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A Novel Virtual Pharmacy Examination Format and Student Self-Perceptions in Making Nonprescription Product Recommendations

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Objective: Determine the impact of the virtual pharmacy examination on student perceptions of confidence, competence, and comfort when recommending nonprescription products. **Methods:** A pre-test post-test survey of student perceptions of their own confidence, competence and comfort following exposure to a "virtual pharmacy" examination was administered. Paired sample t-tests and independent samples t-tests were used for pre-post comparisons where appropriate. **Results:** Analysis showed a pre-post mean increase of 1.25 on a 5-point scale ($p < 0.001$) for the 3-item subscale measuring perceived confidence in making nonprescription product recommendations. A single item for a pre-post comparison of perceived competence showed a mean increase of 1.45 on a 5-point scale ($p < 0.001$). Pre-post comparisons of self-reported comfort in making nonprescription recommendations showed a mean increase of 0.49 on a 5-point scale ($p < 0.01$). **Conclusions:** The virtual examination format improved student perceptions of their own confidence, competence and comfort in making nonprescription product recommendations.

Keywords: Virtual Simulation; Practice Simulation; Computer-Based Examination; Therapeutic Recommendations; Nonprescription Products; OTC Products; Pharmacy Work Experience

Introduction

Simulations have been used as learning and assessment tools since the 1960s and can take the form of an actor playing the role of a patient, mannequins with physiologic responses and the ability to communicate, virtual laboratories, virtual families, virtual examinations, and other computerized tools (Srinivasan, 2006). Universities currently face larger class sizes, distance learning, and the expectation to do more with less (Tompson, 2003; Sibbald, 2003; Alexiou, 2004; Brands, 2009). In health care education, students must not only gain knowledge, but also master clinical and personal skills (Kinkade, 1995; Schlicht, 1997; Fuhrman, 2001; Sibbald, 2003, 2004; Kiegaldie, 2006; Kluge, 2007; Orr, 2007; Tsai, 2008; Bambini, 2009; Brands, 2009; Paige, 2009; Kameg, 2010; Liaw, 2010). Simulations have commonly been useful as supplements in teaching complex concepts in pharmacology and pharmacokinetics (Li, 1995; Sewell, 1996; Haworth, 1997; Hedaya, 1998; Boje, 2005). Mannequin simulations have been used to develop communication, assessment, and clinical skills (Bambini, 2009; Brands, 2009; Kameg, 2010; Liaw, 2010). Sibbald and Schlicht developed virtual patient case studies (Schlicht, 1997; Sibbald, 2003; 2004). Orr enlisted the help of pharmacy faculty and residents who had prior community pharmacy experience to act as virtual patients; throughout the semester students would receive emails from their virtual patient asking them self-care questions likely to be encountered in practice (Orr, 2007). Fuhrman assigned virtual families to pharmacy students for whom they were to answer questions based upon what the students were learning in didactic lectures (Fuhrman, 2001). Kinkade developed a text-based computer program in which students made decisions on patients (Kinkade, 1995). Alexiou created a virtual laboratory designed for radioactive pharmaceuticals so people could work independently on experiments and techniques or to work collaboratively (Alexiou, 2004). Boje created a virtual laboratory where students learned about the drug development process (Boje, 2005). Simulations can allow students to accomplish experiential learning in a relatively low risk environment (Schlicht, 1997; Tompson, 2000; Kiegaldie, 2006; Bambini, 2009). From using simulations, students felt that they improved their understanding of complex concepts, enhanced communication and clinical skills, improved judgment, stimulated analytical thinking, increased information retention, and improved self-efficacy (Haworth, 1997; Fuhrman, 2001; Sibbald, 2003; Boje, 2005; Kiegaldie, 2006; Kluge, 2007; Orr, 2007; Tsai, 2008; Bambini, 2009; Paige, 2009; Kameg, 2010; Liaw, 2010). In previous studies, students who learned with simulations scored higher than students who were taught with traditional methods (Fuhrman, 2001; Liaw, 2010).

Overall, students reported that they felt the simulation experiences were beneficial, valuable, and relevant, and that they would recommend the simulation to other students (Sewell, 1996; Hedaya, 1998; Tompson, 2000; Sibbald, 2003, 2004; Boje, 2005; Kiegaldie, 2006; Orr, 2007; Tsai, 2008; Bambini, 2009; Brands, 2009; Kameg, 2010). However, the user-friendliness of the simulation is a factor in how the students perceive

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simulations. In a study that used a simulation game that was not very user-friendly, students did not respond as favorably to this experience as did students in other studies (Kinkade, 1995).

Current Accreditation Council for Pharmacy Education (ACPE) Guidelines stress an experiential educational model (Accreditation Council for Pharmacy Education, 2007). Yet many pharmacists learn about nonprescription products through a combination of personal use and some training and experience after they graduate from pharmacy school (Consumer Healthcare Products Association, 2012). The authors propose that a component of the professionalization of pharmacy students should include knowledge of, and experiential training in, making nonprescription/over-the-counter (OTC) product recommendations. Consistent with ACPE Guideline 11.2 under Standard 11: Teaching and Learning Methods, a virtual pharmacy examination assessment provides a closely guided simulation that mimics pharmacy practice in that "Active learning strategies include… simulations and other practice-based exercises." (Accreditation Council for Pharmacy Education, 2007). With this challenge in mind, the instructors of the Nonprescription Therapeutics course (PHA 413) have employed pedagogical strategies that require students to engage actively in making therapeutic decisions based upon course didactic content while not being limited to traditional multiple choice assessments.

PHA 413 is a four-semester-hour required course offered to almost 200 students in the second professional year. Engaging such large classes in the application of knowledge from didactic content is a challenge. One way the course instructors addressed this issue was by incorporating a "virtual pharmacy" component into the examinations routinely given in this four-credit-hour nonprescription therapeutics course. The term "virtual pharmacy" refers to a computerized simulation of the nonprescription products area of a community pharmacy. Students in the combination campus and distance-based class in the spring of 2011 were transitioning from being consumers of nonprescription products to becoming professionals who recommend products to patients for a variety of health issues.

The multiple choice examination format does not provide students with the same number of possible choices that they would have in a pharmacy. To solve this problem, we developed a virtual pharmacy exam. The virtual pharmacy examination contains images of numerous products that one would encounter in an OTC aisle of the pharmacy. On the examination, the student is given a self-care question or issue and they must select an appropriate recommendation from numerous options. Product images are separated into different sections similar to the aisles one would find in a pharmacy, e.g. cough and cold products, gastrointestinal products.

Although it would be possible to administer the virtual pharmacy examination in a paper version, the combination of: 1) students having laptop computers that allow them to take on-line examinations; 2) examination software, such as Question Mark®; and 3) a secure browser system provided an opportunity to create and use a virtual pharmacy examination format. Creighton University pharmacy students have been issued laptop computers since the fall of 2000. Examination software is embedded in all the issued laptops. Examination software allows students to take examinations in any location with supervision by a proctor who oversees the student while taking the examination; results are immediately available for access by students and instructors. A secure browser allows students to log into the examination while it blocks any other computer use such as web surfing for answers.

Students look at images of product packaging and labels, and then select what they conclude would be the best choice for a patient in a given situation. The virtual pharmacy is set up as a group of linked web pages. Examination web pages were authored by creating two views of each product, one large, one small with a third large view of the Drug Facts of each product. Naming conventions for image files were standardized (examples VP01_ProductLarge_001.gif, VP01_ ProductSmall_001.gif, VP01_ ProductLabel_001.gif) as were label page names (VP01_Product001.html). Standardization of naming conventions allowed for use of an Excel® spreadsheet to create necessary names by changing the numerical portion of each file name by an increment of one. The mail merge function of Microsoft Word® was then used to create individual .txt files containing appropriate html code. File extensions were then changed to .html and pages copied to a web server. See **Figure 1** for examples of examination questions and pictures.

The main page represents shelves in a pharmacy and displays small pictures of various product packages. Clicking the small picture provides a larger picture of the front of the package. This process can be thought of as taking a product off the shelf. Clicking a larger image turns the package around to allow students to view the back where Drug Facts are listed. Returning to the main page can be thought of as putting a product back on the shelf to once again view all products available in the virtual pharmacy.

Objective

The objective of the study was to determine the impact of the virtual pharmacy examination format on student perceptions of confidence, competence, and comfort when recommending a nonprescription product.

Null Hypotheses

1) There will be no change in the level of a student's confidence in making nonprescription product recommendations after the virtual pharmacy examination experience;

2) Pharmacy work experience is not related to levels of confidence;

3) There will be no change in the level of a student's perceived competence in making nonprescription product recommendations after the virtual pharmacy examination experience;

4) Pharmacy work experience is not related to levels of perceived competence;

5) There will be no change in the level of a student's perceived comfort in making nonprescription product recommendations after the virtual pharmacy examination experience;

6) Pharmacy work experience is not related to levels of perceived comfort.

Methods

Survey Instrument Design, Administration, and Validation

A survey instrument was designed for electronic administration. The instrument was composed of: 1) categorical demographic items; and 2) likert-scale items designed to assess students' self-perceptions of confidence, competence and comfort when making nonprescription product recommendations (**Figure 2**).

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Figure 1.
Sample "virtual pharmacy" format. Note: The larger individual product picture below can be viewed by clicking the thumbnail in the "virtual pharmacy aisle". The student can click on this product and see the back of the box or the specific information that the instructors wish to provide.

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Q#13. Have you ever worked in a pharmacy as an intern since you began pharmacy school?

1) Yes (If yes, please go to question 14)

2) No (If no, please go to question 16)

Q#14. Please indicate the type of pharmacy (s) you have worked in as a pharmacy intern. Check all that apply.

a) Independent community pharmacy

b) Chain or other corporately owned pharmacy

c) Hospital pharmacy—inpatient

d) Nursing home or long term care pharmacy

e) Home infusion pharmacy

f) Nuclear pharmacy

g) Pharmaceutical industry

h) Pharmacy benefit manager

i) Other (please specify) _____

Q#15. About how many total hours have you worked as a pharmacy intern since you began pharmacy school? ____

Q#16. Identify your pathway: Campus *insert radio button* Distance *insert radio button.*

Q#17. Identify your gender: Male *insert radio button* Female *insert radio button.*

Q#18. What was your age on your last birthday: ____

Pre-test and post-test survey instruments were administered to 182 students at the beginning and end of the semester. Confirmatory factor analysis with Varimax rotation was used to establish validity of subscale composition. Cronbach's alpha was calculated to determine subscale reliability. This study was considered exempt by the Creighton University Institutional Review Board.

Results

Of the 182 pre and post surveys administered, 168 students completed both (106 by campus students and 62 by distance students) for a usable response rate of 92.3%. Among these, for those who chose to answer the gender item, gender distribution was 107 females and 59 males. There were 122 respondents with pharmacy work experience and 46 with none.

Paired sample t-tests and independent samples t-tests were used for pre-post comparisons where appropriate. Analysis showed a pre-post mean increase of 1.25 on a 5-point scale for the 3-item subscale measuring perceived confidence in making OTC recommendations ($p < 0.001$, Cronbach's alpha = 0.91). Confirmatory factor analyses with Varimax rotation and reliability analyses were conducted on the three-item scale measuring respondent confidence in making an OTC product recommendation. For the pre-confidence analysis, of three components extracted, the primary component had an Eigen value of 2.579 explaining 86.55% of the variance. Reliability analysis for this subscale had a Cronbach's Alpha of 0.92. For the post-confidence analysis of three components extracted, the primary component had an Eigen value of 2.722 explaining 90.72% of the variance. Reliability analysis for this subscale had a Cronbach's Alpha of 0.95. A single item for a pre-post comparison of perceived competence showed a mean increase of 1.45 on a 5-point scale ($p < 0.001$). A single item for a pre-post

Instructions: Please indicate the extent to which you agree or disagree with each statement using the answer codes provided. Survey Items:	Response Codes: 1 = Strongly Disagree 2 = Disagree 3 = Neither Agree nor Disagree 4 = Agree 5 = Strongly Agree				
Q#01. I am confident in my ability to make a recommendation to a patient for use of a self-care product.	1	2	3	4	5
Q#02. I think I can do a good job when making a recommendation to a patient for use of a self-care product.	1	2	3	4	5
Q#03. I am confident that I can select an appropriate product in response to a patient's request for a self-care product recommendation.	1	2	3	4	5
Q#04. The virtual pharmacy examination format used in this course is a realistic simulation of the types of problem solving a pharmacist engages in when making recommendations to a patient regarding self-care.	1	2	3	4	5
Q#05. The use of the virtual pharmacy examination in this course helped me to become more confident when making a self-care recommendation to patients.	1	2	3	4	5
Q#06. The use of the virtual pharmacy examination in this course has helped me to become more confident when making a self-care recommendation. Not used because it is a duplication of 5.	1	2	3	4	5
Q#07. I am currently competent to make self-care recommendation to patients.	1	2	3	4	5
Q#08. The use of the virtual pharmacy examination in this course helped me to become more competent to make a self-care product recommendation to a patient.	1	2	3	4	5
Q#09. I feel nervous when I make a recommendation to a patient for use of a self-care product.	1	2	3	4	5
Q#10. The use of the virtual pharmacy examination in this course has helped me to become less anxious when making a self-care recommendation.	1	2	3	4	5
Q#11. I like the virtual pharmacy examination format used in this course more than the traditional multiple choice examination format.	1	2	3	4	5
Q#12. The virtual pharmacy examination format used in this course is harder than the traditional multiple choice examination format.	1	2	3	4	5

Figure 2.
Survey instrument.

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comparison of perceived comfort in making nonprescription product recommendations showed a mean increase of 0.49 on a 5-point scale ($p < 0.001$). See **Table 1** for comparisons by subgroups.

Comparisons based upon whether or not respondents had pharmacy work experience, showed significant differences only for comparisons of pre-test perceived competence (0.31 less for the group with no work experience, $p < 0.05$) and for post-test competence (0.43 less for the group with no work experience, $p < 0.05$), see **Table 2**. The negligible differences seen between responses of campus and distance pathway students were not statistically significant.

Discussion

Overall and within subgroups with and without work experience, respondents' levels of self-perceived confidence, competence and comfort in making nonprescription product recommendations increased significantly from pre-test to post-test, thus refuting the Null Hypotheses 1, 3 and 5. Of interest is that the presence or absence of work experience had no relationship to these pre-post increases, thus refuting Null Hypotheses 2, 4 and 6 vis-à-vis pre-post comparisons. Both groups showed increases in their perceived levels of confidence, competence and comfort in making nonprescription product recommendations. **Table 3** summarizes support and lack of support for the null hypotheses.

The presence of work experience does play a statistically significant role when contrasting pre-test levels of self-perceived competence, with the experienced group having statistically significant higher values of pre-test competence. Of note is

Table 1.
Pre-post comparisons.

Null Hypotheses Addressed	Comparisons via Paired Samples t-tests Mean (SD) N		Mean Scale Difference	Significance (2-tailed)
1	Pre Confidence—All 2.95 (0.88) N = 168	Post Confidence—All 4.19 (0.50) N = 168	1.25	$p < 0.001$
1	Pre Confidence—Work 3.03 (0.84) N = 122	Post Confidence—Work 4.20 (0.53) N = 122	1.17	$p < 0.001$
1	Pre Confidence—No Work 2.74 (0.96) N = 46	Post Confidence—No Work 4.16 (0.44) N = 46	1.42	$p < 0.001$
3	Pre Competence—All 2.62 (0.91) N = 168	Post Competence—All 4.07 (0.68) N = 168	1.45	$p < 0.001$
3	Pre Competence—Work 2.75 (0.91) N = 122	Post Competence—Work 4.07 (0.71) N = 122	1.32	$p < 0.001$
3	Pre Competence—No Work 2.28 (0.86) N = 46	Post Competence—No Work 4.04 (0.60) N = 46	1.76	$p < 0.001$
5	Pre Comfort—All 2.65 (0.91) N = 167	Post Comfort—All 3.13 (0.68) N = 167	0.49	$p < 0.01$
5	Pre Comfort—Work 2.69 (0.96) N = 121	Post Comfort—Work 3.07 (1.13) N = 121	0.38	$p < 0.01$
5	Pre Comfort—No Work 2.54 (0.91) N = 46	Post Comfort—No Work 3.28 (0.68) N = 46	0.74	$p < 0.01$

Table 2.
Comparisons within subgroups: Work versus no work.

Null Hypotheses Addressed	Comparisons via Independent Samples t-tests Mean (SD) N		Mean Scale Difference	Significance (2-tailed)
2	Pre Confidence—Work 3.03 (0.84) N = 122	Pre Confidence—No Work 2.74 (0.95) N = 46	−0.29	N.S.
2	Post Confidence—Work 4.20 (0.53) N = 122	Post Confidence—No Work 4.16 (0.43) N = 46	−0.05	N.S.
2	Post Confidence Diff.—Work 1.18 (0.81) N = 122	Post Confidence Diff.—No Work 1.42 (0.97) N = 46	0.24	N.S.
4	Pre Competence—Work 2.75 (0.91) N = 122	Pre Competence—No Work 2.28 (0.86) N = 46	−0.46	$p < 0.01$
4	Post Competence—Work 4.07 (0.71) N = 122	Post Competence—No Work 4.04 (0.60) N = 46	0.03	N.S.
4	Post Competence Diff.—Work 1.33 (0.83) N = 122	Post Competence Diff.—No Work 1.76 (0.85) N = 46	0.43	$p < 0.01$
6	Pre Comfort—Work 2.69 (0.96) N = 121	Pre Comfort—No Work 2.54 (0.94) N = 46	−0.14	N.S.
6	Post Comfort—Work 3.07 (1.13) N = 122	Post Comfort—No Work 3.28 (0.68) N = 46	0.20	N.S.
6	Comfort Diff.—Work 0.39 (1.33) N = 121	Comfort Diff.—No Work 0.74 (0.93) N = 46	0.35	N.S.

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Table 3.
Summary of null hypothesis results.

	Null Hypotheses	Null Hypothesis Supported?	Significance
1	There will be no change in the level of a student's confidence in making OTC product recommendations change after the virtual pharmacy exam experience.	No	$p < 0.001$
2	Pharmacy work experience is not related to the level of confidence in making OTC product recommendations.	Yes	N.S.
3	There will be no change in the level of a student's perceived competence in making OTC product recommendations change after the virtual pharmacy exam experience.	No	$p < 0.001$
4	Pharmacy work experience is not related to the level of perceived competence in making OTC product recommendations.	Partially	$p < 0.01$ N.S. $p < 0.01$
5	There will be no change in the level of a student's perceived comfort in making OTC product recommendations change after the virtual pharmacy exam experience.	No	$p < 0.001$
6	Pharmacy work experience is not related to the level of perceived comfort in making OTC product recommendations.	Yes	N.S.

the statistically non-significant comparison of competence in the post-test. Respondents with and without work experience reported a virtually identical level of competence. This indicates that respondents' exposure to the virtual pharmacy examination format and course content brought both experienced and inexperienced respondents up to the same level of post-test competence. The statistical significance of the pre-post difference in competence between the work-experienced and work-inexperienced groups is not attributable to the difference seen in the pre-test, nor to the course or exam. Differences are significant but are in the opposite direction. This significance is attributable to the fact that work-inexperienced respondents had a higher and statistically significant pre-post increase than those with pharmacy work experience. Neither the presence nor absence of work experience had a statistically significant relationship with confidence and comfort levels compared within the pre-test and post-test groups (**Table 2**).

Though not specifically addressed by the research questions, possible relationships among age, gender and experience with the outcome variables of confidence, competence and comfort were examined in order to take into account possible alternative explanations for the results. While respondent age correlated significantly with work experience ($r = 0.398$, $p < 0.001$), gender did not. Yet, when examining confidence, competence and comfort among the work-experienced group by gender, males had significantly higher levels of pre-confidence ($p < 0.01$) and pre-competence ($p < 0.05$) with no significant difference by gender in either of the comfort measures. Of interest is that subsequent to exposure to the virtual pharmacy examination and course content, there was no significant difference by gender in the post-confidence and post-competence measures. Men and women were virtually at the same level. These same comparisons by gender showed no significant differences in any comparisons in the respondents with no work experience.

Limitations

There was no measure of actual or real world performance in making nonprescription product recommendations by these students. Exposure to course content likely contributed to changes observed in respondents' perceptions of confidence, competence and comfort when making nonprescription product recommendations.

Conclusion

The survey measured student self-perceptions of confidence, competence and comfort in making nonprescription product recommendations. The analysis indicates that exposure to the course content and the more realistic simulation experiences of the virtual pharmacy examination were strongly related to the observed increases in confidence, competence, and comfort. Despite differences in prior pharmacy work experience, the data indicate that students arrived at the same levels of competence, confidence and comfort in making nonprescription product recommendations.

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