Distance Education

Leveraging learning technologies for collaborative writing in an online pharmacotherapy course

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The purpose of this project was to evaluate the development and delivery of a hypertext case scenario document to be used as the capstone assessment tool for doctoral-level physical therapy students. The integration of Web-based collaborative tools (PBworks™ and Google Sites™) allowed students in this all-online course to apply their pharmacotherapy knowledge in a physical therapy patient scenario, while working with colleagues to determine the best route of patient care. Students developed digital writing skills imperative to a patient-centered, collaborative health-care field, and practiced evidence-based patient care. The findings demonstrate that the implementation of collaborative digital writing with a hypertext document case scenario assessment as the primary assessment tool in this online pharmacotherapy course delivered to doctoral-level physical therapy students is a feasible and effective educational strategy.

Keywords: collaborative digital writing; authentic assessment; health professional; whole-task

Introduction

Most educational programs state that competence in some field is the primary educational objective. However, what does it mean to be competent? Most definitions combine the use of knowledge, skills, and attitudes to solve problems within a particular field (Baartman, Bastiaens, Kirschner, & van der Vleuten, 2007). Van Merriënboer (2007) defined competence as the effective combination of declarative, procedural, and conditional knowledge, automated routines for solving familiar problems fast and with few errors, metacognitive knowledge to monitor and regulate task-related activities, and the acknowledgement of expertise by the specific professional community. Competence, therefore, is also socially constructed, context specific, and durable; a person maintains competence in a field, even as tools or working methods change. The metacognitive portion of competence in this definition is described as "reflective expertise" (van Merriënboer, 2007, p. 74); self-awareness is important for achieving competence and maintaining it. In short, competence is an integration of knowledge, skills, and attitudes and also acknowledgment of expertise by one's peers.

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If the primary educational goal of educational programs is to graduate students who can competently address complex problems, how does this influence instructional strategies? Merrill (2002) identified five first principles of instruction:

> Learning is facilitated when: learners are engaged in solving real-world problems, existing knowledge is activated as a foundation for new knowledge, new knowledge is demonstrated to the learner, new knowledge is applied by the learner, and new knowledge is integrated into the learner's world. (p. 44–45)

All programs and educational contexts seek to create learning environments that allow learners to apply the content in a personal and authentic way, stimulating greater interest and expanding learning in ways unanticipated by the instructor. Learning, then, requires authentic problems that are complex and ill-defined. Real-world settings present complex and ill-defined problems whereby the solution is beyond the abilities of any one learner; collaboration with peers is necessary to create the best solution. Thus, learners are required to actively engage in problem solving with each other, struggle with the many possible solutions, build on prior knowledge, and incorporate and build new understanding (Bransford, Brown, & Cocking, 2000).

Theoretical framework

Authentic educational strategies to develop clinical competency

It is not possible to include all related content into the formal curriculum. Therefore, students must be able to transfer learning from situations encountered within the formal curriculum to real-life scenarios for which they have had no formal exposure. Many educators argue that whole-task, authentic, collaborative educational experiences are required for meaningful learning, which makes transfer possible (Doering & Veletsianos, 2008; Keller, 2008; Merrill, 2002; van Merriënboer, 2007). This educational position requires a post-structuralism, social constructivist philosophy (Weedon, 1997); the instructor must hold that learning is social and that meaning is constructed by the learner (Wang, 2008). Implementation of whole-task and social interaction as learning strategies requires a social constructivist epistemology; one has to accept that learning is constructed and that there is not one "T"ruth or one "R"eality that is handed down from teacher to student; this philosophical view also holds that meaningful learning does not occur in isolation (Amhag & Jakobsson, 2009; Cole, 2009; Duffy & Cunningham, 1996; Jonassen, 2000; Kramarae, 2007; Paulus, 2005). By incorporating social interaction into the design of the learning environment, the constructivist philosophy becomes that of social constructivism, which differs from cognitive constructivism on the essential component of collaborative learning (Wang, 2008), and incorporates the socially constructed concept of competence.

Using learning technologies to provide scaffolding

The idea that learning requires grappling with authentic problems with ill-defined solutions is also consistent with cognitive complexity theory, which argues that both cognition and affect domains must be engaged (Tennyson & Breuer, 2002), and motivational design theory (Keller, 1987, 2008), which argues that educational

problems must have personal relevance to attract and hold learners' attention. However, ill-defined, authentic tasks are often too complicated for developing clinicians. As Merrill (2002) emphasized, students may not have the prior knowledge necessary to engage in an authentic, complex task. Merrill also emphasized the importance of supporting students with educational scaffolding. The provision of student support through demonstration, feedback, and necessary resources ensures that students will not become frustrated and give up; this also builds learner confidence that successful completion is possible and worthwhile (Keller, 1987, 2008). Merrill also argued that learners must have the opportunity to "go public" with knowledge as a means to socially construct competence, through demonstration and defense of knowledge, skills, and attitudes. The argument that students must apply, practice, and struggle with the material in a way that is purposeful, situated, and collaborative has support in many theorists' works, such as Vygotsky, Dewey, Bruner, Whitehead, Duffy, Jonassen, Lave and Wenger, Wertheimer, and others (as cited in Duffy & Cunningham, 1996; Hull & Saxon, 2009; Jonassen, 2000; Lave & Wenger, 1991; Lund, 2008). Most importantly, these theoretical frameworks support the overall implementation of collaborative, complex learning experiences (coupled with necessary learner scaffolding) that engage learner cognitive and affective domains to facilitate meaningful learning and knowledge transfer.

Language and writing as strategies for learning

Many have argued in favor of the social nature of learning (Gee, 2005; Lave & Wenger, 1991; Lewis & Ketter, 2004). Many, too, have argued for the role of language and writing in learning (Alverman, O'Brien, & Dillon, 1996; Bean, 2001; Berninger & Winn, 2006; Hull & Saxon, 2009; Sosnoski, 1999). The combining of learning, language, and social interaction has been defined as "sociogenesis—that we come to knowledge by taking part in collective activities that evolve over time, and where language and material artifacts function as collective structural resources" (Lund, 2008, p. 36). As students join a profession, they not only adopt the knowledge of the group, but also take on ways of thinking, acting, and communicating; they take on the identity of someone in that profession. This is what Gee (2005) described as "D"iscourse (p. 7) and is also consistent with the socially constructed definition of competence: the assertion that competence is not only a matter of skill, but also acknowledgment from colleagues. If competency is the educational goal, then competency is not only demonstrated through knowledge acquisition, application, and integration, but also demonstrated through "D"iscourse.

One way for students to demonstrate that they are thinking, acting, and communicating like a member of a professional field is to ask them to collaboratively create written communications appropriate for different audiences, namely, for the students in this project, patients, and other members of the health-care team. According to a sociocultural view, learning is both a social and collaborative process, where meaning is co-constructed and co-authored (Amhag & Jakobsson, 2009). Language is central to this social construction of meaning. As Weedon (1997) explained, language is "the place where our sense of ourselves, our subjectivity, is *constructed*" (p. 21). Providing students with a platform to collaboratively grapple with constructing audience-appropriate written communications requires students to engage with, and at the same time, identify with, the "D"iscourse of the profession. This strategy also requires students to demonstrate

the application of the course content in a way that traditional, individual exams do not. Learning technologies provide a mechanism through which the necessary scaffolding can be provided, so that learning experiences can be complex, authentic, and collaborative, and thereby motivating and meaningful.

Leveraging learning technologies for collaborative writing in an all-online course

This redesign project used collaborative writing as a teaching strategy to model effective professional communication and as an assessment component to demonstrate content mastery. Bean (2001) eloquently described the connection between writing and learning: "When we make students struggle with their writing, we are making them struggle with thought itself" (p. xiii). Writing has traditionally been a solitary activity, and one that has been difficult to scaffold in a timely manner, yet many have demonstrated the educational affordances of co-writing as a central pedagogical strategy (Trentin, 2009). Digital writing allows for the incorporation of an authentic communication component into a course and provides timely scaffolding in a logistically manageable way. For example, wikis can be used for creating collaborative writing and hypertext documents for showcasing final communication products (Landow, 2006; Lund, 2008). Combining collaborative learning and writing communication using digital writing is one potential strategy to develop competency in health professional students. Writing challenges students to master content and discourse by collaboratively constructing meaning, while practicing being a health-care provider; what Gee (2003) referred to as projected identity. Here was an opportunity for using learning technology to purposely meet an educational need.

Use of collaborative learning experiences are also important for health professionals, such as the physical therapy students specific to this project, who will deliver care in a collaborative team once in practice; students, then, benefit from learning to negotiate strategies for effective communications prior to entry into the professional setting. In a review of the literature, Rourke and Kanuka (2009) reported that measures of student learning in online collaborative environments remain an unexplored area of research, and that educators rely on student perception of learning and application of potentially invalid student assessment strategies. They concluded that there does not appear to be consistent, deep, or meaningful learning within online communities of inquiry. In addition to implementing authentic learning experiences, an authentic assessment strategy was used, which many have argued is essential for effective and engaged learning (Jonassen, 2000; Merrill, 2002).

In this course redesign, whole-task, competency-based learning (4C/ID instructional design model) utilizing collaborative learning and first principles of instruction strategies was integrated within a pharmacotherapy course to doctoral-level physical therapy students. In this instructional design model, the C refers to the four components of learning tasks, supportive information, just-in-time information, and part-task practice. The advantage of this model is that it allows instructors and designers to create learning experiences that are complex and authentic because of the supportive design features of scaffolding, practice opportunities, and procedural information (van Merriënboer, 2007). See Table 1 for additional description of how the four components of the 4C/ID model were defined in the course design.

Table 1. 4C/ID model and corresponding redesigned course features.

4C/ID model	Course feature
Whole-task	Very complicated patient case
Scaffolding	Case divided up into steps Online lectures and materials
Additional practice opportunities	Smaller cases, with solutions provided
Procedural information	Daily feedback/opportunity to use instructional team

Context of the study

Phar 6800: Rehabilitation Pharmacotherapy is a doctoral-level course for students enrolled in a physical therapy program at a large Midwestern university, starting the second year of a continuous three-year program. The required pharmacotherapy course for these students has always been offered by the University of Minnesota's College of Pharmacy in a distance format, traditionally with online lectures, study guides, and practice cases with the final grade determined by an average score from four multiple-choice exams.

In the redesigned offering, students were divided into small groups of five students at the beginning of the summer semester; typically, 50 students enroll for the course each summer semester, creating 10 groups of 5 students. Groups were assigned unique, complex patient case scenarios (involving approximately 18 medications), containing six major pharmacotherapy issues (cardiovascular, infectious disease, central nervous system/pain, endocrine, gastrointestinal, respiratory), correlating with each of the content sections of the course. Please see Figures 1–3 for screen shot examples of a case scenario, medication list, and referring physician and medical chart information. (The images are of actors, not real patients or physicians. Medical scenario is fictitious and any reference or similarity to actual persons is purely coincidental and unintentional.) To ensure the cases were as authentic as possible to the physical therapy practice setting, the cases were collaboratively developed between the College of Pharmacy and the Program in Physical Therapy; two PhD candidates from the physical therapy program, already licensed in physical therapy, wrote the physical evaluation components of the cases, using physical therapy specific language and format. These candidates also provided detailed feedback to students as they completed the steps of the case assignment and served as the two independent raters for the final project. Groups were required to identify the significant pharmacotherapy issues present within the case and develop their responses in a PBworks™ (http://pbworks.com/) course wiki. Please see Table 2 for an example of the table students were required to complete within the wiki and Google Sites (http://www.sites.google.com) environments.

Groups were asked to collaboratively create physical therapy treatment plans within a pharmacotherapy context—that is, choose and justify therapy regimens based on the pharmacotherapy risks specific to the case scenario—using the ICF (International Classification of Functioning, Disability and Health) model (Steiner et al., 2002). The work-in-progress was accomplished within the wiki site. For their final project, groups submitted in Google Sites a hypertext document demonstrating *evidence-based* recommendations (recommendations were linked to supporting evidence within the Google Sites final case solution) appropriate for three levels of audience: the patient, referring physician, and physical therapy colleagues. The three levels of audience build from Fairclough's explanation of how language figures into

Figure 1.   Screen shot of patient case scenario example. The image is of an actor, not a real patient. Patient scenario is fictitious and any similarity to an actual person or persons is purely coincidental and unintentional.
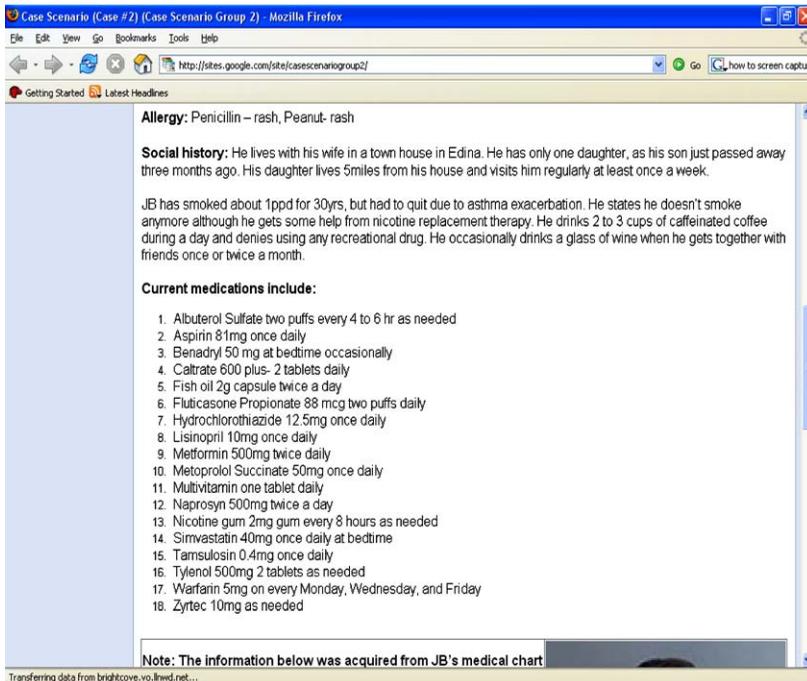

Figure 2.   Screen shot of medication list example. Patient scenario is fictitious and any similarity to an actual person or persons is purely coincidental and unintentional.
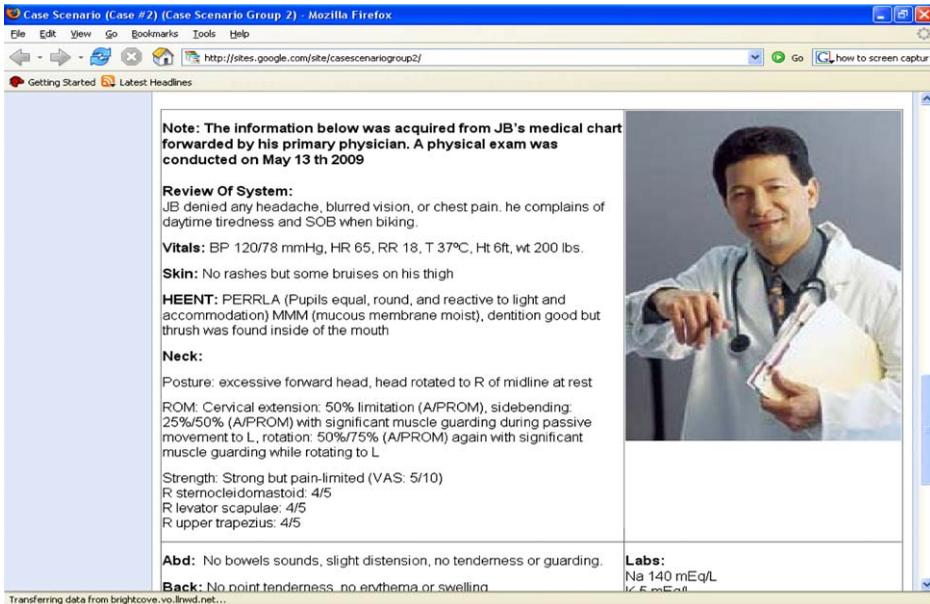
Figure 3.   Screen shot of referring physician and medical chart information example. The image is of an actor, not a real physician. Medical referral scenario is fictitious and any similarity to an actual person or persons is purely coincidental and unintentional.

Table 2.   Column headings of pharmacy table completed by students in part 1 of the course.

Condition medication is treating	Brand name	Generic name	Two agents in the same class	Basic mechanism of action	Common side effects	How this treatment impacts PT

social practice (2004); namely, "ways of acting, ways of representing, and ways of being" (p. 228). Not only were students using language to act discursively and represent the practice of physical therapy, but also they used language as a way of self-identifying as a physical therapist (Fairclough, 2004; Gee, 2003). Students were required to provide hyperlinks to evidence appropriate for each respective audience within their recommendations. Final collaborative hypertext projects were also made available to faculty within the physical therapy program, providing students with the additional public component of competency development (Merrill, 2002), as well as an opportunity to begin to develop professional "D"iscourses not only within their groups and class, but also within their practicing professional community (Gee, 2005).

Purpose of the study

The purpose of this study was to investigate the use of hypertext document case scenario assessment for use as the primary assessment tool in this online pharmacotherapy course delivered to doctoral-level physical therapy students. Specifically, the questions we sought to answer were:

(1) To what extent does collaborative writing within a wiki effectively facilitate learning?
(2) Is it feasible to use a completed hypertext document to demonstrate content mastery and health professional competency?
(3) How does working within a group, addressing interprofessional audiences as well as a patient audience, impact professional identity development?

Methods and materials

Data collected

This study included what Patton (2002) referred to as a "triangulation of data sources and analytical perspectives to increase the accuracy and credibility of finding" (p. 93). Multiple sources of quantitative and qualitative data were collected for the purposes of increasing breadth and depth of understanding of the research questions posed (Creswell, 2009, 2010; Patton, 2002).

Entrance survey and course evaluation

The entrance survey and course evaluation were developed using the guidelines described by Gaddis (1998) and Dillman, Tortora, and Bowker (1998). Following the initial survey development, a health-care professional student took the two surveys using the "think aloud" approach (Collins, 2003), where an investigator sat with a student as she took the survey and she described what she thought the survey was asking her, what she was thinking as she responded, and any difficulties she was having completing the survey. Based on these comments, the survey was revised. The survey was then piloted with five students not involved in the study, resulting in further, minor modifications of the survey. At the beginning of the semester, students were invited to complete the consent form and survey via a hypertext link sent in an email, which also assured the anonymity of responses, and were sent one reminder notification to complete the survey one week following the original invitation. The course evaluation was delivered similarly and also made available as a link from the course site. Responses for the consent form, survey, and evaluations were all collected using SurveyMonkey™ (http://www.surveymonkey.com). The entrance survey contained 10 questions, 8 of which were open-ended. The course evaluation contained 32 questions, 18 of which were close-ended questions required by the university. The remaining 14 questions on the course evaluation were added to specifically address the redesign of the course. Of these, 12 were open-ended or contained an open-ended field for additional comments from students.

Focus group sessions

The focus group questions were developed using the guidelines described by Krueger and Casey (2009). For the faculty and student focus group sessions, questions were developed to gather feedback related to the three primary research goals: was this redesign effective, was it feasible, and did it impact professional identity development? Although questions were developed, a semi-structured question methodology was used to allow for further examination of feedback not anticipated by the investigators. Sessions were scheduled for 90

Table 3.   Data types and sources.

Data type	Data source
Quantitative	Student-ranked entrance survey and course evaluation responses
	Final project scores
	Grade distribution
Qualitative	Open-ended responses on entrance survey and course evaluation
	Student reflection papers
	Student focus group session
	Faculty focus group session

minutes, recorded with a digital audio recorder, and occurred approximately two weeks following the end of the course; full transcripts of sessions were created.

Both quantitative and qualitative data sources were collected to evaluate the course redesign. Please see Table 3 for a listing of data type and source.

Analysis strategy

Quantitative data analysis involved the generation and interpretation of descriptive aggregate data of student scores on assignments and overall course scores in relation to student performance for past course offerings when more traditional pedagogical strategies were used. Inter-rater reliability of the grading rubric was assessed by calculating kappa value (PASW 18).

Qualitative data analysis involved content analysis of both the student reflection assignments and focus group sessions using the classic analysis strategy (Krueger & Casey, 2009), a constant comparison-like approach to reveal *what* participants said within their groups and allow for the evaluation of the quality and effectiveness of hypertext documents, another measure of content mastery and professional competency development (Paulus, 2006). Within themes, student and physical therapy faculty comments were independently reviewed by the two investigators and compared for internal consistency.

Using the comparative analysis methodology described by Glaser and Strauss (1967), the focus group data were analyzed for emerging categories and themes. To obtain a mixture of female and male participants, a purposeful sampling of students from all 10 small groups was targeted.

From the analysis of these data sources, the success of the process of students creating hypertext documents as an educational strategy, as well as the feasibility of demonstrating content mastery through a hypertext document, was determined. Evidence of transformation in both student and group identity, related to professional identity and power identity, was also evaluated.

The primary research questions were evaluated using three data sources. Course scores on individual components of the project development and within-group peer review were used to evaluate the process of collaborative writing. Hypertext document quality, determined by averaging two independent rater scores (a rubric was developed and used), was used to evaluate content mastery and professional competency development. Content analysis was used to identify themes within the student reflection assignments and focus group sessions (Krueger & Casey, 2009).

Findings

Quantitative data

Entrance survey: background information and attitudes

Of the 50 students enrolled in the 2009 summer semester offering, 76% (38 students) completed the entrance survey. Student background attitudes and experiences with online learning and collaborative projects were primarily positive.

Attitude towards working as a group. Students were primarily "accepting" of working in a group: 87% of students (32) responded as such; 16% of students (6) were "very excited." Despite being generally accepting of working collaboratively in this course, students voiced a number of consistent concerns through open-ended feedback from the entrance survey. Many students were concerned about unequal contributions of work by group members, their grade being impacted by the lack of work of others, poor communication within groups, and individuals in the group taking over and not allowing for cooperative learning to take place.

Experience with online learning. Eighty-one percent of students (31) described previous experience with online learning as "mostly positive"; 14% (6) "mostly negative"; 3% (1) "very positive"; and 3% (1) "very negative."

Confidence about course being a meaningful learning experience. Overall, 70% of students (26) were confident this learning experience would be meaningful; 16% (5) were "very confident"; and 16% (6) were "not confident." Students' concerns about taking a pharmacotherapy course online varied, but many students were concerned about the technical elements of the course and the ability to successfully complete while at a distance from the instructional team.

Course evaluation: effectiveness and feasibility

Of the 50 students enrolled in the 2009 offering, 64% (32) completed the course evaluation. Students generally thought the course redesign was a successful model for learning and that the course helped to emphasize the importance of pharmacotherapy to the practice of physical therapy, but many commented that the difficulty level of learning pharmacotherapy in this manner was greater than if a more traditional pedagogical strategy had been used.

Redesign is successful model for learning. Of the students who completed the course evaluation, 81% (26) felt they learned the amount expected or more than expected. Furthermore, 25% (8) felt the pace of the course was too fast, while 75% (24) felt it was just right. With reference to workload, 53% (17) felt the workload was just right, while 4% (15) felt it was too much. Overall, 81% (26) felt the structure of the course was satisfactory, good, or very good.

Pharmacotherapy content in physical therapy practice emphasis. The course strategically emphasized the importance of pharmacotherapy content for physical therapy practice. Of the respondents, 72% (23) commented that the material is either important or very important to their future practice.

Final project quality and inter-rater reliability of grading rubric. Inter-rater reliability of the final project grading rubric was assessed by calculating a kappa value. Kappa value for the two raters was 0.196, indicating poor agreement of scores using the rubric for the two independent raters (please see Table 4 for rater scores for all 10 groups). The final project score for all 10 groups was determined by averaging the two raters' scores. Final project scores were 82–98% and the overall final

Table 4. Two independent rater scores for final hypertext document; total possible score is 30.

Group	Rater 1	Rater 2
1	28	27
2	29	23
3	30	29
4	28	25
5	29	30
6	28	30
7	28	27
8	26	28
9	24	25
10	24	25

grade distribution for the class was 48 As, 1 A−, and 1 B−. This grade distribution is consistent with grade distributions in past offerings when a more traditional pedagogical model was used.

Qualitative data

Student reflection assignments: professional identity development

All student reflection assignments were first reviewed by two independent reviewers for emerging themes; after several passes over the responses, four emerging themes were identified and used for coding.

Theme 1: evidence of collaborative learning. Consistent with the ranking and comments from the entrance survey, students commented on their initial reluctance with the collaborative format of this course, but described how working in a group was a valuable experience that enhanced and expanded their learning by allowing them to address an authentically complex patient scenario that they could not have successfully completed on their own:

> I was very hesitant going into this class with having to work with four other group members to complete this course case study. However, once we started the ongoing project together, I developed a whole new attitude about the "group work." I soon found it a relief to be able to collaborate with others and bounce ideas off one another throughout the course. I think I would have been completely over my head if having to work on that intense of a case study [*sic*] on my own.

> Working collaboratively in a group can be both frustrating and rewarding and I feel that this semester was a little bit of both. It was frustrating at times when other group members are not participating equally and contributing less to the project. Also in group projects some people like to plan ahead, whereas others would rather procrastinate and wait until the last minute. This was one of the largest difficulties I think our group encountered during the project. However, it was also a learning experience because each group member brought a different perspective and new ideas to the case study that I wouldn't have thought of just by myself. In the end, this project has been rewarding because all together in a group we have accomplished a large project that we have worked really hard on.

> Collaboratively working with others in the group helped because we were able to bounce treatment ideas off of each other to best treat this individual. We all have different experiences in the past and we can bring different things to the table when

treating a patient. What I think may help this patient may not be the best option and if I can use my colleagues to [provide] more suggestions I will have a better knowledge base to best treat my patient. This will be utilized in the future to ensure I am always striving to achieve the [best] treatment plan available for my patient.

This experience taught me a great deal about communicating with others in the health-care field and even about communicating with individuals in a group. I have never committed myself to a project of this magnitude in a group setting and therefore had a lot of learning to do in that regard. It became very clear that simply splitting up the project and going our separate ways would not suffice, and I got a real appreciation for the amount and quality of work that can be accomplished when a group of people gets together and bounces ideas off of one another. The group setting made me much more comfortable giving constructive feedback and critically analyzing the thoughts and ideas of other people. The feedback provided by the pharmacy and physical therapy instructors paved the way for a lot of my understanding about proper communication within the health-care field. Many of the suggestions for improvement never even crossed my mind when creating the original draft, and I quickly learned the precision and attention-to-detail required to effectively communicate, especially when it concerns individuals with varying levels of education and understanding and requires that our thoughts and motivations be portrayed in writing. I never thought it would be so difficult.

Theme 2: how writing impacted learning. Students stated the writing component was both helpful and difficult. The requirement to put their intended communication with the three audiences into text, as well as explain rationale for treatment decisions in writing, proved to be more challenging than students anticipated, but students acknowledged the extra struggle to put thoughts into writing was worthwhile and positively impacted their learning:

Putting our ideas into writing for this project helped me think more critically about how I would actually choose to speak to each of the three audiences. We often role-play how we would speak to a patient, but so far this was our first experience in school where we critically thought about how we would talk to our physical therapy colleagues and the referring physician.

Writing everything out also provided a unique challenge. At times it was difficult to detail on paper what you had in your head. I do think it was of value because being able to specify what you want to be done in writing makes you a better communicator so I did think that this was a valuable piece of this project.

It was challenging to write to the different audiences. I definitely needed the practice in writing down my thoughts in an effective manner. I think it was a good learning experience to have to change the way we approached each different audience and made me really understand what I was talking about.

By actually writing out explicitly what we were going to say to each different person made me think in a way that I was not used to. It forced me to take a step back and really think about each sentence and how that would impact the person reading the information.

I am glad we had to write out our treatment plan and apply the context in words. It is easy to think about what you would do to treat a patient and that your therapy plan will flow consistently and will make sense to their condition and not confuse the patient. When you have to write things down and make sure they flow and all make sense together you realize things may not all be useful for a patient. It is easy to come

up with ideas, but sometimes too many ideas are thought of and therapy becomes overwhelming for the patient and the therapist.

Theme 3: authentic assessment fostered professional identity. A primary objective of the redesign of this course was to provide students with a learning environment and experience that allowed for authentic application of pharmacotherapy content to the physical therapy practice setting. Students stated that the complexity of the learning format allowed them to take on the role of physical therapist in addressing the entire patient, both in designing physical therapy recommendations within a pharmacotherapy context, but also communicating with multiple audiences as the physical therapist. This instructional strategy seems to have allowed students the opportunity to apply the pharmacotherapy content in a meaningful and authentic way:

> I felt as though through this whole process I learned a lot about physical therapy interventions and communications with other [disciplines]. I understood the fact that we would communicate differently with a patient than with others in the medical field but I was unaware our communication would vary so much between a physical therapist and a medical doctor. My future identity as a physical therapist will be impacted by this course because I really was taught how to critically think about a patient's case and take a holistic approach to their treatment. We had to apply evidence for any treatment decisions utilized and we had to think about how other aspects of the patient's case my affect their treatment. This I will utilize when I am a practicing physical therapist. I will make sure I have an evidence-based practice and that I am looking at various things the patient presents with, such as pharmacological agents, vitals, lab values, as well as the usual subjective items the patient identifies.

> I also learned, at least partly, the process necessary to develop an entire plan of care with a holistic approach centered around specific patient needs and circumstances. It's clear that in some form, every patient presents differently, and therefore every plan of care must be constructed with that in mind. I always knew that I would be an advocate for my patients, but I never really realized that the intimate contact that physical therapists have with patients relative to other health-care professionals could be used to affect so many things concerning patient care, especially when it comes to educating and informing them about all aspects of the medical care they are receiving.

Negative feedback via course evaluation and student reflection assignment

Unfortunately, not all students had a positive experience with the course redesign. Five students (all within the same small group) submitted very angry and negative student reflection statements and also provided very negative responses in the course evaluation (these are surmised to be the same students, since identical statements were included in both places). The comments from these students are somewhat difficult to use, from a constructive standpoint, since they mostly include statements such as:

> This is the worst class I've ever taken.

> I did not learn one thing from this class.

> I HATED THIS CLASS!!!!!!

This one group (5 students out of an enrolment of 50) represented 10% of the course. The goal is for all learners to have a positive and meaningful learning experience and trying to avoid such a negative experience is an ongoing issue being explored by the instructional development team.

Focus group sessions

Students

Students who participated in the focus group session provided similar information to the course evaluation and student reflection assignments. One new issue that emerged from the focus group session was the student desire for exams. Students stated that even though the pharmacotherapy information was readily available to them on the course Web site, they did not engage with it as much as they would have wanted, simply because they were busy and they knew it would not be assessed by an exam. Without the consequence of a lower score on an exam, they did not have the motivation to spend time with the content, even though they fully recognized the relevance and importance to their future practice. The case scenario was so complex that they did use the course content, but not as extensively as they wanted or that they anticipated they should for future practice.

Another recommendation from the student focus group session was that the wiki be removed, and that all the collaborative writing occurs within the Google Sites page itself. Students felt it was cumbersome to have to move between the two sites and found that collaborative writing was possible within the Google Sites page.

Faculty

The focus group with the faculty primarily centered on whether or not students had demonstrated mastery of the content through this alternative assessment strategy and if the faculty felt it had been a successful course redesign. Overwhelmingly, the faculty agreed that this course design was a success. Faculty felt, after reviewing the students' work in the Google Sites space, that students demonstrated both pharmacotherapy knowledge and, more importantly, how that knowledge impacted physical therapy decisions. A focus of the physical therapy program is the use of evidence-based medicine. Students were required in this project to support all recommendations with evidence. Faculty noted that this purposeful focus on and use of documentation was an important addition to their overall curricular focus. The requirement to explicitly cite medical evidence for both pharmacotherapy and physical therapy aspects of the patient's care also expanded student knowledge of and ability to use reputable information outside of the physical-therapy-related medical literature, a skill development opportunity that the faculty felt was not available in other areas of the existing curriculum. At the time of these focus group sessions, the faculty could not comment on the long-term effects of students participating in this unique educational experience, since the sessions occurred prior to the start of the next semester session. However, they were very pleased with the application of pharmacotherapy within a physical therapy practice scenario and were overall very happy with the evidence-based decision-making process students demonstrated within their Google Sites final projects.

When asked about the recommendation from the student focus group session for exams, the faculty supported the idea. After much discussion, the final recommendation from the faculty was to add required, individual multiple-choice exams to the current case scenario course format. To accommodate the additional course requirements, the faculty recommended limiting the audience communication focus only to the patient. Despite the benefits of having students practice communicating to multiple audiences, the faculty felt that the most valuable audience was the patient and the most appropriate audience given the student point of progression through the program when taking this course.

Revisions and implementation in subsequent offering

Based on this evidence, the following revisions were made to the course design for the 2010 summer semester offering. Five quizzes were added, although the course content remained the same, with the exception of a few updates related to therapies. The quizzes were multiple choice and administered online with a severe time restriction. Feedback from students regarding the quizzes and the course format in general was positive and the changes remained in the course for the 2011 offering.

Students were asked to practice only communicating to the patient, although the examples that were provided in the first offering of how to adjust communication to other audiences were still provided in the course materials. The recommendation to eliminate the wiki site and just use the Google Sites tool for both collaborative writing and the presentation of the final project was also implemented for this offering.

Grant money to employ physical therapy PhD students for physical therapy specific feedback was no longer available for the 2010 offering. As an alternative source of physical therapy assistance with the course, students enrolled in the 2009 offering were asked to act as teaching assistants on a volunteer basis. The familiarity of these students with the course design and the level of feedback helpful to them when they were enrolled in the course made them ideal candidates to provide the physical therapy guidance and perspective for the 2010 offering.

The grading rubric was still used for overall final project score for the 2010 offering, but the course director determined the final score. Students were provided with the option to formally request that the course director reconsider their final scores if there were areas the group felt were unfairly scored, but none of the group during the semester made this request.

Among the original goals for the course redesign was the incorporation of different audiences into the communication practice elements. Concern was expressed that limiting the audience to only the patient would significantly diminish the learning experience. Despite this change, students enrolled in the 2010 offering stated that they considered the course to be an interprofessional experience; they felt they were learning with, from, and about other professions through this course. An interprofessional aspect was never a formal consideration of this course redesign, but in retrospect, feedback from students made it apparent that they do receive information about pharmacy and the pharmacist's role on the health-care team, as well as some experience considering the referring physician role, although these individuals are fictional and simulated.

Implications: feasibility, effectiveness, professional identity development

Collaborative learning and whole-task educational design was implemented in an online pharmacotherapy course delivered to doctoral-level physical therapy students. The main competency objective for students in this course was to be able to identify patient and pharmacologic situations that required adjustments to the physical therapy strategies they were implementing in care settings and communicate the recommendations to three levels of audience: patient, referring physician, and fellow physical therapy colleagues.

Feasibility

This redesign of a distance education pharmacotherapy course is a feasible educational strategy. Although the first offering of this strategy had grant support allowing for PhD physical therapy student assistance, the subsequent offerings were successfully implemented without this instructional support. Through the use of third-year physical therapy students providing more advanced peer review of student work in the Google Sites pages on a volunteer basis, in conjunction with the pharmacist course director review, a cost-effective way of incorporating a physical therapy validation of the application of pharmacotherapy concepts was implemented; learning technologies allowed this easy access and quick turnaround for advanced peer feedback. The Web-based collaborative tools also allowed for longitudinal learning with more advanced students revisiting the application of this content from the role of expert peer. From the perspective of course director workload, this was also a feasible option. Teaching through the use of online resources and Web-based collaborative tools required significant up-front development time, but update and revision of the learning materials and Google Sites structure have required only minimal instructor attention prior to each subsequent offering. The Web-based collaborative tools allowed the course director to interact with the students in a time-sensitive and frequent manner, but in a manageable way.

Effectiveness

This redesign of a completely online course was also effective at accomplishing the primary learning goals. Students demonstrated in the final projects that they were able to recognize and address medication-related issues specific to physical therapy strategies. Student collaboration was evident in the history tabs and through the student reflections. A majority of students reported that this redesign provided a difficult, but meaningful, educational experience, and one that stretched their physical therapy knowledge and required them to apply it to an authentic physical therapy context, rather than simply memorizing mechanisms of action. Leveraging learning technologies allowed for the collaborative environment, which allowed students to learn from each other as well, from the peer review of other patient scenarios in addition to working within their individual groups, further expanding the learning possible.

Professional identity development

Students were required to assume the role of the physical therapist through this educational experience and communicate to various audiences through that voice, rather than the voice of a physical therapy student taking a pharmacy course.

Through the use of digital collaborative writing, students also developed professional identities and competencies as they practiced "ways of acting, ways of representing, and ways of being" (Fairclough, 2004, p. 228). Students stated overwhelmingly that they, for the first time in their curriculum, had to address the patient as a whole person, not a system requiring attention, and with the authority of a practicing physical therapist. Students reported that this was a powerful identity shift and they were happy to have been able to do it in a collaborative way, noting that individually they would have been overwhelmed and this course provided an opportunity to practice this assumed role in a safe, simulated, and supported environment.

Traditional classroom pedagogical strategies and assessment methods, such as lecture-based resources and multiple-choice exams administered face-to-face or online, have been used over the past five years to demonstrate mastery of the content of this course. Students successfully completed the course by achieving passing scores on the exams, which focused on pharmacology mechanism. However, these pedagogical and assessment tools were not authentic learning or assessment strategies, as students in this professional role will not administer medication, nor in most cases, provide pharmacotherapy recommendations. Because physical therapists generally spend an extended period of time with patients, they play an integral role in encouraging patient adherence, recognizing adverse events, adjusting physical therapy regimens to accommodate drug therapy and patient specific characteristics, as well as providing a communication bridge between the patient, referring physician, and fellow physical therapists. Therefore, instead of assessing students' abilities to memorize pharmacology information, assessment of physical therapy students' abilities to effectively *communicate* evidence-based strategies that incorporate pharmacotherapy concepts with the patient, attending physician, and physical therapist audiences serves as a much stronger educational tool, mirroring future practice. Physical therapy students must not only practice identifying issues and making the appropriate clinical judgments, but also communicating these ideas and supportive reasoning. Without effective communication and collaboration skills and the ability to adjust messages to various audiences, quality health care is not delivered.

Limitations

Although this course redesign has successfully created a learning experience that allowed students to apply pharmacotherapy content to a specific practice experience, how overall physical therapy competency was impacted is currently unknown, nor is there evidence that students approached subsequent courses in new ways. As in previous face-to-face and traditional educational approaches, students adequately achieved the learning outcomes of the course, but the role successfully meeting educational goals played in creating more clinically competent and adaptable practitioners remains unknown. Proactively building extensions from this experimental approach to evaluate the overall impact of integrating content and application after the three implementations of this redesign was a missed opportunity, but the redesign strategy needed to be tested before connections to performance outcomes could be measured.

Future research

Evaluating the impact of this course strategy and use of learning technologies beyond the individual course is an area of current research exploration. Specifically,

ways of threading additional pharmacotherapy application opportunities throughout the physical therapy curriculum and measuring clinical performance while at practice sites is currently underway; the impact of using authentic application opportunities early and throughout the curriculum on practice performance, something that is of interest to educators in all areas of focus, is being measured.

The grading rubric used in this course proved to have too much subjectivity, resulting in poor inter-rater reliability. Despite the lack of consistency between potential graders, the rubric has continued to be used by the course director as the sole final project grader. Developing a grading rubric with a high inter-rater reliability would allow grading to be shared among others, minimizing the grading workload associated with this course.

Conclusion

Evaluation of the process of collaboratively creating hypertext documents for multiple audiences, as well as the end product of a hypertext document as a demonstration of content mastery, served to further develop this tool for future offerings and other courses offered using a distance education format. In this example, learning technologies allowed a more learner-centered educational strategy and authentic means to acquire content knowledge and assess student mastery. Application and evaluation of these Web-based collaborative tools contributed to evidence-based writing strategies implemented in the classroom as a means for students to demonstrate mastery of content and effective communication skills, imperative to the health-care profession. The findings demonstrate that the implementation of collaborative digital writing with a hypertext document case scenario assessment as the primary assessment tool in this online pharmacotherapy course delivered to doctoral-level physical therapy students is a feasible and effective educational strategy. The description of this course redesign process, grounded in educational theory and guided by instructional design principles, can hopefully aid educators who wish to use learning technologies to create distance education environments and experiences that are meaningful and authentic.

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References

Alverman, D. E., O'Brien, D. G., & Dillon, D. R. (1996). Conversations: On writing qualitative research. *Reading Research Quarterly, 31*, 114–120. Retrieved from http://www.jstor.org/stable/748242?origin=JSTOR-pdf

Amhag, L., & Jakobsson, A. (2009). Collaborative learning as a collective competence when students use the potential of meaning in asynchronous dialogues. *Computers & Education, 52*, 656–667. doi: 10.1016/j.compedu.2008.11.012

Baartman, L. K. J., Bastiaens, T. J., Kirschner, P. A., & van der Vleuten, C. P. M. (2007). Evaluating assessment quality in competence-based education: A qualitative comparison of two frameworks. *Educational Research Review, 2*, 114–129. doi: 10.1016/j.edurev.2007.06.001

Bean, J. C. (2001). *Engaging ideas: The professor's guide to integrating writing, critical thinking, and active learning in the classroom*. San Francisco, CA: Jossey-Bass.

Berninger, V. W., & Winn, W. D. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 96–114). New York, NY: Guildford Press.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Cole, M. (2009). Using wiki technology to support student engagement: Lessons from the trenches. *Computers & Education, 52*, 141–146. doi: 10.1016/j.compedu.2008.07.003

Collins, D. (2003). Pretesting survey instruments: An overview of cognitive methods. *Quality of Life Research, 12*, 229–238. doi: 10.1023/A:1023254226592

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: Sage.

Creswell, J. W. (2010). Mapping the developing landscape of mixed methods research. In A. Tashakkori & C. B. Teddlie (Eds.), *Handbook of mixed methods in social & behavior research* (pp. 45–68). Thousand Oaks, CA: Sage.

Dillman, D. A., Tortora, R. D., & Bowker, D. (1998). *Principles for constructing web surveys* (SESRC Technical Report). Pullman: Washington State University. Retrieved from http://www.websm.org/uploadi/editor/Dillman_1998_Principles_for%20Constructing.pdf

Doering, A., & Veletsianos, G. (2008). What lies beyond effectiveness and efficiency? Adventure learning design *Internet and Higher Education, 11*, 137–144. doi: 10.1016/j.iheduc.2008.07.004

Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 170–198). New York, NY: Macmillan Library Reference.

Fairclough, N. (2004). Semiotic aspects of social transformation and learning. In R. Rogers (Ed.), *An introduction to critical discourse analysis in education* (pp. 225–235). Mahwah, NJ: Lawrence Erlbaum Associates.

Gaddis, S. E. (1998). How to design online surveys. *Training and Development, 52*(6), 67–71. Retrieved from http://www.astd.org/TD/

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York, NY: Palgrave.

Gee, J. P. (2005). *An introduction to discourse analysis theory and method* (2nd ed.). New York, NY: Routledge.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine.

Hull, D. M., & Saxon, T. F. (2009). Negotiation of meaning and co-construction of knowledge: An experimental analysis of asynchronous online instruction. *Computers & Education, 52*, 624–639. doi: 10.1016/j.compedu.2008.11.005

Jonassen, D. H. (2000). *Computers as mindtools for schools: Engaging critical thinking* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Keller, J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development, 10*(3), 2–10. Retrieved from http://www.jstor.org/stable/30221294?origin=JSTOR-pdf

Keller, J. M. (2008). First principles of motivation to learn and e[3]-learning. *Distance Education, 29*, 175–185. doi: 10.1080/01587910802154970

Kramarae, C. (2007). Gender matters in online learning. In M.G. Moore (Ed.), *Handbook of distance education* (pp. 169–180). Mahwah, NJ: Lawrence Erlbaum.

Krueger, R. A., & Casey, M.A. (2009). *Focus groups: A practical guide for applied research* (4th ed.). Thousand Oaks, CA: Sage.

Landow, G. P. (2006). *Hypertext 3.0: Critical theory and new media in an era of globalization*. Baltimore, MD: Johns Hopkins University Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York, NY: Cambridge University Press.

Lewis, C., & Ketter, J. (2004). Learning as social interaction: Interdiscursivity in a teacher and researcher study group. In R. Rogers (Ed.), *An introduction to critical discourse analysis in education* (pp. 117–146). Mahwah, NJ: Lawrence Erlbaum.

Lund, A. (2008). Wikis: A collective approach to language production. *ReCALL, 20*, 35–54. doi: 10.1017/S0958344008000414

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development, 50*(3), 43–59. doi: 10.1007/BF02505024

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

Paulus, T. M. (2005). Collaborative and cooperative approaches to online group work: The impact of task type. *Distance Education, 26*, 111–125. doi: 10.1080/0158791050008 1343

Paulus, T. M. (2006). Challenge or connect? Dialogue in online learning environments *Journal of Computing in Higher Education, 18*, 3–29. doi: 10.1007/BF03032722

Rourke, L., & Kanuka, H. (2009). Learning in communities of inquiry: A review of the literature. *Journal of Distance Education, 23*(1), 19–48. Retrieved from http://www.jofde.ca/index.php/jde/index

Sosnoski, J. (1999). Hyper-readers and their reading engines. In G. Hawisher & C. Selfe (Eds.), *Passions, pedagogies and 21st century technologies* (pp. 161–177). Logan: Utah State University Press.

Steiner, W. A., Ryser, L., Huber, E., Uebelhart, E., Aeschlimann, A., & Stucki, G. (2002, November). Use of the ICF model as a clinical problem-solving tool in physical therapy and rehabilitation medicine. *Physical Therapy, 82*, 1098–1107. Retrieved from http://www.ptjournal.org/

Tennyson, R. D., & Breuer, K. (2002). Improving problem solving and creativity through use of complex-dynamic simulations. *Computers in Human Behavior, 18*, 650–668. Retrieved from http://elsevier.com/locate/comphumbeh

Trentin, G. (2009). Using a wiki to evaluate individual contribution to a collaborative learning project. *Journal of Computer Assisted Learning, 25*, 43–55. doi: 10.1111/j.1365-2729.2008.00276.x

van Merriënboer, J. J. G. (2007). Alternate models of instructional design: Holistic design approaches and complex learning. In R.A. Reiser & J.V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (pp. 72–81). Upper Saddle River, NJ: Pearson Education.

Wang, Q. (2008). A generic model for guiding the integration of ICT into teaching and learning. *Innovations in Education and Teaching International, 45*, 411–419. doi: 10.1080/14703290802377307

Weedon, C. (1997). *Feminist practice and poststructuralist theory* (2nd ed.). Oxford: Blackwell.