MULTIMODAL AND ADAPTIVE LEARNING MANAGEMENT: AN ITERATIVE DESIGN

By

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ABSTRACT

The purpose of this study is to measure the outcome of a comprehensive learning management system implemented at a Spinal Cord Injury (SCI) hospital in the Southeast United States. Specifically this SCI hospital has been experiencing an evident volume of patients returning seeking more information about the nature of their injuries. Recognizing the need to disseminate SCI information, the hospital seeks to overhaul the current patient and family education program and to incorporate a blended learning model. The researchers investigation seeks to identify and bridge a gap between patient access to health related learning content and vital learning materials related to spine and neck injuries. The preliminary findings suggest that the e-learning and software development community can benefit from implementing a multimodal learning management system, and adaptive online learning content database, as pervious international spinal cord injury studies have also successfully demonstrated.

Keywords: Adaptive Learning, Anywhere Anytime Learning, e-learning, Just-In-Time-Learning, Learning Management Systems.

INTRODUCTION

Agile learning is defined in a varieties of ways within the field of development and instructional design community and can take on several meanings: "There seems to be quite a confusion between 'agile planning of instruction' (as one may find on commercial e-learning web sites), introducing 'agile design methodology in the project-oriented and/or reflective classroom, and finally introducing 'agile thinking' in a given population" (Agile learning, n.d.). The agile design method proposed in this paper is based on an iterative development cycle, and direct medical practitioner feedback. That is each element of the patient learning is completed in a process sequence. By condensing each SCI learning module into a practitioner defined section, SCI patients begin accessing detailed online learning content as soon as patients arrive at the hospital. Applying an agile methodology to development, each iterative cycle consists of a problem analysis phase, followed by the development of a single feature of the final product (Kats, 2013).

Once a feature is successful after feedback is collected, and alpha testing, more module features are developed using the same LMS framework to upload and host the SCI e-Learning modules. This design framework based on the analysis of Chhabra, et al. details the implementation of 7 e-Learning modules within an LMS hosted by the Education Committee of The International Spinal Cord Society (Chhabra et. al., 2013). This study illustrates how an international multi-disciplinary research team effectively implemented a SCI and patient e-Learning procedure. The team was able to achieve an effective product by merging instructional design principals with clinician practice based models and then hosting the content in an accessible online format (Chhabra, et. al., 2013). Furthermore, access to SCI content will be made obtainable from personal computers, mobile devices, and on-site computers at the hospital (Pimmer et al., 2013).

Multimodal technology integration, especially mobile and other assistive technologies, promote learning by doing with an emphasis on interactive learning experiences (Aldrich, 2005). Based on multimodal communication adaptive learning on assistive devices is utilized in a multitude of targeted domains: For example, cloud-based computing is essential for a variety of assistive devices.

Cloud-based systems facilitate distance-based learning, where learners do not need to be in a physical location and can upload instruction or uplink to pertinent content instantaneously (Goh & Hooper, 2007). Adaptive learning design incorporates multiple strategies to provide real-time feedback about individual and group learners, and personalized learning content recommendations based on users knowledge-levels (Goh & Hooper, 2007). Further, data analytic integration in Adaptive Learning and Assessment Systems (ALAS), to gain empirical analysis of learner performance, perception and achievement, illustrates that learners can seamlessly move between the standard desktop computer-style electronic learning models, and m-Learning systems without significantly affecting learning outcomes (Nedungadi, 2012).

Need for the Study

Developing multimodal access to learning content can allow medical practitioners to monitor both individual and group performances irrespective of the end-learning environment used to gain insightful analysis from scaled-data collections (Zaki & Meira, 2014). Functionality as a learning instrument supports facilitating a rapid transferability of feedback, knowledge, and adaptive content through a learner-based environment, especially when the overall tools available to the learner are restricted due to debilitating injury.

Just-In-Time-Learning Methodology

The Just-In-Time-Learning (JITL) in the context of this study, means content access for SCI patients anytime, anywhere and on any user enabled device with the ability to display Hypertext Markup Language (HTML). This also means functionality, and ease of use features: For example, adding a single sign on feature that integrates common Social Media software development add-ons with a one time patient login. The multimodal design for the learning management system and online patient portal are constructed based on a JITL and a flipped classroom-learning model in order for patients to namely practice on their own, then at a later time attend classes to participate in practitioner facilitated cognitive engagement (Chih-Yuan, Martinez, & Seli, 2014; Pamfilie, Onete, Maiorescu, & Pleşea, 2012).

Further, the flipped classroom learning theories have been targeted specifically to increase patient accomplishments, and learning objectives through autonomous access as similar studies have shown (Daetwyler, Cohen, Gracely, & Novack, 2010). When the patient leaves the hospital, continued login access is granted, enabling custom content to be updated to the patient's online learning profile associated with a unique patient identifier and the online access portal.

Anywhere Anytime Learning

The Learning Management System (LMS) development cycle followed an agile iterative design approach to build a customized e-Learning and learning management content system. Patient knowledge gap related to their injury will arguably be lower based on the customized learning content system, the blended learning classroom environment, and the available SCI content database; (Daetwyler, Cohen, Gracely, & Novack, 2010; Lukassen, Pedersen, Nielsen, Wahl, & Sorensen, 2014). Patients that enter the hospital will be able to view customized and bespoke learning programs guided by their nurse practitioner's direction. The patients will be more aware of their medical situation, and demonstrate improved student engagement in their required training at the hospital's face-to-face classroom sessions (Gilboy, Heinerichs, & Pazzaglia, 2014). Patients that can access content in an any time-anywhere setting can also access Just-In-Time Learning content when they need assistive instructions and guidance the most (Stefanut, Marginean, & Gorgan, 2010). This framework informs practice, as well as supports the identification of new dimensions for anywhere-anytime learning. When patients leave the hospital, they will have access to an adaptive learning system that will provide rapid access to medical content related specifically to the collected data analytics of their learning management system profile.

Just-In-Time-Learning Objectives

An adaptive platform facilitates patient and practitioner access to vital information regarding spine and neck injuries at a moment's notice. Utilizing the learning management system patients are able to study and progress through targeted and succinct learning modules

during their stay at the Hospital, and follow up testing both online, and in face-to-face classrooms before they leave. In alignment with previous studies at major SCI medical hospitals, the implementation of a 'Just-In-Time' learning and user management system, with a mobile ready application platform, can benefit patients by providing critical knowledge instantly online (Drazdilova, Obadi, Slaninova, Al-Dubaee, Martinovic, & Snasel, 2010; Kahn, Santos, Thao, Rock, Nagy, & Ehlers, 2007; Pimmer, Mateescu, Zahn, & Genewein, 2013).

Research Questions

1) To what extent is an online learning management system, programmed to deliver personalized information related to patients' specific injuries, an effective and useful tool for a patient's continuous SCI education?
2) Does a targeted LMS help to reduce the overall gap between a patient's access to content and their comprehension of vital learning content related to their injuries in the patient and family education program?
3) By providing patients with information adaptively, through their mobile devices and personal computers, will the patient be more or less informed about the nature of their injuries, in not only their large group classroom at the hospital, but also when they leave the hospital?
4) After randomized trial implementation, what percentage of patients have follow-up questions related to the online SCI learning management system and personalized learning content?

Research Design

Participants

Spine and neck injury patients; Medical research team, and healthcare practitioners.

Context

SCI Hospital for spine, neck, and brain injury.

Data Tools

Customized learning management system using Sharable Content Object Reference Model (SCORM) packages. The LMS records user activity and completion rates. This information is recorded in the e-Learning course management database, and any activity is quantified, and the LMS resources are used as source information.

Discussion

Through operating a handheld mobile device, patient's act as avatar participants in each module to earn points within the LMS before their face-to-face class by answering SCI questions related to specific spinal cord injury data. Allowing patients to reiterate and replay learning modules with new content, identifies executive skills directed at improving patient content knowledge and goal-direction (Kaufman, 2010, p. 46).

At Stage 1

The first stage of the lesson involves opening the application, logging in to the LMS and clicking on the module. The patient can then select from categories and sections containing more in-depth question and answer content.

At Stage 2

The second stage is to take a baseline calculation of potential differences in working memory or attention. Once the assignment is calculated after clicking on a module and answering questions concerning their level of knowledge, each patient/learner is assigned specific content based on their nurse practitioner's feedback and their online assignments.

At Stage 3

The third stage is accessing the specialized online content. This stage is a mastery stage where the leaners interact with the modules, quiz questions, and interactive simulations until they achieve a passing grade and can follow up with their content knowledge in the flipped classroom environment. Since working memory and attention vary from learner to learner, this stage is for learners, primary care providers and family members, to have access to individual patient content related to their specific injuries and what steps they can take after they leave the hospital to help themselves, and how their lives are impacted by their SCI and what steps can be taken to help increase awareness of and how their daily habits and routines may

be impacted by these new changes.

Learners login to their custom patient portal, and then select the assigned instructional content. Ideally, the patient will rehearse the content attempting to earn points within the LMS system: "Elaborative Rehearsal helps learners build mental models because it promotes integration of new content with existing knowledge" (Clark, 2008, p. 206). In the process, the patient/learner's success and calculated interactions with the online content can be displayed in the Learning Management System, and viewed by the practitioner facilitating the role of instructor in the flipped classroom environment.

By offering relevant visuals to the content learners build mental models of the abstract process described in the questions (Clark, 2008, p. 175). The next option opens detailed graphics, that can help learners build accurate mental models through dual encoding, once the answer choice is selected and the user receives feedback; however, if they did not receive full points they can retake the assignment, or reset the answers to test their knowledge again multiple times.

Learners are debriefed that, continuously practicing before class is important and by repeating the content they can hypothetically increase their performance testing in class as they are familiar with the novel content. Further, the ability to login and access training and content is also important after they leave the hospital, and the learner can login with a personal device at a later time to rehearse content. In addition, the skill can be modified to transfer to other online lessons and related SCI lessons when SCI content is interchanged with alternative questions and answers related to the specific individuals' injuries and when supplemented in class with additional rehearsal and preparation.

Feedback is provided after every module and the questions answer section explains in detail what the patient got wrong, correct, and why. The patients can then retake the modules. Based on the learners baseline rating, if their cogitative deficits make it too difficult to process the module in favor of a one-on-one session with a nurse practitioner. In this case, the online content is referred to their family member or primary care provider for after they leave the hospital. Including the family and care providers is a step that is taken if the content maybe too much for them to process while at the hospital and therefore training and content related to their injuries can be accessed after they leave the hospital and learning programs can be setup and practiced at a later date.

Limitations

There are limitations in presenting graphical information with complex image and of large size, and increased challenges to interactivity without a mouse and a keyboard, as well as small screen size (Ting, 2012). Perhaps using a personal computer, or using a larger tablet with wider screen size can address some of these limitations. Further limitations exist when selecting the right method to display learning content, such as using wearable or haptic devices versus personal computers and mobile friendly devices. The limitation of skill development is that it requires the user to go back over their content multiple times, and assumes there will be engagement with the material – at least enough to complete the assignment before they attend the face-to-face meeting with a nurse practitioner. Issues also exist with the knowledge gap using the technology, when selecting the right device to display the learning content, such using wearable displays, personal computers, tablets and mobile devices depending on the nature of the injury. Arguably, using a larger screen / personal computer, or using a larger tablet with wider screen size can address some of these user display limitations.

Conclusion

The research reviewed in this study was applied in an iterative design cycle allowing for learning to be developed adaptively to the patients needs. This design style allowed for feedback to be applied rapidly, and without causing gaps in the projects completion. By returning to a model of analyzing the fundamental learning gaps presented by the in-classroom instructors, then designing a framework based on the analysis for development, we were able to implement the learning modules successfully. Based on the initial qualitative data, the multimodal design approach to utilize effective learning strategies using a LMS deployment medium was

fruitful. This assertion is founded on the iterative design cycle, that not only addressed timely learning issues related to patients' injuries, it also allowed for a greater degree of adjustment, and rapid implementation from direct practitioner and patient feedback into learning modules and subsequently the hosting LMS.

Recommendations

Further longitudinal data collection is recommended by the research team to measure the effectiveness and applicability of the research questions being sought. Due to the rapid implementation of the LMS and adaptive modules collecting long-term patient feedback, data, and follow up questions would help to illustrate the potential assistances of a learning management system, with a mobile ready application platform, that can assist SCI patients by providing critical knowledge instantly online in a Just-In-Time Learning environment.

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