Project Title: Using eye-tracking technology to teach nursing students surveillance skills to reduce medical error

Project Category: Scholarship of Teaching and Learning Grants

Principal Investigator: Elizabeth A. Henneman RN,PhD
Assistant Professor
School of Nursing
715 N. Pleasant Street
henneman@nursing.umass.edu

Participants: Donald Fisher PhD
Professor
160 Governors Drive
Vze29yxh@verizon/net

Karen Plotkin RN, PhD
Assistant Clinical Professor
School of Nursing
715 N. Pleasant Street
plotkin@nursing.umass.edu

Joan Roche RN, PhD
Assistant Clinical Professor
School of Nursing
715 N. Pleasant Street
jproche@nursing.umass.edu

Helene Cunningham RS, MS
Assistant Clinical Professor
School of Nursing
715 N. Pleasant Street
helene@nursing.umass.edu

Cheryl A. Reilly RN, PhD
Assistant Professor
School of Nursing
715 N. Pleasant Street
careilly@nursing.umass.edu

Campuses and Disciplines: Amherst
Nursing and Engineering

Funds requested: $5000.00

Project Summary: Eye tracking devices are playing an increasing pedagogical role in classrooms across the University of Massachusetts campuses. Here at Amherst, these include courses in the College of Engineering and Schools of Management and Public Health. The first goal of this particular project is to demonstrate the usefulness of this innovative instructional technology, i.e., an eye-tracking device, to improve nursing students' learning and enhance their

academic experience. Previous studies suggest that ongoing surveillance of the environment is used by nurses to recovery medical error. Surveillance is defined as the “purposeful and ongoing acquisition, interpretation, and synthesis of patient data for clinical decision-making. Effective surveillance demands that the nurse selectively attend to patient and environmental factors in an appropriate sequence, double checking on some of them. If surveillance is effective, the nurse will pick up early problems or potential problems. If not, the nurse may miss something, for example, that the patient is receiving the wrong intravenous solution or developing and abnormal heart rhythm. This would be considered an error.
The purpose of this educational program will be to evaluate the effectiveness of an eye-tacking device to teach nursing students to use selective attention processes (surveillance) to identify medical errors related to patient identification and patient monitoring. Our long term goal is to improve patient safety. Although the focus of this proposal is on teaching safe healthcare practices, we seek to describe and evaluate an educational technology that is useful in other, diverse settings (e.g., art, forestry, management, computer science, and engineering).

Signature of Dean: _____

Signature of Campus Provost: _____

PROJECT NARRATIVE

Goals of the Project: Scholarship of Teaching and Learning Grant

Eye tracking devices are playing an increasing pedagogical role in classrooms across the University of Massachusetts campuses. Here at Amherst, these include courses in the College of Engineering and Schools of Management and Public Health. The first goal of this particular project is to demonstrate the usefulness of this innovative instructional technology, i.e., an eye-tracking device, to improve nursing students' learning and enhance their academic experience. Much of what nursing students' need to learn requires them to engage in behaviors which have been difficult to monitor effectively. These behaviors include surveillance of the patient, other health care professionals and various pieces of equipment. Eye trackers allow such monitoring. Dramatic improvements in surveillance strategies in related areas have been found when eye tracking devices were used to provide feedback to the individuals attempting to learn such strategies. (Romoser et al, 2005). Those same improvements are expected here. The second, related goal is to provide general guidelines for instructors wishing to use eye trackers in their classroom to enhance learning. Ongoing surveillance in the clinical environment is an essential process used by nurses to recover medical error. Effective surveillance skills assist nursing students in the identification, interruption, and correction of medical errors which ultimately improves patient safety. The specific aim of this project involves a comparative study that will test the usefulness of an innovative technology, an eye-tracking device, to teach and evaluate nursing students' surveillance skills using patient simulators.

Background/Significance

The landmark Institute of Medicine (IOM) report indicated that as many as 98,000 people die in hospitals each year as a result of preventable medical errors (IOM, 1999). As a result of this report, congress appropriated $50 million to the Agency for Healthcare Research and Quality (AHRQ) to support a variety of efforts to reduce medical errors. Efforts include the development and testing of new technologies to reduce medical errors as well as the funding of researchers to develop, demonstrate and evaluate new approaches to improving provider education in order to reduce errors (IOM, 1999).

The nurse's role in the identification, interruption and correction of error, a term called recovery, is now being recognized as integral to patient safety. (Henneman and Gawlinski 2004; Henneman et al, 2006; Rothschild, 2005; Rothschild et al., 2006) The use of an eye-tracking device offers a unique opportunity to teach student nurses effective methods to use surveillance to identify medical errors.

Selective attention processes/ surveillance

Previous studies suggest that ongoing surveillance of the environment is used by nurses to recovery medical error. (Henneman et al.,2006). Surveillance is defined as the "purposeful and ongoing acquisition, interpretation, and synthesis of patient data for clinical decision-making" (McCloskey et al., 2003). Effective surveillance demands that the nurse selectively attend to patient and environmental factors in an appropriate sequence, double checking on some of them. If surveillance is effective, the nurse will pick up early problems or potential problems. If not, the nurse may miss something, for example, that the patient is receiving the wrong intravenous solution or developing and abnormal heart rhythm. This would be considered an error.

Understanding selective attention processes in detail is important because it can provide insight into the sources of errors and the ways in which one can remediate those errors. As a start, it is necessary to identify the optimal scanning pattern and decisions to be made at each point information is acquired. Identifying the optimal pattern and decision usually requires modeling the selective attention processes mathematically. Much is known about how to

optimize sequential decision making and we can draw upon this literature. The difficult problem comes in identifying the actual network of latent cognitive processes that is governing the decision of the nurses. In order to remediate any errors, one needs to know how to develop optimal models for the surveillance process, compare the optimal models with the models that nurses are actually using, and then train the nurses to attend better to the environment under high and low load conditions and/or redesign the process.

Despite the important role that surveillance plays in patient care, there is little empiric evidence supporting how nurses perform this function. In addition, there is no data available to explain effective surveillance patterns or to teach nurses how to perform effective surveillance. Some processes used in surveillance are directly observable, e.g., whether the nurse looks at the name of the patient on the armband. Other states however are not directly observable and need to be inferred from the observed behaviors, e.g., whether the nurse has actually read the name of the patient.

When the steps of interest are not all observable, eye movements can be used to measure the scanning behavior of the operator in order better to infer the likelihood that the operator is in a particular state at a particular point in time (Reichle et al., 1998). The investigators have extensive experience with the use of eye trackers to identify the latent cognitive processes and associated states that are unfolding in real time (61,62). Not only have they used eye trackers to study behaviors such as reading which are relatively static (Reichle et al., 1998), but they have used eye trackers to study the eye movements of drivers, both in a driving simulator (Pradham et al., 2005.) and in actual on road conditions (Fisher, Pollatsek and Pradhan, in press).

Once the scanning behavior has been measured, the latent network governing operators' performance has been inferred, and the optimal pattern has been identified, the optimal and observed patterns can be compared. The determination can then be made of whether the operators are optimal and, if not, what can be done to improve the situation.

Purpose

The purpose of this educational program will be to evaluate the effectiveness of an eye-tacking device to teach nursing students to use selective attention processes (surveillance) to identify medical errors related to patient identification and patient monitoring. Our long term goal is to improve patient safety. Although the focus of this proposal is on teaching safe healthcare practices, we seek to describe and evaluate an educational technology that is generalizable to other diverse settings (e.g., art, forestry, management, computer science, and engineering). For example, eye-tracking has been used in collaboration research in management to identify what artifacts people use to help them create shared situation awareness (personal communication, Dr. Sara McCoomb, Feb 19, 2007).

Methods

The instructional technology being evaluated in this project is the use of an eye-tracking device. Our project is designed to use the technology to assist students in performing effective surveillance which we believe will result in an increased ability to recognize potential errors related to patient identification and assessment.

Students will be randomly assigned to control and experimental groups and will participate in pre-intervention, intervention, and post-intervention simulation experiences. (a) Pre-intervention. Students in the experimental and control groups will use the eye-tracking device during the baseline (pre intervention period) to perform various surveillance activities,. The simulation/eye-tracking experience will utilize a variety of previously developed structured simulation scenarios. The simulations take a long time to create if administered for the first time. However, we will use existing simulations created by the project team and will modify them as needed. (See Appendix for examples of existing simulations) Each simulation will have built-in errors related to patient identification and monitoring (e.g., lack of an allergy wristband). We

expect no difference in their surveillance patterns during the pre-intervention assessment given the random assignment. (b) In the intervention period, the experimental group will watch a recording of what they looked at in the simulation scenarios. Specific failures of surveillance will be identified. They will be given a similar set of simulation scenarios a second time, their eye movements recorded, and feedback administered. In the intervention period, the control group will be taught again the patterns of surveillance which are optimal. However, they will not receive feedback specific to areas which they did and did not attend. They too will then be given a similar set of simulations scenarios a second time and, at the end, read the surveillance guidelines once more. (c) In the post-intervention period, the students in the experimental and control groups will be assessed one final time, both wearing the eye tracker. No feedback will be given. It is our hypothesis that students in the experimental group (eye-tracking) will identify significantly more errors ($P<.05$) during post-intervention phase than the control group.

How this project will support the goals of this grant category

The proposed project promotes academic development and is congruent with the objectives of the strategic initiative grant by advancing the use of existing technology to create an interactive student-focused, earning environment. The project encourages students to reflect on their performance and allows them an active role in the learning process.

PROJECT DELIVERABLE

The primary project deliverable is a "best practice" toolkit for implementing eye-tracking technology with nursing students to use in the simulated clinical setting. This toolkit will include: device specifications, sample simulation scenarios and evaluation tools. In addition we will write a publishable paper describing the effectiveness of the eye-tracking device in assisting nursing students to identify medical error and potentially decreasing errors in the clinical setting.

DISSEMINATION OF PROJECT RESULTS

Results of this project will be reported in both nursing and interdisciplinary forums at the local, regional and national level. We would expect to present at the 5 campus School of Nursing meetings, Nursing Research conferences (such as Sigma Theta Tau). We would also expect to present at one or more of the UMass IT forums. In addition, we would submit our findings for presentation at regional and national nursing and educational conferences (e.g., American Association of Nurses) and publish our findings in a peer-reviewed nursing journal such as Nurse Educator.

PROJECT BUDGET

RA (Nursing) support of @ 20/hour		100 hours	$2000.00
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Stipend for student participants (volunteers) @ 10/hr		80 hours	$800.00
Paper supplies/videotapes/ink cartridges			$200.00
		Total:	$5000.00

PROJECT TIMETABLE

March 2007- June 2007	Hire and train graduate students
July 2007- January 2008	Intervention/data collection

Jan 2008- March 2009	Data analyses
April 2008-June 2008	Dissemination of findings/Final Report

Principal Investigator, Participants, Qualifications

Elizabeth A. Henneman- (Principal Investigator) is an Assistant Professor of Nursing at the University of Massachusetts and a staff nurse in the Medical-Surgical ICU at Baystate Medical Center. Dr. Henneman is a nationally recognized expert in patient safety, medical simulation, critical care nursing, family-centered critical care, and nurse-physician collaboration. She is currently a Co-PI on a National Science Foundation Grant evaluating the safety of medical processes.

Donald L. Fisher- (Co-Investigator) is a Professor of Mechanical and Industrial Engineering at the University of Massachusetts at Amherst and Director of the Human Performance Laboratory.

Karen Plotkin- (Co-Investigator) is a Clinical Assistant Professor at the University of Massachusetts at Amherst.

Joan P Roche- (Co-Investigator) is a Clinical Assistant Professor of Nursing at the University of Massachusetts and a Clinical Nurse Specialist at Baystate Medical Center.

Helene Cunningham (Co-Investigator)- is a Clinical Assistant Professor of Nursing and Director of the Nursing Clinical Simulation Laboratory at the University of Massachusetts at Amherst. She also consults at Baystate Medical Center Simulation Laboratory.

Cheryl Reilly (Co-Investigator)- is an Assistant Professor in the School of Nursing at the University of Massachusetts at Amherst.

LETTERS OF SUPPORT ATTACHED

APPENDIX (See attached)

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