Online versus Face-to-Face: Development, Refinement, Implementation, and Evaluation of an Online Intravenous Pump Emulator, Including Outcomes for Clinical Practice for Nursing Students

Doctor of Philosophy

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Abstract

Preparing undergraduate nursing students for the nursing profession via distance education has created the challenge of finding innovative ways to teach clinical skills online. As intravenous (IV) pump devices are commonly used in clinical settings, gaining competence in their use is of particular importance for nursing students. The purpose of the present research was to develop, refine, implement and evaluate an online IV pump emulator (IVPE) modelled on the actual IV pumps used in on-campus nursing laboratories, with the specific aim of evaluating student’s learning outcomes along with their perceptions of device use. Using a quasi-experimental design method including a longitudinal element, the implementation and evaluation was undertaken among undergraduate nursing students using the online IVPE, an actual IV pump, or a combination of the two. In Stage 1, a prototype online IVPE was developed and evaluated using Remote Access Laboratory (RAL) technology. In Stage 2, the prototype online IVPE underwent preliminary evaluation by first year undergraduate nursing students (n = 20) to assess its functionality, perceptions of use, and equivalence in learning outcomes compared to nursing students using an actual IV pump. In Stage 3, a more comprehensive mixed-methods evaluation was conducted with refined methods and an improved version of the online IVPE. A larger sample of first year undergraduate nursing students (n = 179) was divided into online only, on-campus only and online + on-campus user groups. In the final stage, retention of competency in actual IV pump use was evaluated among a sub-sample of Stage 3 participants (n = 102) as they progressed into the next year of their program. No significant differences in learning outcomes were found between the online only and on-campus only groups, thus demonstrating equivalency of the online technology with the traditional face-to-face training with an actual IV pump in
a simulated laboratory. Significantly better learning outcomes were evident among the combined group, who trained with both forms of the IV pump, compared to the online only and on-campus only groups. At the 26-week follow-up testing period, the combined group showed superior learning outcomes on some activities and completed the activities on the actual IV pump faster than the other two groups. A high percentage of participants, regardless of group, reported feeling confident using the actual IV pump. In summary, the online IVPE was shown to produce equivalent learning outcomes to traditional training methods, and superior learning outcomes when used in conjunction with face-to-face training; thereby contributing to more competent nurses responsible for the preparation and administration of IV infusions. Recommendations on the viability of including the IVPE as an online resource in undergraduate nursing programs locally and internationally are provided.
Certification of Dissertation

I certify that the ideas, experimental work, results, analyses, software, and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

__________________________  ____________________________
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ENDORSEMENT

__________________________  ____________________________
Associate Professor Clint Moloney  Date

__________________________  ____________________________
Dr Leslie Bowtell  Date
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Dedication

My husband, Peter
and
My son, Finn

Love always,
Dr Pump
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<th>Description</th>
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<tbody>
<tr>
<td>AAT</td>
<td>Assessment Activity Tool</td>
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<tr>
<td>ACSQHC</td>
<td>Australian Commission on Safety and Quality in Health Care</td>
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<tr>
<td>CPR</td>
<td>Cardio-Pulmonary Resuscitation</td>
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<tr>
<td>ECG</td>
<td>Electrocardiogram</td>
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<td>HWA</td>
<td>Health Workforce Australia</td>
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<td>HMI</td>
<td>Human-Machine Interface</td>
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<td>IM</td>
<td>Intramuscular</td>
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<td>IV</td>
<td>Intravenous</td>
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<td>IVPE</td>
<td>Intravenous Pump Emulator</td>
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<tr>
<td>LMS</td>
<td>Learning Management System</td>
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<td>NQC</td>
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<td>NMBA</td>
<td>Nursing and Midwifery Board of Australia</td>
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<tr>
<td>ONL</td>
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<td>ONC</td>
<td>On-campus participants</td>
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<td>ONL + ONC</td>
<td>Online and On-campus participants</td>
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<td>OSCE</td>
<td>Objective Structured Clinical Assessment</td>
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<td>PLC</td>
<td>Programmable Logic Controller</td>
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<td>RAAT</td>
<td>Revised Activity Assessment Tool</td>
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<td>RAL</td>
<td>Remote Access Laboratory</td>
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<td>RN</td>
<td>Registered Nurse</td>
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<td>SCADA</td>
<td>Supervisory Control and Data Acquisition</td>
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<td>SDT</td>
<td>Self-Determination Theory</td>
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