD6	Faculty expected students to integrate learning from several courses to solve problems	.76
	ALD3	Faculty used small groups to promote problem-solving	.51
	ALD7	Faculty used interactive methods while lecturing to stimulate discussion about information and concepts	.56
	ALD8	Faculty used activities to promote the connection of information to student's prior knowledge	.49

indirectly contributed to the variation in posttest HSRT scores. Its contribution was primarily through Engaged Learning, which had a direct effect on critical thinking skills as measured by post-HSRT scores. Two student entry characteristics were also significant predictors of the variation in posttest HSRT scores: English as a first language and pretest critical thinking scores. Active Learning in both the clinical and didactic settings was the primary contributor to the latent factor of Engaged Learning, contributing indirectly to critical thinking skills at graduation.

Discussion

Structural equation modeling (SEM) was used to test a robust hypothesized Structural Regression Model that included variables that have been demonstrated in undergraduate and graduate programs to influence critical thinking gains. One hundred eighty-two students within four doctoral health professions programs at one university participated in the study. The model that emerged from that process was much less complex than originally proposed and consisted of three pedagogical or learning environment variables: Clinical active learning, didactic active learning, and engaged learning. The two variables, clinical active learning and didactic active learning, were two factors of the ALHPS, and both factors predicted engaged learning in the study population. Engaged learning was the only direct predictor of critical thinking after accounting for native language and pretest critical thinking.

The original 32-item draft of the ALHPS underwent several revisions before a 13-item, 3-factor version maintained strong psychometric properties. In the population of 182 doctoral students from four programs, a reduced 10-item, 2-factor version fit the data well. The strong psychometric properties of the ALHPS instrument indicate that it is possible to reliably assess students' perceptions of the frequency with which they experience active learning pedagogy within doctoral health professions education, and that such strategies are predictive of engaged learning and indirectly of increases in students' critical thinking skills. Because the instrument was developed to understand the practices of faculty, ALHPS scores did not depend on whether students fully participated in the activities or found them engaging, but rather whether the activities occurred at all. The critical component in impacting critical thinking over the length of a program is whether such teaching strategies result in engaged learning. Because engagement is the synergistic interaction between motivation and active learning (Barkley, 2010), the faculty member has the responsibility to provide active teaching that promotes engagement and supports motivation, but it is the student's responsibility to engage in learning (Fink, 2013).

The primary implication of this study is that the ALHPS can be used as a tool for faculty and colleges who seek to use active learning pedagogy, including hybrid versions of PBL and other collaborative active learning pedagogy (e.g., team based learning, case based learning), as a means to engage students, and ultimately, to achieve learning outcomes such as critical thinking. Specifically, the ALHPS supports the implementation and assessment of active learning strategies within both the clinical and didactic environments. The instrument was designed to query the extent to which instructors incorporate three essential aspects of teaching that are foundational to active learning (Bonwell & Eison, 1991; Fink, 2013). Such teaching is expected to guide students in seeking and organizing information independently, provide opportunities for students to do something actively such as problem-solving with that information, and promote reflection on learning.

As health professions programs attempt to shift to a deep learning paradigm aimed at improving the clinical reasoning and diagnostic skills of graduates, assessment methods are needed to ensure that such student learning outcomes are met. Methods of assessing whether a curriculum includes teaching that results in deep learning are limited, as existing instruments emphasize student responses to teaching (e.g., student involvement or engagement), rather than assessing what teaching methods are actually implemented in the classroom. The ALHPS contains three key aspects for types of teaching strategies within both the clinical and didactic setting that would comprise active learning: (a) searching for, organizing, and connecting information to prior knowledge; (b) actively interacting with the learning content in creative and problem-solving ways, and (c) reflecting on learning and the quality of thinking. Each of these core ingredients provides a more specific direction for colleges to implement, assess, and reward faculty as they develop courses and curriculum.

Instruments that assess the active learning that is in alignment with the goals of deep learning and the development of higher-order thinking skills will also enable PBL strategies to be assessed more reliably and connected intentionally to these goals. As health professions educational leaders encourage the use of PBL on campus, documenting the specific types of pedagogy that contribute to the learning gains in a PBL classroom can help more faculty adopt a PBL or other active learning approach. The ALHPS can be used in two ways in this process—as a summative evaluation tool or as a formative faculty and student feedback mechanism.

In order to use the ALHPS as a summative evaluation, it could be used at the end of a course to help an individual instructor determine the perception of the students with regard to his or her teaching strategies within the context of the classroom or as a clinical instructor. It could also be used at the end of a quarter or semester as a form of feedback for curricular interventions with a group of courses.

Within the clinical teaching environment, for example, if a clinical instructor has three or four individual students he or she is supervising during patient care, and students responded with an average low score (e.g., 3 or below) on the item, *faculty provided opportunities for observing or practicing complex clinical skills,* then the score could act as summative feedback and stimulate an increased awareness for the instructor that opportunities may need to be increased for future students. Or, if the item, *faculty guided students in debriefing activities that enabled students to evaluate and judge the quality of their thinking*, revealed a low agreement score, the instructor may need to re-evaluate how and if debriefing activities are conducted so that opportunities for metacognition are provided in more obvious ways. The ALHPS items do not inquire if the student is satisfied with the type of instruction or if they desire for certain aspects of instruction to be changed, but rather, they inquire if the activities were actually provided.

Within the context of the didactic portion of the curriculum, the individual scores of items or the mean scores from the Didactic Reasoning and Didactic Strategies factors from the 13-item version could also be used for instructor summative feedback. If the students demonstrated a low agreement to the item, *faculty expected students to search for and find relevant information to answer questions or solve problems,* the instructor may wish to enhance the out-of-class assignments so that all reading and preparation done by the students is utilized fully within the in-class sessions to solve problems, and students are able to see the relevance and purpose of their information gathering.

If the items or overall factor scores are used for formative assessment, the feedback to the instructor on student perception of their teaching can be used mid-course to adjust teaching. Open comment boxes could be used with each item so examples or suggestions for revisions might provide more extensive feedback. As the items are not connected to personal attributes of the instructor but are related to specific teaching strategies used in the course, the feedback can be constructive. For example, in the clinical setting, the item, *faculty expected students to acknowledge and improve areas of weakness in skills and knowledge* could be used to stimulate group discussion about what it means to the instructor for students to demonstrate self-reflection as opposed to self-deprecation or denial. Students could discuss or write ways to acknowledge their limitations and how they could improve those areas in the context of a learning plan for the remaining learning period. This topic fits within the active learning aspect of reflection. Within the classroom setting, the item, *faculty expected students to think about how information or concepts are connected to one another* (ALD5), also represents a form of reflection on learning that enables cognitive connections to be made for the formation of strong neural networks. This item could be used in a formative way if feedback is provided to the student in a manner that both encourages more effort on their part to make connections and makes explicit their role in that process, whereas it can be formative to the instructor if they have not revealed strong enough explicit instructions within assignments to foster conceptual relationship building for students. Not only do these items represent the reflection aspect of active learning pedagogy fostered by the instructor, they also relate to a specific aspect of metacognition needed in critical thinking: "the goal of metacognitive skills in the context of critical thinking is to monitor and evaluate the quality of thinking during the process of interpreting and evaluating the argument" (Finn, 2011, p. 70).

In addition, certain items within the Didactic Factors of either the 13-item or the 10-item ALHPS instrument may be more applicable depending on the program and the course. If a curriculum primarily characterized by PBL methods were using the instrument, the item about small groups (ALD3) would be highly relevant, whereas the item about interactive lecturing (ALD7) may need to be removed. The item inquiring if the instructor used activities to promote the connection of information to student's prior knowledge would be highly relevant in a PBL curriculum or any course using active learning.

Although learning in an active environment may be enjoyable for some students, it may also represent a very difficult transition in learning that challenges students' preconceived ideas about what good teaching is or how to achieve high grades. As such, global satisfaction items often used in summative evaluations of faculty are not very helpful to assess deep and meaningful learning. Sometimes course evaluations are more appropriately described as faculty ratings (Nuher & Dewar, 2008). Many course evaluations ask students about the instructor's knowledge of the subject matter, communication skills, ability to organize material, and fairness in grading. In fact, the enthusiasm of the professor has been demonstrated to be the single highest factor impacting faculty ratings or evaluation scores (Watson, 2011). Thus, faculty may complain that in order to achieve high evaluations they have to oversimplify material, inflate grades, and keep students entertained (Watson, 2011). Satisfaction and the corresponding rating of faculty is a response to a complex set of factors that may include actual impressions of learning, but also a personal reaction to the instructor's personality, teaching style, and many other affective factors (Shevlin, Banyard, Davies, & Griffith, 2000). Students' own learning style, background, and personal biases also influence student satisfaction.

Nuher and Dewar (2008) recommended that several measures should be used to assess instructional practices not only for summative assessment purposes, but also for providing important feedback to faculty during mid-course delivery. The ALHPS could be used to provide insight into students' perception of the teaching methods. This feedback can be used as a mechanism to help faculty understand how the execution of their teaching is received and how it has impacted student learning. Mid-course modifications can be made based on the feedback and then compared to the end-of-course evaluation.

Limitations

The primary limitation of this study exists in the reliance on the retrospective recollection of students about types of teaching strategies encountered over the course of their program. This extended recollection presents a complication in whether students remembered accurately. Student responses are undoubtedly influenced by attitudes—graduating students may care little about assessing their environment in a fair and thorough manner, but may be more concerned about leaving and starting their career or next phase of education. Attitudinal questions are highly susceptible to context effect (Porter, 2013). Students also recall experiences differently from one another, and an active learning strategy may have left an impression of extreme negativity or positivity depending on their perception as a learner and the culture of the overall learning environment. An additional limitation is related to the methods of data collection, as some programs responded to an online version of the instruments, and other programs administered only a face-to-face paper version. There are some concerns that administration mode may influence the responses of the participants (Duffy, Smith, Terhanian, & Bremer, 2005); however, at least one of the variables, the HSRT, had been validated in both online and face-to-face environments (HSRT Manual, 2012).

Suggestions for Future Research

Further analysis using larger samples from many different campuses and a variety of health professions programs would allow for cross-validation of these results. Both the 13-item version and the final 10-item version may be useful in different situations. For example, a curriculum that contains service-learning courses could utilize the longer version that includes an item addressing service learning. Testing the ALHPS in more than one college but within a single profession would be an important addition to the current research to explore variation between programs.

A larger sample would allow for greater generalization of the findings for each of the health professions involved. In addition, assessment of the teaching strategies used in different environments that are recognized for their active methods would enable a comparison of the effectiveness of specific strategies across different variations of PBL, as well as between PBL classrooms and traditional lecture environments. Also, the ALHPS may be useful in professional programs that are not at the doctorate level. The primary consideration to utilize both factors of the instrument is that a program incorporates both classroom and clinical courses. Undergraduate nursing programs, for example, meet this dual environment criterion and may utilize the ALHPS in the same manner as the programs in this study. It is conceivable that the ALHPS could also be utilized in nonclinical degree programs if only one factor (6-item), Didactic Teaching, is used.

Conclusion

The modern health care environment has become increasingly complex with demands for accountability, integrated care, efficiency, and access for all. Problem-based learning has been proposed as an avenue to enhance professional skills and complex-reasoning abilities necessary for health professionals to not only enter the current workforce, but also to become innovative leaders of future practice (Facione & Facione, 2008; Varkey, Home, & Bennet, 2008). The ALHPS and its conceptual framework of active learning can be used to help determine the effectiveness of a teaching environment in promoting the engagement, higher-order thinking, and deep learning required of health care leaders.

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