

Utilizing the Intervention Mapping Protocol to Improve the E-learning Self-efficacy of Operating Room Nurses

Article by Paul John G. Aventurado
Ph.D., Cebu Doctors' University, College of Nursing
E-mail: pjaventurado0521@gmail.com

Abstract

This study developed an intervention to improve the e-learning self-efficacy of operating room nurses utilizing the Intervention Mapping Protocol (IMP). The 6-step process of IMP which includes (1) Logic Model of the Problem, (2) Logic Model of Change, (3) Intervention Design, (4) Intervention Production, (5) Implementation Plan and (6) Evaluation Plan was followed which resulted to a self-administered, computer-based intervention, which embedded theory-based strategies into a learning management system for implementation. The effect of the intervention was determined through a quasi-experimental, one group pretest-posttest design involving 31 operating room nurses of Cebu Doctors' University Hospital. E-learning self-efficacy was measured using the Modified E-learning Readiness Assessment Tool (MERAT). The median score for e-learning self-efficacy among the participants of the study during pretest was 66, with scores ranging from 43 to 78. The e-learning self-efficacy median score increased to 72, with scores ranging from 53 to 80, during the posttest. Data were statistically treated using Wilcoxon Signed-ranks test. The difference between the pretest and posttest scores was found to be significant with $p < 0.05$ at 95% level of confidence ($z = -3.103$, $p = 0.002$). A medium effect size ($r = 0.56$) was reflected in the analysis. This study highlighted the potential of IMP as a systematic framework to develop evidence-based interventions in the field of nursing.

Keywords: *Intervention Mapping Protocol, e-learning, nursing informatics, operating room.*

Introduction

A human resource crisis in health is now globally recognized by stakeholders as we face issues of nursing shortage and high turnover all over the world (Littlejohn, Campbell, Collins-McNeil, & Khayile, 2012). This translates into a salient problem in the operating room where new nurses fill the knowledge and skills void created by experienced nurses migrating out of the country. The current fast-tracked orientation and training programs may not prepare the nurses for the operating room where highly specialized and technical skills are required to provide quality care. E-learning could address this concern due to its potential to relay the highly procedural nature of surgery, with additional benefits of accessibility, flexibility, and low cost (Maertens et al., 2016). To achieve its full potential and prevent failure of e-learning initiatives, however, we must ensure that nurses are ready to engage with the new modality (Demir & Yurdugul, 2015). An intervention was developed by the proponent of this study to enhance the e-learning self-efficacy of operating room nurses through the Intervention Mapping Protocol (IMP). The IMP framework was first published in 2016 and is now widely adopted in behavior modification and intervention studies. To date, the IMP was mostly employed for lifestyle-related behaviors such as weight management and treatment regimen compliance. This paper demonstrates the utilization of the IMP in developing a computer-based intervention to improve the e-learning self-efficacy of operating room nurses. This practical and theory-based framework presents great potential to the nursing profession as an additional tool to develop and promote evidence-based practice in the field.

Methods

An intervention was developed to enhance the e-learning self-efficacy of operating room (OR) nurses utilizing the Intervention Mapping Protocol (IMP). The IMP imposes a 6-step process which includes the following: (1) Logic Model of the Problem, (2) Logic Model of Change, (3) Intervention

Design, (4) Intervention Production, (5) Implementation Plan and (6) Evaluation Plan. This process starts with problem identification and ends with the development of theory and evidence-based solution.

A quasi-experimental, one group pretest-posttest design was employed to determine the effect of the intervention to e-learning self-efficacy. It was administered to 31 OR nurses of Cebu Doctors' University Hospital. Only nurses with active personal email accounts were recruited as this is necessary for the intervention protocol. Those who refused to participate and with pending resignation during the dates of data collection were not included.

The Modified E-learning Readiness Assessment Tool (MERAT) adapted from Doculan (2016) was used to measure e-learning self-efficacy. The MERAT is a 16-item questionnaire that assesses for self-efficacy in using the computer, internet and learning management system. It uses a 5-point Likert scale with options presented as 1 (not at all), 2 (very least extent), 3 (little extent), 4 (great extent) and 5 (very great extent) representing the respondent's confidence to perform an activity. Score range is 16 to 80. It obtained a Cronbach's alpha of 0.737 as administered to students of the Ifugao State University, Philippines.

The author complied with institutional guidelines in the conduct of the study. Transmittal letters were submitted and approved as required. The study was subjected to review by Cebu Doctors' University Institutional Ethics Review Committee and was approved for implementation.

The researcher met the participants during the pretest to obtain their baseline e-learning self-efficacy. A computer-based intervention that sends self-administered instructions to the participants by email throughout the course of 7 days was created using the IMP. An intervention algorithm was made to ensure treatment fidelity. Posttest was administered after the intervention.

Data analysis

The scores of the participants based on the Modified E-learning Readiness Assessment Tool (MERAT) during the pretest and posttest were tabulated and processed for statistical analysis. Wilcoxon Signed-ranks test was used to determine for significant difference in the e-learning self-efficacy in the pretest and posttest scores. Kolmogorov-Smirnov test *S* revealed that the score differences were not normally distributed ($D=0.194$, $p=0.005$). Data were processed using the statistical software IBM SPSS version 22.

Results

Developing the intervention using intervention mapping protocol (IMP)

Step 1: Logic model of the problem

Needs assessment was conducted for this phase through interviews among the stakeholders and literature review. Operating room nurses verbalized a need to supplement their fast-paced preceptor-based training with additional skills enhancement and continuing education to provide quality care at the OR setting. Kadivar, Seyedfatemi, Zolfaghari, Mehran, and Hossinzade (2016) contended in their paper that nurses have high client loads and rotational shifts which make traditional education impractical; using e-learning may decrease learning time by 30 to 35%. However, the self-efficacy of nurses to handle e-learning materials may not be fully realized due to lack of standardized competencies, inconsistency in the integration of Nursing Informatics into the curricula and lack of nursing experts in the field (Staggers, Gassert, & Curran, 2001).

Step 2: Logic model of change

In this step, the determinants of e-learning self-efficacy were matched to appropriate performance outcomes. Alqurashi (2016) dissected the determinants as computer utilization, internet and information seeking, and learning management system self-efficacy. The behavioral changes expected to result from the intervention were then aligned to each determinant. This process resulted to a 2x3 matrix of change objectives.

Step 3: Intervention design

The determinants previously identified were mapped to theory-based behavior change techniques (BCTs). Heath, Cooke, and Cameron (2015) called this as a translational process of aligning theoretical constructs to specific strategies to elicit change. The BCTs employed for this study were Guided Practice (facilitated rehearsal and repetition of behavior), Enactive Mastery (incremental difficulty of task), Provision of Contingent Reward (giving encouragement relative to accomplishment), Goal Setting (planning of behavior), and Setting Graded Tasks (giving indicators of capability). Theories on self-efficacy suggest that these strategies may help achieve the performance objectives identified in step 2.

Step 4: Intervention production

The behavior changes strategies (BCTs) identified in the previous step was converted into intervention mechanics. This was done by intertwining the performance objectives to the BCTs identified in the previous steps. A self-administered intervention was conceived through this process with the following mechanics aligned to the selected BCTs: Self-directed Instructions and Feedback, Objective-based Tasks, Tiered Instructions, Compliance Evaluation, and Tailored Messaging System. Studies further showed that self-administered interventions, though simple, were sufficient enough to achieve desired outcomes (Black & Cameron, 1997).

Step 5: Implementation plan

The mechanics of the intervention conceptualized in the previous step were operationalized for implementation. These mechanics were blended into the Edmodo Learning Management System software and were delivered to the recipients through the e-learning platform. The Intervention Mapping Protocol (IMP) led to the inception of this computer-based, self-administered intervention deployed in a 7-day period with 3 phases: (1) Initiation, (2) Compliance and Feedback, and (3) Termination. An email message with self-instruction was delivered in the Initiation phase. A series of evaluation and feedback regarding the compliance of the instructions commenced up to the 7th day from initiation, and termination was done through an email informing the recipients that the intervention has ended. The status of the participants was tracked throughout the intervention by using a preformatted sheet.

Step 6: Evaluation plan

The Modified E-learning Readiness Assessment Tool (MERAT) was used to evaluate the effect of the intervention to the nurses' e-learning self-efficacy as it is aligned to the identified determinants, was developed within the context of the Philippine setting and has reliable psychometric properties.

Effect of the intervention

The study determined the effect of the intervention developed through IMP to e-learning self-efficacy of operating room nurses. Scores were obtained during the pretest and posttest and processed using statistical software.

Table 1. Pretest and Posttest E-learning Self-efficacy (N=31)

Score	Median	z-value	p-value	Effect	Interpretation
Pretest	66	-3.103	0.002	-0.56	Significant
Posttest	72				

The operating room nurses involved in the study obtained the median scores of 66 and 72 for the pretest and posttest respectively. The difference between the pretest and posttest scores was found to be significant with $p < 0.05$ at 95% level of confidence ($z = -3.303$, $p = 0.002$). A medium effect ($r = 0.56$) was reflected in this analysis.

Discussion

The Intervention Mapping Protocol (IMP) served as the framework for intervention development in this study. It is a response of the scientific community to the ongoing need for a systematic framework to develop interventions and programs. Its potential for this purpose was tested by the proponent of this study as an intervention was developed to enhance the e-learning self-efficacy of operating room nurses. The IMP imposes a linear and cumulative 6-step process involving problem identification, gradually incorporating theory-based strategies and culminating to an evidence-based solution. The process includes (1) Logic Model of the Problem, (2) Logic Model of Change, (3) Intervention Design, (4) Intervention Production, (5) Implementation Plan, and (6) Evaluation Plan. (Bartholomew et al., 2016).

Each step of the IMP involves different tasks to design and develop the intervention. Needs assessment and validation were conducted for the Logic Model of the Problem. Determinants and outcomes were determined for the Logic Model of Change. Five Behavioral Change Techniques (BCTs) were incorporated during the Intervention Design including Guided Practice, Enactive Mastery, Contingent Rewards, Goal Setting, and Graded Tasks. The intervention mechanics were refined during the Intervention Production. The delivery of the intervention was finalized during the Implementation Plan, which involves the 3 deployment phases of Initiation, Compliance and Feedback, and Termination, using the Edmodo e-learning platform. The product of these steps led to the development of a self-administered computer-based intervention that embedded theory-based strategies in a learning management system. Evaluation Plan involved using the Modified E-learning Readiness Assessment Tool (MERAT) to determine the change in e-learning self-efficacy after the intervention.

The difference between the pretest and posttest scores was found to be significant with $p < 0.05$. This implied that the intervention produced an effect on the e-learning self-efficacy, with an increase in scores from pretest to posttest reflected among the participants.

The result may be attributed to the intricate weaving of theories into the intervention through IMP. Theories are used to predict outcomes, determine the course of a phenomenon, or in this case, determine viable strategies to enhance e-learning self-efficacy. Several interventions have been developed through the use of theories especially in modifying behaviors. There is a current understanding that a reciprocal relationship exists between theories and interventions: interventions refine theories and theories make interventions more effective. Some scholars even consider strategies based on theories as the "active ingredients" of interventions (Heath et al., 2015). As such, these theory-based interventions were expected to produce larger and more sustained effects in behavior change.

Surprisingly, studies showed that the effects of incorporating theory on interventions vary in effect, and even less effective at some point. Prestwich, Webb, and Conner (2015) attributed this to (1) ineffective incorporation of theories, (2) multiple theories used or by the (3) confounding effect towards the population group under study. The proponent of this study noted however that these concerns were addressed in using IMP. The process strongly incorporated theories into the intervention by aligning the BCTs to the identified constructs. Appropriate strategies were selected and merged into the final intervention. Prestwich et al. (2015) further suggested for transparent reporting of the theoretical constructs targeted by each BCT which was achieved by the matrices produced during each step of IMP. There were concerns relayed by literature that the use of multiple theories may reduce effect size, render the intervention atheoretical or become totally irrelevant to the outcome (Prestwich et al., 2015). The use of IMP, however, addressed this limitation as the BCTs were consolidated to target a single construct, e-learning self-efficacy. Confounds create limitations when doing an intervention study. Strict methodological control may mitigate the effects of confounds (Prestwich et al., 2015). The intervention protocol was developed prior to implementation and was not subjected to any modification along the course of the study. Treatment fidelity was ensured through the compliance phase where intervention compliance was evaluated through specific checkpoints. The inclusion of all eligible participants of the selected hospital also minimized selection bias, but there were factors however beyond the control of the researcher such as potential participants who were on leave ($n=6$) during the data collection period.

Conclusion

The potential of the Intervention Mapping Protocol (IMP) as a tool to develop an evidence-based intervention in nursing was depicted in this study. The 6-step process allowed the design and development of a computer-based intervention, intertwining theory-based strategies to improve the e-learning self-efficacy of operating room nurses. The IMP framework has sustained its reputation as a simple, practical and evidence-based framework for behavior-change interventions and projects.

References

- [1]. Alqurashi, E. (2016). Self-Efficacy in online learning environments: A literature review. *Contemporary Issues in Education Research*, 9(1), 45-52. doi: 10.19030/cier.v9i1.9549.
- [2]. Arimbuyutan, R. C., Kim, S., Song, J., & So, W. (2007). A study on e-learning for Philippines. *International Journal of Multimedia and Ubiquitous Engineering*, 2(4), 49-54. Retrieved October 15, 2018, from https://www.researchgate.net/publication/229052306_A_Study_on_e-Learning_for_Philippines.
- [3]. Bahrambeygi, F., Shojaeizadeh, D., Sadeghi, R., Nasiri, S., & Ghazanchaei, E. (2018). The effectiveness of an e-Learning program on nurse's knowledge and behavior for caring of patients with thromboembolism: A comparative study. *Journal of Nursing and Healthcare Management*, 1(1), 1-7. doi: 10.18875/2639-7293.1.105.
- [4]. Bernal, A. B. S., Tolentino, P. A. P., Gavino, A. I., Fontelo, P., & Marcelo, A. B. (2008). Nursing informatics: Challenges to Philippine nursing curriculum. *AMIA ... Annual Symposium proceedings / AMIA Symposium*. AMIA Symposium 876. Retrieved October 15, 2018, from https://www.researchgate.net/publication/23463446_Nursing_informatics_challenges_to_Philippine_nursing_curriculum.
- [5]. Black, D. R., & Cameron, R. (1997). Self-administered interventions: A health education strategy for improving population health. *Health Education Research: Theory & Practice*, 12(4), 531-545. Retrieved March 9, 2019, from <https://www.ncbi.nlm.nih.gov/pubmed/10176375>.
- [6]. Demir, Ö., & Yurdugül, H. (2015). The exploration of models regarding e-learning readiness: Reference model suggestions. *International Journal of Progressive Education*, 11(1), 173-194. Retrieved October 15, 2018, from https://www.researchgate.net/publication/271646243_The_Exploration_of_Models_Regarding_E-learning_Readiness_Reference_Model_Suggestions.
- [7]. Doculan, J. A. (2016). E-Learning readiness assessment tool for Philippine higher education institutions. *International Journal on Integrating Technology in Education*, 5(2), 33-43. doi: 10.5121/ijite.2016.5203.
- [8]. Ekici, D. I. (2017). The use of Edmodo in creating an online learning community of practice for learning to teach science. *Malaysian Online Journal of Educational Sciences*, 5(2), 91-106. Retrieved March 9, 2019, from <https://files.eric.ed.gov/fulltext/EJ1142512.pdf>.
- [9]. Fung, K. Y. (2016). *Utilizing TIGER competencies to improve informatics practice* [Doctoral dissertation]. Retrieved October 15, 2018, from <https://repository.usfca.edu/dnp/76>.
- [10]. Heath, G., Cooke, R., & Cameron, E. (2015). A theory-based approach for developing interventions to change patient behaviours: A medication adherence example from paediatric secondary care. *Healthcare*, 3(4), 1228-1242. doi: 10.3390/healthcare3041228.
- [11]. Intervention mapping. (n.d.). Retrieved October 15, 2018, from <https://interventionmapping.com/>
- [12]. Kadivar, M., Seyedfatemi, N., Zolfaghari, M., Mehran, A., & Hossinzade, Z. (2016). The impact of virtual-based education on nurses' self-efficacy in the level II neonatal care. *Critical Care Nursing*, 9(4), 1-7. doi: 10.17795/ccn-9281.
- [13]. Kok, G., Gottlieb, N. H., Peters, G. J. Y., Mullen, P. D., Parcel, G. S., Ruiters, R. A. C., ... Bartholomew, L. K. (2015). A taxonomy of behaviour change methods; an intervention mapping approach. *Health Psychology Review*, 10(3), 297-312. doi: 10.1080/17437199.2015.1077155.
- [14]. Learning management system (LMS) guide. (2014). Retrieved October 10, 2018, from <https://www.k12blueprint.com/sites/default/files/Learning-Management-System-Guide.pdf>.
- [15]. Littlejohn, L., Campbell, J., Collins-McNeil, J., & Thembisile, K. (2012). Nursing shortage: A comparative analysis. *International Journal of Nursing*, 1(1), 22-27. Retrieved October 15, 2018, from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.300.9995&rep=rep1&type=pdf>.
- [16]. Maertens, H., Madani, A., Landry, T., Vermassen, F., Van Herzeele, I., & Aggarwal, R. (2016). Systematic review of e-learning for surgical training. *The British Journal of Surgery*, 103, 1428-1437. doi: 10.1002/bjs.10236.

- [17]. Momanyi, N. D., & Kaimenyi, C. K. (2015). An investigation into factors causing high nurse turnover in mission hospitals in Kenya: A case for Pcea Chogoria Hospital. *International Journal of Academic Research in Business and Social Sciences*, 5(3), 55-86. doi: 10.6007/IJARBSS/v5-i3/1499.
- [18]. Neal, J. (2013). Innovation in education: Using elearning to improve the quality of education for practice nurses. *Practice Nurse*, 40-43. Retrieved March 9, 2019, from <https://www.educationforhealth.org/wp-content/uploads/2015/03/PN-Promo-v3.pdf>.
- [19]. Prestwich, A., Webb, T. L., & Conner, M. (2015). Using theory to develop and test interventions to promote changes in health behaviour: Evidence, issues, and recommendations. *Current Opinion in Psychology*, 5, 1-5. doi.org/10.1016/j.copsyc.2015.02.011.
- [20]. Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *The Turkish Online Journal of Educational Technology*, 5(2), 14-23. Retrieved March 15, 2019, from https://www.researchgate.net/publication/284675572_Detailed_review_of_Rogers'_diffusion_of_innovations_theory_and_educational_technology-related_studies_based_on_Rogers'_theory.
- [21]. Smeekens, A. E. F. N., Broekhuijsen-van Henten, D. M., Sittig, J. S., Russel, I. M. B., Cate, O. T. J., & Turner, N. M., & van de Putte, E. M. (2011). Successful e-learning programme on the detection of child abuse in Emergency Departments: A randomised controlled trial. *Archives of Disease in Childhood*, 6(4), 330-334. doi: 10.1136/adc.2010.190801.
- [22]. Staggers, N., Gassert, C. A., & Curran, C. (2001). Informatics competencies for nurses at four levels of practice. *Journal of Nursing Education*, 40(7), 303-316. Retrieved October 15, 2018, from <http://tigercompetencies.pbworks.com/f/Informaticscompetenciesfourlevelsofpractice.pdf>.
- [23]. Stinson, J., Wilson, R., Gill, N., Yamada, J., & Holt, J. (2009). A systematic review of internet-based self-management interventions for youth with health conditions. *Journal of Pediatric Psychology*, 34(5), 495-510. doi.org/10.1093/jpepsy/jsn115.
- [24]. Sumabat, K. R. (2010). History of nursing informatics in the Philippines. Retrieved March 9, 2019, from https://www.google.com.ph/search?q=history+of+nursing+informatics+in+the+philippines+sumabat&rlz=1C1CHBD_enPH789PH789&oq=history+of+nursing+informatics+in+the+philippines+sumabat&aqs=chrome..69i57j0j4&sourceid=chrome&ie=UTF-8.
- [25]. Taipjutorus, W., Hansen, S., & Brown, M. (2012). Improving learners' self-efficacy in a learner-controlled online learning environment: A correlational study. In M. Brown, M. Hartnett, & T. Stewart (Eds.), *Proceedings of ASCILITE - Australian Society for Computers in Learning in Tertiary Education Annual Conference* (907-911). Retrieved March 9, 2019, from <https://www.learntechlib.org/p/42705/>.
- [26]. Tiered instruction. (2015). Retrieved October 15, 2018, from http://www.ssgt.nsw.edu.au/documents/5_tiered_instruct.pdf.
- [27]. Verbestel, V., De Henauw, S., Maes, L., Haerens, L., Marild, S., Eiben, G., . . . De Bourdeaudhuij, I. (2011). Using the intervention mapping protocol to develop a community-based intervention for the prevention of childhood obesity in a multi-centre European project: The IDEFICS intervention. *International Journal of Behavioral Nutrition and Physical Activity*, 8(82), 1-15. Retrieved October 15, 2018, from <https://ijbnpa.biomedcentral.com/articles/10.1186/1479-5868-8-82>.