Online Continuing Education for Health Professionals: Does Sticky Design Promote Practice-relevance?

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Abstract: Online continuing education (CE) holds promise as an effective method for rapid dissemination of emerging evidence-based practices in health care. Yet, the field of CE continues to develop and delivery is predominately face-to-face programs. Practice-oriented online educational methods and e-learning platforms are not fully utilized. Educational theorists suggest an experiential approach to CE consistent with adult learning theory. A compelling question remains: Can online asynchronous CE programming prepare health care providers in delivering higher-level practice competencies?. To address this question, the authors have identified seven composite "sticky" factors that have been critical to the engagement of learners and the creation and delivery of practice-oriented online educational programs (Zaghab et al, 2015). The sticky factors are based in knowledge management (Nonaka, 1994; Szulanski, 2002) and adult education or andragogy (Knowles, 1970; 1984). In this paper, sticky factors are mapped to Moore and colleagues' (2009) higher level learning outcomes in health care CE. Data are presented on learner reported practice-related outcomes in a selection of online CE courses on the CIPS Knowledge Enterprise™ portal with the University of Maryland School of Pharmacy's Center for Innovative Pharmacy Solutions (CIPS). A dynamic, adaptive e-learning environment built by technology partner, Connect for Education, Inc., provides the innovative platform and the Acclaim! interactive learning technology. This technology-instructional partnership is dedicated to an iterative continuous improvement process called the Learner Stewardship Cycle (Zaghab et al, 2015). The cycle improves stickiness and learner engagement in order to achieve higher-level learning outcomes in CE. Findings suggest that of the 769 learners successfully completing an online course with two or more sticky design segments, the majority report reaching level 4, 5 and 6 learning competencies. Learners from the professions of pharmacy, nursing, medicine, and other health decision makers also found the courses relevant, easy to use and evidence-based.

Keywords: Health Care Practitioner, continuing education, situated online learning, learner engagement, continuous improvement, and practitioner-learner

1   Background – Challenges in online continuing education

While emerging options in the online delivery of education have expanded exponentially in the last decade, health care continuing education (CE) offerings have not kept pace with the capabilities offered (Furman & Sibthorp, 2013). Health care is a rapidly changing field driven by the extraordinary pace of scientific discovery and CE is an important way that health professionals are "updated" with the latest knowledge and skills. New scientific discoveries often require changes in clinical practices. However, practice is slow to change (Ferlie et al, 2005) and CE professionals are stepping into this gap. Pressure is mounting to expand the use of dynamic online platforms for CE to meet health professional needs (ACEHp, 2015).

Online asynchronous programs allow for standardized, geographically dispersed learner enrollment anytime and anywhere without cost of travel. When compared to live programming, online CE is an accessible, convenient, and often cost-effective alternative. Asynchronous CE is also a viable option to disseminate new evidence and best practices to a broad audience of health professionals.

A global meta-analysis conducted by Cook and colleagues (2009) compared the effectiveness of 201 online CE programs to live programs to find no significant difference in the effectiveness of online versus face-to-face CE in achieving the stated learning outcomes. This meta-analysis compared learner outcomes in internet and

face-to-face delivered CE programs over a 17 year period of time. However, the study did underscore the variation in the quality of the CE programming.

Even in agencies charged with practice dissemination, e-learning technologies are not fully utilized. One example of this is the CE programs offered by the Effective Healthcare Program of the U.S. Agency for Healthcare Research Quality, the agency responsible for dissemination of evidence-based practice change (http://effectivehealthcare.ahrq.gov/tools-and-resources/cmece-activities/). The Effective Healthcare Program offers a total of 41 continuing education modules targeting physicians (41), pharmacists (14), nurses (14), nurse practitioners (14), case managers (14) and health educators (6). The educational strategies for AHRQ's CE offerings included readings from medical publications, visual (not audio) slide presentations, and multiple choice post-tests. Three of the 41 modules were playback webinars (7.3%) and eight (19.5%) programs had playback audiovisual. None of the 41 modules on dissemination of best practices in effective health care were interactive. Six workshops were delivered face-to-face in locations across the U.S.

2 Measuring health practitioners' needs as learners

The learning orientation of health care practitioners presents particular challenges for asynchronous online CE programming. Practice, by definition, is a series of interconnected behaviors including: "forms of bodily activities, forms of mental activities, "things" [tools and artifacts] in their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge." (Reckwitz, 2002, p. 249). In short, practitioners require practice in order to learn to practice.

Moore, Green and Gallis (2009) built and have improved a widely accepted framework for the measurement of CE program success in achieving practice-oriented outcomes for health professionals. In their framework, learning for practice is connected to "doing". Thus, effective CE programs should transmit actionable knowledge and provide a forum for learners to demonstrate physical competencies. Table 1 summarizes the outcomes to be measured in health care CE programming. These outcomes serve as metrics for the CE activity evaluations reviewed in this paper.

When designing online programs, quality factors for experiential CE point to the learning outcomes framework proposed by Moore, Green, and Gallis (2009). The learning outcomes for medical practitioners, argued Moore, must extend beyond declarative or domain knowledge to include process-type knowledge such as adhering to clinical practice guidelines when treating patients. Ultimately, practitioners must demonstrate competency (level 4) and the ability to perform patient care in an authentic setting (level 5). In addition to command over domain knowledge, Levels 5 and 6 CE learning outcomes involve mobilization of embodied knowledge. Learner simulation of practice skill in a trial-and-error setting is important for practitioner-learners to ultimately achieve these learning outcomes online.

Health care is not the only field where learning is experiential. Adult learning theorists endorse educational methods with relevant, actionable knowledge for all adult learners (Knowles, 1984). Adults who are rich in practice experience must have opportunities to demonstrate the application of learning to authentic work settings.

As noted in an earlier publication (Zaghab et al, 2015), many learning management systems and online learning environments (Hassanzadeh et al, 2012; Wang, Want & Shee, 2007; Liu, 2014) fail to measure the engagement of the learner, and the inclusion of situated, contextual learning, active learning components, and authentic learning environments. Table 3 identifies program design factors from the literature and shares implications for online engaged learning. Online CE can be designed with higher level learning competencies as the desired outcomes. Design factors can be, and in the study today, are, integrated into program design to meet the CE needs of adult practitioners.

Source	Educational factors identified	Implications for course design
Martz & Shepherd (2003)	Demonstration of skill is required. Course design must address not only changes in content or domain knowledge, it must address behaviors associated with practice change.	Active learning exercises encourage practice. Hands-on practice demonstrates competency.
Herrington & Oliver (2000)	Authentic learning environments are essential for practitioners. Learning and the context of learning cannot be separated. Knowledge must be "relevant to solve problems"-- not to memorize facts. Praxis creates actionable knowledge for practice.	Learning environments simulate authentic settings for professional practice and provide evidence-based tools for clinical decision-making.
Brown, Collins & Duguid (1989)	Practitioners learn in a way that will prepare them for complexity and performance in real life.	Complex case studies and real-life challenges are opportunities for critical thinking and translation of knowledge into practice. Feedback on case work is formative.
Moore, Green & Gallis (2009)	Techniques to reinforce learning include: a) creating and reinforcing a learning experience as a "teachable moment"; b) enabling practitioner-learners to utilize critical thinking and reasoning in treatment decisions; c) structuring an experience to elicit learner's commitment to improving competency; and d) providing formative feedback to learners.	Utilize experts to testify, provide relevance, and model behavior prior to learner demonstration.
Osman & Hannafin (1992)	Metacognition or self-assessment by learners is an ongoing process to improve practice. Learners interpret and generate inferences. Reflection facilitates meta-learning.	Reflection exercises relate to the performance or practice exercises by learners or peers.

Table 1: Literature on experiential education: Implications for educational program design excerpted from (Zaghab et al, 2015)

3   Structure and purpose of the paper

This paper will review the factors in experiential learning for health care professionals. Next the authors will apply these factors to online learning environment in light of Moore, Green and Galli's long-standing framework for CE competencies. Sticky aspects of e-learning environment will be described with regard for how to address the unique challenges of designing and delivering practice-oriented online CE for health professionals. The setting for the study will be described. Program evaluation data from 769 CE learners and 87 sticky course learners will report descriptive learning outcomes according to Moore's framework. The learners' perceived outcomes and competencies are noted. Findings will be discussed and limitations will be noted.

4   Research question and definitions

The question to be addressed in this research is: When e-learning design factors are optimized in evidence-based online CE programs, can health care practitioners consistently achieve high levels of learning outcomes?

Knowledge is extremely useful in informing clinical practice, the CIPS Knowledge Enterprise philosophy aligns with Moore and company regarding the importance of an evidence-based transfer of knowledge and also the importance of integrating such evidence into embodied knowledge for clinical action demonstrated in Moore's levels 4, 5 and 6.

		Proposed sticky factor	Online manifestation of the factor
LEVEL 4	Competence	A. Active learning exercises focus on competencies	Active learning exercises encourage practice. Hands-on practice demonstrates competency. Authentic settings are key to the transfer of tacit knowledge into practice skills.
		B. Multimedia demonstrations of skills	Experts provide testimonial and can be engaged in modeling or demonstrating processes.
		C. Role reflection	Explore care roles from a variety of perspectives.
		D. Self-assessment	Solve complex problems individually and with a team.
LEVEL 5	Skill in Practice	E. Real-world tasks in authentic settings	Activities are true to the tasks and experience of the practitioner.
		F. Practice coaching	Non-linear instruction represents the complexities of real-world practice.
		G. Authentic practice assessments	Authentic assessments of knowledge, skills and abilities.

Table 2: "Sticky" online program design and delivery based on Moore's CE outcome levels (Adapted from Zaghab et al, 2015)

Moore and colleagues' framework on the levels of continuing education outcomes has been widely accepted and serves as the basis for our approach. The framework was developed primarily for medical education but has been applied broadly to the health professionals (AChEP, 2015). Moore's framework includes:

- Level 1 tallies nothing more than participation or attendance.
- Level 2 notes learner satisfaction.
- Level 3 focuses on the learner expectations and the level to which the course meets or exceeds those expectations. Level 3 includes two types of knowledge: a) declarative knowledge or ability to recall facts; and b) the learners' ability to restate how to do what the CE activity intended.
- Level 4 examines competencies gained by the learner through the CE experience, specifically how to demonstrate in an educational setting the knowledge transmitted in the CE activity.
- Level 5 targets the learner's ability to translate the knowledge or skill into the performance of practice.
- Level 6 reaches the patient experience and seeks benefit to the patient's condition as a result of the health practitioner's action.
- Level 7 is the degree to which the health status of the community changes.

The focus of this paper is on Levels 4 (Competence), 5 (Performance) and 6 (Patient Health Outcomes).

The paper links sticky factors in module design in the e-learning environment with the learner reported achievement of these levels.

The term "sticky" utilized in Table 2 is borrowed from Szulanski (2000), who coined the term and articulated the challenges of transferring tacit knowledge between individuals in the workplace. His research substantiates that "knowing in practice" is the most difficult kind of knowledge to transfer. In this paper, tacit knowledge is known as embodied knowledge or knowledge that is held in experience. Examples include: how to give an injection, conduct an ultrasound, and perform a surgical procedure.

The term "sticky" is borrowed from Szulanski. Szulanski's (1994) research found that tacit knowledge "sticks" to the owner and rejects transfer unless it is accompanied by embodied experiences. Since early research in knowledge transfer, innovative educators have shed light on situated learning and practice-based learning as noted in Table 2. The literature delineates desirable instructional factors in situated learning (Martz & Shepherd 2003; Moore et al 2009). This work extends and organizes these factors into educational elements necessary for design, delivery and evaluation of experiential learning in online learning environments.

5   Measures and methodology

This real-world investigation examines learner-reported learning outcomes in a total of 769 CE activity evaluations submitted by learners enrolled in the CIPS Knowledge Enterprise portal between November 2012 and October 2015. Electronic surveys via Survey Monkey were administered to learners immediately following successful completion of each course. Course instructors were blinded as to the learner's completion and responses. Completion rate of the survey was 100% for health professionals seeking CE credit because the activity evaluation was required to receive CE credit. Courses were certified for pharmacist, pharmacy technician, physician, and school nurse participation, and more recently physicians. Two hybrid courses had a final course component by phone or face-to-face.

The activity evaluations maintained consistent elements for reasons of certification but varied according to the learning outcomes of the modules. Two forms of Likert Scale questions (four point and five point scales) were used and these variations are noted in the analysis. Four point Likert questions were adjusted with zero for neutral in calculating a mean score. Only one survey response was allowed per learner and no identifiable learner information was used. Thus, learners may have participated in one or more courses, a matter not considered in this analysis. It may have influenced the learner's cumulative competencies-- an area for future research.

The course mix totaled 87 CE hours involving 24 courses. Of these courses 19 included active learning exercises, 20 involved multimedia, 6 practiced active self-assessment, 7 provided real-world tasks and cases, 14 required skills practice, 12 guided learners in role reflection, 4 involved practice coaching, and 15 involved real-world assessments.

Online courses selected for this analysis include two or more segments with sticky design factors CE activities ranging from 1-20.5 hours of credit. Courses, series of courses, and practice certificate programs were selected based on the factors in Table 2. Qualifying design factors included practice activities, interactive problem-based learning, hands-on skills practice, practice skill demonstrations with stakeholders, either assessments or practice using real-world cases, self-assessment through reflection, and application of actionable knowledge such as clinical guidelines to complex clinical examples. In certificate programs and a handful of skill-based online courses, e-learning technologies have enabled individualized skill demonstration and individualized coaching.

Each CIPS Knowledge Enterprise course (module) is comprised of many segments combined to achieve the application and practice-based learning objectives. Components include but are not limited to the design factors in Table 3: a) instructional materials; b) faculty introductions, disclosures; c) learning objectives and description of the larger series or certificate; d) testimonials from experts in the field as well as practitioners on the application; e) multimedia knowledge-based instruction (also referred to as micro-lectures); f) correct and incorrect video demonstrations of practice activity; g) active learning complete with interactive question and answers as well as discussion; g) professional self-reflection; h) hands on demonstrations of learners for skills practice; i) complex case studies including patient videos, medical charts for practitioner intervention; and j) case studies requiring the application of clinical guidance.

Each online course consists of artful rather than prescribed combination of possible segments. Modules vary in how sticky segments are designed and combined to achieve the learning outcomes. Only courses with two or more segments with sticky designs were included in the study.

6   The theoretical perspective

The authors adopt a social constructivist epistemology of teaching and learning (Palincsar, 1998) in this examination of learning outcomes and course design. The sticky design and related technologies when combined act as the mediator between learner and the e-learning environment. This is similar to the dominant role the instructor plays in a face-to-face classroom. Thus, sticky design is considered by the authors, to be a compelling theoretical factor in how e-learning can achieve practice-related competencies in online learners.

7   The setting

Since 2011, the University of Maryland School of Pharmacy's CIPS and Connect for Education, Inc. (C4E) have collaborated in a university-technology partnership. The CIPS Knowledge Enterprise™ (www.pharmacists4knowledge.org) is a mobile-accessible, asynchronous, continuing education portal for practicing health professionals. The CIPS Knowledge Enterprise uses a quality improvement approach termed the Learning Stewardship Cycle (LSC) (Zaghab et al, 2015), a step-by-step process of micro-improvement to improve the stickiness of the online program based on data provided by the e-learning environment. The LSC micro-improvements aim to optimize stickiness and learner engagement for the practitioner-learner in the online asynchronous classroom.

The portal offers e-commerce services including registration, payment, and certification history for learners. Since its inception the portal has offered over 550 continuing education hours, many practice series, and four practice-based certificate programs with additional practice certificates planned. Enrollments have been concentrated regionally, but numbers include learners from across the globe, including physicians, pharmacists, school nurses, pharmacy students, pharmacy technicians, and health decision-makers. Working side-by-side with content experts, the CIPS-C4E team plans and shapes segments carefully to ensure that content is optimized through the use of sticky factors in design. Higher level learning outcomes require more rigorous educational plans. One powerful capability offered in the e-learning environment is Acclaim™, a virtual simulator. The CIPS Knowledge Enterprise provides individualized coaching in the form of formative feedback via Acclaim!

CIPS Knowledge Enterprise online CE courses are created from building blocks or "segments" which range in length from 15 seconds to 15 minutes. Segments include: expert testimonials, program mapping, audiovisual didactic presentations, interactive inquiries, self-reflection, learner feedback on exercises, regular learner reinforcements, active learning exercises, audiovisual case studies, skill demonstrations, practice skill exercises, scaffold case video scenarios, mailed inhaler placebo devices, videotape help tools, instructor coaching and feedback session, hands-on video simulation (assessment), and knowledge-based assessment, among others. Educational programs range from one to over 20 hours. As the length of the program grows, so does the importance of improved stickiness in design.

8   Findings

Drawing from a sample of 769 learners in sticky designed courses, the findings in this section suggest patterns and emerging trends in the relationship between sticky design and learner reported level 4, 5 and 6 outcomes. This section will provide a summary of CE offerings in the form of practice certificates (15 or more hours), series (multiple modules focused on application of skills), and course offerings with two or more sticky factors integrated into the design. Given the importance of academic integrity, learner reports of the evidence basis and credibility of the course is provided. Differences among health care professionals are noted. Next the learner reported competencies and outcomes will be presented.

Balance, objectivity, and a current base of scientific evidence are all foundational elements in any certified continuing educational course for health professionals. Table 3 presents learner perceptions of course credibility, accessibility, and overall satisfaction. The mean responses are aggregated for both 4 and 5 point Likert questions for all sticky courses.

Table 3: Learner Perceptions of Module Integrity and Academic Credibility

Statement	N	Mean	N	Mean
Easy to use, accessible, convenient	514	4.3	93	3.7
Training was evidence-based	590	4.4		
Balanced and objective	676	4.5	18	3.8
Satisfaction with module	590	4.3		

The mean score for credibility was 4.4; for objectivity a mean of 4.5; and a mean of 3.8 was reported. Learners indicated agreement and strong agreement for ease of use (4.3 and 3.7) and overall satisfaction with the online CE course (4.3). As noted in the methods, the post-course surveys varied slightly which accounts for the differences in numbers.

Physician satisfaction, in general, ranked the e-learning environment ranked lower (mean 3.6) than nurses/pharmacists (mean 4.5) and pharmacists alone (mean 4.4). Other health professionals and decision makers ranked the e-learning environment as 3.9 which indicated a slant toward agreement but some level of neutrality.

Table 4: Appropriateness of e-learning environment as ranked by profession

Professional Affiliation	N	Mean[i]	Mean[ii]
Pharmacists	446	4.5	
Nurses and pharmacists	144	4.5	
Physicians	18		3.6
Healthcare Decision-Makers	75	3.9	
Question Not Asked	86		
TOTAL	769	4.3	3.6

Learner reported benefits from the sticky courses are broken down by number and percent of respondents in each Likert measure. Level 6 learning outcomes were not achieved by every learner. Ninety-seven point seven of 679 respondents reported the competencies and skills from the course will impact their patients positively. Only 2.7% disagreed. A similar impact was reported by 635 learners where 96.8% agreed that the course improved their clinical service delivery. Only 3.3% reported disagreement or strong disagreement with a perceived impact on their clinical practice. While 1.3% of the learners disagreed and did not feel more confident in applying learning to problem decisions in their authentic work environment, 94.7% reported agreed or strongly agreed that they felt more confident after the online training.

A similar pattern is found in level 5 learning outcomes where 92% of 567 learners agreed or strongly agreed that the case studies had practice-relevant application. This question is unique in that it directly associates a single sticky course design element to a specific learning outcome. Level 4 learning outcomes are also essential to the learner-practitioner's experience. In a cohort of 75 hybrid course learners, 93.3% found the course design and concepts applied to real decisions.

Learners were asked to rate the appropriateness of the online environment for practice-based CE. There were notable differences between professions. The physician ratings ranked between agree and neutral (3.58) with only 15 learners reporting. Decision makers (mean 3.93) included physicians, consultants, nurses, and non-pharmacists. Whereas, pharmacists and mixed cohorts of nurses and pharmacists ranked higher with a mean of 4.36 and 4.57, respectively.

In a longitudinal study of an interprofessional cohort of health decision-makers, Pickering and colleagues (Pickering et al, 2015) found that learners in the practice certificate rated real-world decision making as 4.04 mean, in the hybrid program in comparative effectiveness research. Learners felt confident of their abilities to impact real work decision-making and to solve problems in their authentic work setting-- both indicators of Moore's Levels 5 and 6 competencies.

Table 5: Sticky courses and learner reported ability to achieve Moore's Level 4, 5 and 6 CE learning outcomes

	Total N	Learner Self-Reported Benefit									
		Strongly Disagree		Disagree		No Opinion		Agree		Strongly Agree	
		N	%	N	%	N	%	N	%	N	%
My patients will benefit from my new knowledge gained from the training. (Level 6)	676	5	0.7%	9	1.3%	0	0%	343	50.7%	319	47.2%
The case studies and interactive exercises helped me to apply the information provided. (Level 5)	567	7	1.2%	36	6.4%	2	0.4%	303	53.4%	219	38.6%
The program will help me better deliver high quality clinical services. (Level 6)	635	3	0.5%	18	2.8%	0	0%	307	48.4%	307	48.4%
The course design and materials showed how course concepts could be applied to real decision problems. (Level 4)	75	0	0%	5	6.7%	4	5.3%	49	65.3%	17	22.7%
I feel more confident in my ability to provide valuable input...into problem decisions in my work setting. (Level 6)	75	0	0%	1	1.3%	3	4.0%	48	64.0%	23	30.7%

9   Conclusion and Study Limitations

This paper is the first step in exploring the complex interrelationship of higher-level learning outcomes in CE and sticky course design. Research into sticky factors can become more robust in a number of ways. Benchmarking learner progress is a challenging task, especially for level 5 and 6 outcomes. In the future, in order to adequately determine how the CE course has changed practice, we must first assess the status of the learner as well as a sense of their practice environment. A pre-course self-report of practice setting could be considered.

To provide needed power for statistical analysis, standardization of the five point Likert scale in activity evaluations is necessary and already underway. The differences between health professionals can be better assessed within the same course, series, or certificate and is another area for future research. With a larger sample size, each specific sticky factor could be analyzed separately to determine its effectiveness in achieving level 4, 5 and 6 learning outcomes. From the continuous improvements and micro-changes discussed in the Learning Stewardship Cycle, CIPS Knowledge Enterprise courses create a unique set of challenges. Continuous improvement suggests that the course at the beginning may not have been as "sticky" as the same course evaluated at the end of the period under study.

Cognizant of the limitations, the authors conclude that the vast majority of the CE learners reported practice-relevant outcomes which will benefit their patients, their practice or their decision-making abilities. This meaningful contribution may open doors for sticky e-learning as a method for widespread dissemination of practice-relevant CE for health professionals. Public, private and governmental units dedicated to

dissemination of best practices should critically assess the design and delivery of their CE programs with the sticky factors in mind.

Sticky factors in e-learning course design are concepts in need of additional definition. The authors urge the development of new metrics and the validation of metrics for each sticky factor in online course design. Once validated, new metrics could serve as a source of guidance for any CE provider who sets sights on optimizing the stickiness of their CE programs.

References

The Alliance for Continuing Education in the Health Professionals (ACEhp). (2015). CEhp National Learning Competencies. Chicago IL, 1-37. www.acehp.org/p/cm/ld/fid=15.

Brown, J.S., Collins, A., and Duguid, P. (1989). Situated cognition and the culture of learning, *Educational Researcher*, 198(1), 32-42.

Cook, D.A., Levinson, A.J., Garside, S., et al, (2008). Internet-based learning in the health professions: A meta-analysis. *Journal of the American Medical Association*, 300(10), 1181- 1196.

DeLone, W.H., and McLean, E. (2003). The DeLone and McLean model of information system success: A ten year update. *Journal of Management Information Systems*, 19 (4), 9-30.

Gold M., Helms D., and Guterman S. (2011). Identifying, Monitoring, and Assessing Promising innovation: Using evaluation to support rapid-cycle change. *Commonwealth Fund Publication* 1512 (12).

Furman, N., and Sibthorp, J. (2013). Leveraging experiential learning techniques for knowledge transfer, *New Directions for Continuing Education*, 137 (Spring). Wiley Periodicals.

Harris, C., and Rausch, D. (2013). Leveraging learning theory and learning management systems in higher education: The critical role of instructor facilitation. In Y. Kats (Ed.), *Learning management systems and instructional design: Best practice in online education* (pp. 248-262). Hershey, PA: Information Science Reference).

Hassanzadeh, A., Kanaani, F., and Elahi, S. (2012). A model for measuring e-learning systems success in universities. *Expert Systems with Applications*, 39, 10959-10966.

Herrington, J., and Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology Research and Development*, 48(3), 23-48.

Knowles, M.S. (1970). *Chapter 4: What is andragogy?* In Malcom S. Knowles, *The modern priorities of adult education from pedagogy to andragogy (rev)*. . Prentice Hall: Englewood Cliffs NJ. (40-59)

Knowles, M. (1984). *Andragogy in Action*. San Francisco: Jossey-Bass.

Martz, W.B., and Shepherd, M.M. (2003). Test for the transfer of tacit knowledge: Making a case of implicit learning, *Decision Sciences Journal of Innovative Education*, 1(1), 41-56.

Moore, D. E., Green, J. S., and Gallis, H. A. (2009). Achieving desired results and improved outcomes: Integrating planning and assessment throughout learning activities. *Journal of Continuing Education in the Health Professions*, 29(1), 1-15.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5 (1), 14-37.

Nonaka, I., and Takeuchi, H. (1995) *The knowledge creating company: how Japanese companies create the dynasties of innovation*. Oxford: Oxford University Press.

Osman, M.E., and Hannafin, M.J. (1992). Metacognition research and theory: Analysis and implications for instructional design, *Educational Technology Research & Development*, 40(2), 83-99.

Palincsar, A. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology*, 49, 345-375.

Pickering, M.K., Perfetto, E.M., Anyanwu C., Zaghab, R.W., Graff, J.S., and Eichelberger, B. (2015). Improvement in self-reported real-world decision-making after completion of a comparative effectiveness research continuing education certificate. [Poster] International Society for Pharmaceutical Outcomes Researach (ISPOR) 20th Annual International Meeting. Philadelphia, PA, USA. May 2015.

Reckwitz, A. (2002). Towards a theory of social practice: A development in cultural theorizing. *European Journal of Social Theory*, 5(20), 243-63.

Szulanski, G. (2000). The process of knowledge transfer: A diachronic analysis of stickiness. *Organizational Behavior and Human Decision Processes*, 82(1), 9-27. doi:1006/obhd.2000.2893

Wang, Y.S., Wang, H.Y., and Shee, D.Y. (2007). Measuring e-learning system success in an organizational context: Scale development and validations, *Computers and Human Behavior*, 23, 1792-1808.

Zaghab, R.W., Maldonado, C., Whitehead, D., and Rodriguez de Bittner, M. (20015). The learner stewardship cycle in asynchronous online continuing education. [Paper] International Conference on e-Learning (Conference & Proceedings). College of the Bahamas. June 25-26, 2015.