

A Comparison of Motivation Between Registered Nurses Participating in  
Gamified and Non-Gamified Learning Modules

by

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## Abstract

**Aim:** The purpose of this study was to answer two main questions: First, does the utilization of gamification in online continued education modules motivate Registered Nurses (RNs)? And second, is the Instructional Materials Motivational Survey (IMMS) a valid tool to assess motivation in the RN population?

**Background:** In Alberta, RNs require participation in yearly educational activities to adhere to continuing competence program requirements and to maintain licensure. Alberta's regulatory nursing body offers several online learning modules that RNs may complete as a component of their continuing competence program. Of these modules, three were developed using a voice over, didactic instructional strategy, whereas the remaining two were gamified. In recent years, gamification has been heralded as an innovative instructional strategy that has the ability to positively impact learner motivation, knowledge recall, and satisfaction. However, these relationships remain largely unexplored in the practicing RN population.

**Methods:** Using a two-group, post-intervention design, participants were recruited via convenience sampling to complete the IMMS following their completion of an online module. Two hundred and thirty-one Alberta RNs from a variety of practice backgrounds participated. Data analysis included the use of descriptive and inferential statistics, and Principal Components Analysis (PCA).

**Results:** This work resulted in three manuscripts: 1) The first manuscript is an integrative review that examines gamification in nursing literature using Whittemore and Knafli's framework. 2) The second manuscript is an overview of survey methodology and threats that have arisen due to digital technological advancement. 3) The third manuscript is the main research study that explores the relationship between gamification and RN motivation, and IMMS validation among the RN population.

**Conclusion:** First, gamification is an increasingly popular instructional strategy for consideration in nursing literature. Several areas arose from the thematic analysis including construct conceptualization,

motivation, the application of gaming elements, the role of technology, and others. Most importantly, construct conceptualization emerged as a significant finding and due to its interwoven influence on the other thematic findings, it was recommended as a priority area of focus for nurse researchers, as a lack of construct conceptualization is consequential. Next, the utilization of survey methodology requires skill, effort, and appropriate consideration; surveys should not be dismissed as an easily used methodology due to their pervasive use in society. The nursing population is not exempt from the threats created by the digital technological evolution, and this manuscript provides a broad overview for nurse researchers considering survey methodology use. Last, the main study determined that there was no noted difference in motivation between RNs completing a gamified versus non-gamified module, and while the components of attention and relevance were supported by the PCA, the constructs of confidence and satisfaction were not. Unfortunately, the lack of difference in motivation between the two groups and the partial validation of the IMMS could be attributed to the limitations of the study. However, these findings still contributed to the foundation of nursing knowledge regarding the understudied area of gamification and the IMMS in a post-graduate nursing population, and also provided an impetus for future exploration of the relationships between gamification, motivation, continued education opportunities, and potential influence on patient outcomes. Future study should build upon the limitations noted, such as the use of a comparative and randomized research design; this is necessary to better understand the relationship between gamification and motivation of RNs, as well as further IMMS validation among an RN population.

## Preface

This thesis is the original work of Upinder Sarker. Ethics approval to conduct this study was obtained from the University of Alberta Research Ethics Board, Project Name “Instructional Strategies and Continued Competency Learning Modules”, No. Pro00081714, July 25, 2018.

Chapter 2 of this dissertation has been published as “Sarker, U., Kanuka, H., Norris, C., Raymond, C., Yonge, O., & Davidson, S. (2021). Gamification in nursing literature: An integrative review. *International Journal of Nursing Education Scholarship, 18*(1)”. As primary author, I was responsible for the literature search, review of articles, extraction of the main themes, writing of the main article, and integrating all feedback from co-authors and editorial reviewers. Norris, C., Yonge, O., and Davidson, S. provided feedback regarding thematic analysis. All co-authors reviewed manuscript drafts and provided feedback. The publisher holds the copyright of this article and this article cannot be published in a repository until after one year from the date of publication.

Chapter 3 of this dissertation has been published as “Sarker, U., Davidson, S.J., Yonge, O., Raymond, C., Kanuka, H., & Norris, C. (2020). Staying ahead of the digital technological curve using survey methods. *Quality Advancement of Nursing Education (QANE), 6*(3)”. I was responsible for the conceptualization and drafting of the manuscript, and responded to feedback from both the editorial reviewers and co-authors. All co-authors reviewed multiple drafts of the manuscript and provided substantive feedback. QANE allows authors to retain copyright of their articles.

Chapter 4 of this dissertation has been submitted to the *Journal of Continued Education for Nurses* and is currently under review as “Sarker, U., Yonge, O., Davidson, S., & Norris, C. Gamification in continued education modules and the instructional materials motivational survey”. I was responsible for study conceptualization and design, data collection and analysis, and writing of the manuscript. Yonge, O. and Davidson, S. provided detailed feedback and reviewed the manuscript drafts. Norris, C. reviewed

the data analysis with great insight and provided critical feedback when reviewing manuscript drafts.

The copyright notice is not available, as this manuscript has not yet been reviewed.

## Dedication

*“Let us step into the night and pursue that flighty temptress, adventure.” – Albus Dumbledore*

Foremost, this work is dedicated to Karnail Singh Bhullar (my *Bapuji* – grandfather), my late father – Gurmukh Singh Bhangu, to Swarnjit Kaur (my mother), and to my husband, Sanjay Sarker. From the fields of Punjab, India, a farmer all his life, my loving, caring, kind, and sarcastic *Bapuji* – I hope you are forever happy and at peace. Dad, you weren’t one for many words, but I will always remember the green highlighter. Mom, I love you so much – your actions always speak louder than words. Sanjay, thank you for being so dedicated to playing hockey so I could concentrate on my studies all these years (haha). I hope I have made you all proud.

This work is also dedicated to the rest of my family and friends, near and far, who have supported me during every moment of this journey. Foremost, thank you to my family – my in-laws, my sister, my cousins, my aunts, and my brother. Thank you for encouraging me, for cooking me meals when I was mired deep in reading and writing, and for helping me to maintain a modicum of sanity during the hectic times. Since embarking upon this quest six years ago, I could not have imagined that I would have achieved all that I have. Thank you for picking me up and for prodding me along to not give up.

To all of my friends, words cannot express how grateful I am to you – for your words of advice and encouragement, for guiding me, for proofreading, for being so understanding for all the times I couldn’t spend with you because of this work, but most importantly, thank you for the debriefs, get-togethers, and laughs. I promise to make it up to you in the coming years. Last, thank you to my friend Jasmine for your kindness, empathy, understanding, and hours of listening - Let’s go start that rock band.

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First, I must acknowledge my supervisors, Dr. Colleen Norris and Dr. Sandra Davidson, for their compassion, patience, and kindness these past six years. Thank you for all of your encouragement and for guiding me when I was confused or scared to take the next step. I am forever grateful that the energies of the universe allowed our paths to cross, so that I had the opportunity to learn from you both. Thank you for pushing me when needed and providing kindness when I was down. I could not have been successful on this journey without you. You have both taught me more than you know about what it means to be a good leader and mentor, and I hope that I may one day pay it forward.

I would also like to acknowledge Dr. Olive Yonge, Dr. Heather Kanuka, and, Dr. Christy Raymond. Dr. Yonge, thank you so much for your gentle, compassionate, and student-centred approach. Your communication style and support for my learning process was always done with such aplomb and grace. I have learned so much from you about mentorship. Dr. Kanuka and Dr. Raymond – thank you so much for allowing me to work with you, for your guidance, and most importantly, for being approachable and patient. Your feedback and your time have been invaluable to my doctoral work, and I would not be where I am today without you both.

Last, I would also like to thank the NorQuest College Professional Development Committee and the Alberta Registered Nursing Education Trust, for supporting me so that I could continue in my studies without financial hindrance. And finally, thank you to the College and Association of Registered Nurses of Alberta for their collaboration and support in completing my study – I am eternally grateful.

## Table of Contents

<b>Abstract .....</b>	<b>ii</b>
<b>Preface.....</b>	<b>iv</b>
<b>Dedication .....</b>	<b>vi</b>
<b>Acknowledgements .....</b>	<b>vii</b>
<b>List of Tables.....</b>	<b>x</b>
<b>List of Figures.....</b>	<b>xi</b>
<b>Definitions &amp; Abbreviations.....</b>	<b>xii</b>
<b>Chapter 1: Introduction .....</b>	<b>1</b>
Cervero’s Framework and the Instructional Materials Motivational Survey .....	3
Guiding Questions.....	4
Assumptions .....	4
Dissertation Papers .....	4
<b>Chapter Two: .....</b>	<b>6</b>
Abstract .....	7
Gamification in Nursing: An Integrative Review .....	8
Background.....	8
Methods .....	9
Problem Identification.....	9
Literature Search.....	10
Data Evaluation.....	11
Data Analysis.....	14
Results .....	15
Construct Conceptualization .....	15
Relationship between Engagement, Satisfaction, and Knowledge Retention .....	16
Knowledge Translation.....	18
Motivation .....	19
Role of Technology.....	21
Gamification Elements .....	22
Discussion .....	23
Limitations .....	27
Conclusion .....	28
References .....	29
<b>Chapter Three: .....</b>	<b>34</b>
Abstract .....	35
Staying Ahead of the Digital Technological Curve Using Survey Methods .....	36
Background.....	37
Discussion .....	38
Trust, Confidentiality, and Privacy .....	39
The Digital Divide .....	42
Satisficing and Survey Fatigue .....	45
Technical and Design Issues .....	47



Contribution to the Quality Advancement of Nursing Education .....	50
Conclusion .....	51
References .....	52
<b>Chapter Four:.....</b>	<b>57</b>
Abstract .....	58
Gamification in Continued Education Modules for Registered Nurses.....	60
Background Information.....	61
Attention, Relevance, Confidence, Satisfaction Model of Motivation.....	62
Continuing Education Modules.....	63
Purpose and Research Questions .....	63
Methods & Study Design .....	64
Participants.....	65
Results .....	65
Demographics .....	65
Group Comparison .....	66
Survey Analysis .....	67
Discussion .....	70
Limitations .....	75
Conclusion .....	75
References .....	76
<b>Chapter 5: Summary and Next Steps .....</b>	<b>80</b>
Discussion, Implications, and Significance to the Nursing Profession .....	80
Next Steps: Future Research.....	83
Limitations .....	84
Conclusion .....	85
<b>Bibliography.....</b>	<b>86</b>
<b>Appendix A: Instructional Materials Motivation Survey (IMMS) .....</b>	<b>98</b>
<b>Appendix B: Modified Instructional Materials Motivation Survey (IMMS) .....</b>	<b>100</b>
<b>Appendix C: Consent Form &amp; Participant Information Letter .....</b>	<b>102</b>
<b>Appendix D: Additional Tables.....</b>	<b>106</b>

**List of Tables**

Table 1: Articles Included in Integrative Review .....11

Table 2: Demographics .....66

Table 3: Rotated Correlation Matrix with Varimax rotation– Gamified dataset .....69

Table 4: Rotated Correlation Matrix with Varimax rotation– Non-Gamified dataset .....70

Table 5: Percentage of Total Variance .....107

Table 6: Eigenvalues .....107

Table 7: Gamified Scree Plot .....108

Table 8: Non-Gamified Scree Plot .....109

**List of Figures**

Figure 1: PRISMA Diagram.....11

### Definitions & Abbreviations

- ARCS – Attention, Relevance, Confidence, Satisfaction (ARCS) Model of Motivation
- Attention – Entails capturing the interest of the learner, stimulating inquiry, and maintaining the learner’s interest (Keller, 1987; Keller, 2010; Keller, 2017)
- Confidence – The expectation that one has for achieving success in relation to a task. It can be influenced by one’s determination, experiences, and achievements to date (Keller, 1987; Keller & Kopp, 1987; Keller, 2010; Keller, 2017)
- Continuing Competence – “...the ongoing ability of a nurse to integrate and apply the knowledge, skills, judgment, and attributes required to practice safely and ethically in a designated role and setting” (Canadian Nurses Association [CNA], 2004, p.1).
- IMMS – The Instructional Materials Motivational Survey (IMMS)
- Motivation – “What people desire, what they choose to do and what they commit to do” (Keller, 2010, p.3). It encompasses the drive and the extent of human behaviour in relation to an individual’s purpose and the magnitude to which they strive to achieve the goal (Keller, 2010)
- RN – Registered Nurse
- Relevance – The elements that learners identify as essential to meeting their needs and goals, and the learning opportunities that align with their learning styles and acknowledge their previous learning experiences (Keller, 1987; Keller, 2010)
- Satisfaction – A feeling based upon one’s accomplishments and achievement of goals through a feedback system of consequence and reinforcement, both intrinsic and extrinsic (Keller, 1987; Keller, 2010; Keller, 2017; Malik, 2014).

## Chapter 1: Introduction

Understanding the essence of desire and reason in human beings has been of fascination to scholars since ancient times. In modern history, the root of advancing achievement has been identified as one aspect of motivation. For example, as an employer, motivating one's employees can lead to higher profit margins and greater productivity; for academics, motivation propels the pursuit and attainment of higher knowledge. For Registered Nurses (RNs), the motivation to learn and to engage in ongoing education enhances knowledge and can positively influence one's practice. However, motivation to learn is not a one dimensional or linear concept – it is contextually bound and dynamic (Keller, 2010). Many have attempted to explicate motivation through a theoretical framework, as evidenced by the existence of numerous theories including those by Houle, Bloom, Deci, Keller, and others (Bloom, 1977; Houle, 1988; Kapp, 2012; Keller, 1987; Knowles, 1973; Reeve et al., 2004).

From undergraduate to post-graduate education, educators are continually challenged to motivate learners by delivering educational material in a manner that is engaging, satisfying, and can positively impact the learners' ability to understand and retain knowledge. This is particularly important in the nursing profession, as competency is related to one's ability to proficiently apply knowledge in the health setting and positively influence or improve patient outcomes (CNA, 2004). If nursing practice and patient outcomes can be impacted by instructional strategies, this warrants a better understanding of instructional strategies that can increase learner motivation and whether some instructional strategies are more adept than others. Educators may now harness the advancements in digital technology and apply strategies to empower the learning process. One such strategy is gamification; gamification can be defined as the application of gaming elements to a non-game setting (Deterding et al., 2011). Gamification proponents advocate for the application of gamification in education due to its successes in other sectors.

However, there remains a gap in current literature regarding the use of gamification in the RN population. Only recently has the nursing profession begun to explore the use of gamification in nursing education (Brull & Finlayson, 2016; Day-Black, et al., 2015; White & Shellenbarger, 2018). Also necessary is a tool to measure the ability of an instructional strategy to motivate learners, particularly RNs. One such tool is the Instructional Materials Motivational Survey (IMMS) (Keller, 1987), which is understudied in the nursing population, obliging further exploration among RNs and for assessing gamification as an instructional strategy. The IMMS is considered an economically prudent means by which educators can assess students' motivational response to instructional strategies and may then adjust their methods accordingly (Malik, 2014). Unfortunately, the widespread use of surveys across society has led to a false perception that surveys are easily deployed; in reality, the development and administration of surveys is an arduous task. The effects of digital technological advancement should be appraised when considering survey methodology to mitigate newly emerged threats and challenges, and when utilizing a survey in a new population, questionnaire validation is recommended. Given the requirement for RNs to participate in continuing education to maintain competence, and the critical role RNs play in the healthcare system, understanding the needs of this population warrants a priority focus.

My research work aims to fill some of these gaps in literature. First, I begin with a review to ascertain the current understanding of gamification in nursing literature. Second, survey methodology is examined to better understand the influence of digital technology. Third, the IMMS was trialed as a method by which to examine the relationship between gamification and RN motivation following completion of an online learning module, as well as survey validation. In doing so, this research will contribute to nursing's body of knowledge related to gamification and the use of the IMMS as a potential tool for use among the post-graduate nursing population.

### **Cervero's Framework and the Instructional Materials Motivational Survey**

The work in this dissertation was guided by the foundational principles found in Cervero's framework. An increasingly critical question which nursing professionals seek to answer is whether continuing competence programs are effective and if patient care outcomes are improved as a result of the knowledge attained via participation in continuing education opportunities. In the 1980s, Ronald Cervero identified a need to better understand how educational strategies used in continuing competence programs impacted behavioural change among professionals and which were most effective (Cervero, 1985; Cervero, 1992). Since then, there has been an amplified interest in better understanding the advantages and disadvantages of these strategies. The proliferation of technology has created an opportunity to use innovative strategies that did not exist in the past. In the nursing profession, this same rapid progression of technology has created a critical need for continued competence programs due to changes in healthcare and care delivery (Cervero, 2000; Cervero, 2001). Unfortunately, traditional forms of continued education have historically presented as didactic, unilateral educational sessions with little application to the actual complexity of the real world (Cervero, 2000). It is only since the beginning of the new millennium that professions have begun to understand the need for diversifying the delivery of education (Cervero, 2000; 2001). This exemplifies the potential role of gamification as an instructional strategy that is championed for its positive impact on learning due to its interactive and immersive abilities.

The IMMS was selected as a tool for this study by which the motivation of RNs participating in gamified and non-gamified online continued education modules could be measured. The IMMS was created by John Keller, the developer of the Attention, Relevance, Confidence, Satisfaction (ARCS) Model of Motivation. While the ARCS model of motivation is its own entity, Cervero's framework assists in grounding this work. The ARCS model and the IMMS are more detailed in Chapter 4 as to how they pertain to this study.

### **Guiding Questions**

To build a foundation for the research work, the following questions were first considered:

- 1) What is known about gamification in nursing literature to date?
- 2) What aspects of survey methodology should one consider prior to implementation?

Once the above subject areas were unpacked, the following primary research questions were explored:

- 1) Is there a difference in motivation among RNs completing a gamified continuing education learning module versus a non-gamified continuing education learning module? If yes, how does gamification impact motivation?
- 2) Is the IMMS a valid tool to measure motivation in the practicing RN population completing continuing competency learning modules with varying instructional strategies?

### **Assumptions**

Several assumptions were made prior to the start of this work. Foremost, it was assumed that the contact list provided would be current and be comprised of only those potential participants who had consented to participate in research opportunities. There was also an assumption that RNs would choose a module based upon its alignment to the competency they had selected for annual licensure, and when participating in the study, RNs would provide honest and truthful responses. Last, it was assumed that most demographics of RNs have some means of access to the Internet, and that the inclusion and exclusion criteria would provide a representative sample.

### **Dissertation Papers**

This dissertation encompasses three papers that seek to answer the questions set forth. The first paper, *Gamification in Nursing: An Integrative Review*, is directed at answering the first foundational question. This manuscript is an integrative review exploring gamification in nursing literature using Whittemore and Knafli's integrative review process. The aim of this paper was to better understand the application of gamification in various nursing populations to date and determine what



aspects require further exploration. From the articles reviewed, six main themes emerged which included construct conceptualization; the relationship between gamification and satisfaction, engagement, and knowledge retention; knowledge translation; motivation; the role of technology; and gamification elements. This paper offered insight into the necessity of construct conceptualization and how the current fluidity of the gamification construct has created uncertainty in relation to many of the other themes identified.

The second paper, *Staying Ahead of the Digital Technological Curve Using Survey Methods*, responds to the second foundational question. This paper provided an overview of survey methods within the context of digital technological advancement for novice researchers and students seeking to gain a foundational understanding of survey methodology. This work reviewed how survey methods have been impacted by the digital technological evolution, as well as a consideration of the traditional threats including nonresponse, sampling, coverage, and measurement error. While these advancements offer both advantages and disadvantages to survey methods, four main areas were discussed including trust, confidentiality, and privacy concerns; the digital divide; satisficing and survey fatigue; and technical and design issues. This paper offered strategies and recommendations for novice researchers and students to help mitigate the issues identified and their subsequent impact on traditional threats.

The third paper, *Gamification in Continued Education Modules and the Instructional Materials Motivational Survey*, aims to answer both primary research questions. This work utilized a post-test, two-group design to assess differences in motivation among RNs completing gamified and non-gamified modules. Participants completed the IMMS following completion of one of five online continued education modules. This work also sought to validate the IMMS among an RN population using Principal Components Analysis (PCA).

## Chapter Two:

### Gamification in Nursing: An Integrative Review

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## Abstract

**Objective:** Gamification is an increasingly popular instructional strategy in nursing. The purpose of this integrative review is to explore gamification as it has been applied in nursing literature. This integrative review seeks to ask the question - What aspects of gamification have been explored in nursing literature and what aspects require further exploration?

**Method:** Whittemore, R., & Knafl, K. (2005). The integrative review: Updated methodology.

*Methodological Issues in Nursing Research*, 52(5), 546–553 integrative review framework guided this review. Seventeen articles were reviewed and a quality appraisal tool (developed by Hawker, S., Payne, S., Kerr, C., Hardey, M., & Powell, J. (2002). Appraising the evidence: Reviewing disparate data systematically. *Qualitative Health Research*, 12(9), 1284–1299) was also used to evaluate the articles.

**Results:** Following the data analysis stage outlined in Whittemore and Knafl's integrative review framework, six themes emerged: construct conceptualization, relationship between engagement, satisfaction, and knowledge retention; knowledge translation, motivation, role of technology, and gamification elements.

**Conclusion:** Gamification is of interest to the nursing profession. More study is needed to better ascertain the relationship between gamification and several of the main themes identified in this review.

## **Gamification in Nursing: An Integrative Review**

Over the past decade, gamification has surged in popularity. As an instructional strategy, gamification is thought to motivate learners by positively impacting the learning process (Dichev & Dicheva, 2017; Kapp, 2012). While the nursing profession was slower than other sectors to adopt gamification, in the past several years, gamification has been increasingly applied in various nursing settings and populations. Hence, the purpose of this integrative review is to explore the use of gamification in nursing literature. This integrative review seeks to ask the question - What aspects of gamification have been explored in nursing literature and what aspects require further exploration?

### **Background**

An innovative instructional strategy, gamification can be tentatively defined as the application of gaming elements to a non-gaming setting, and one that is increasingly being utilized in the educational sector (Deterding et al., 2011; Dichev & Dicheva, 2017). The popularity of gamification extends from its accomplishments in the corporate sector, in which it has demonstrated great success in increasing motivation, changing behaviours, and instituting friendly contest and teamwork across varying settings (Dichev & Dicheva, 2017). It is presumed by gamification proponents that if gaming elements can positively impact other sectors, one can also apply gaming elements to education. Several studies have reported a positive relationship between gamification and areas such as knowledge retention, satisfaction, and motivation (Buckley & Doyle, 2016; Davidson & Candy, 2016; Hung, 2017; Jang et al., 2015). The advent of technology and web-based capabilities have fostered the idea of games across traditionally non-gaming settings, and the use of the Internet and computer technology has simplified the manner and ease in which gamification can be applied (Nacke & Deterding, 2017). While gamification can be employed with other instructional approaches and technologies such virtual reality, simulation, or item response systems, these are separate entities with their own definitions, abilities, and purposes. Due to the vast knowledge and information within these other fields, this review was

restricted to examining gamification as it was identified by researchers within the scope of education for nurses and excluded the aforementioned terms. As the application of gamification in nursing is a recent phenomenon (Brull & Finlayson, 2016; Day-Black et al., 2015; White & Shellenbarger, 2018), the extent to which gamification has been explored in nursing literature requires further investigation, especially for the nursing profession whose participation in foundational and continuing education programs has potential implications for patient care. The ability for gamification to positively effect the learning process (Broer, 2014; Dichev & Dicheva, 2017; Hamari et al., 2014; Looyestyn et al., 2017) and the proliferation of gamification in nursing, necessitates a review to better understand its use to date in the nursing field.

### **Methods**

The integrative review method outlined by Whittemore and Knafl (2005) allows for the inclusion of various types of studies to ascertain the breadth of literature. The diversity of literature included in integrative reviews provides a comprehensive understanding of the knowledge to date and has the potential to apprise future practice (Whittemore & Knafl, 2005; Hopia et al., 2016). Due to the diversity of these articles, the articles were appraised using a quality appraisal tool (Hawker et al., 2002) by which each article was rated on a scale and assigned a numerical score of '4' (good) to '1' (very poor). The scores of the articles ranged from 2.2-4.0. For criteria that were not applicable to some articles (for example, those which did not report any empirical findings), the category was removed from the total score to maintain equity in scoring. While no article was excluded based upon their score, the total score was considered during data analysis. The application of the Whittemore and Knafl (2005) framework is described per stage below.

#### **Problem Identification**

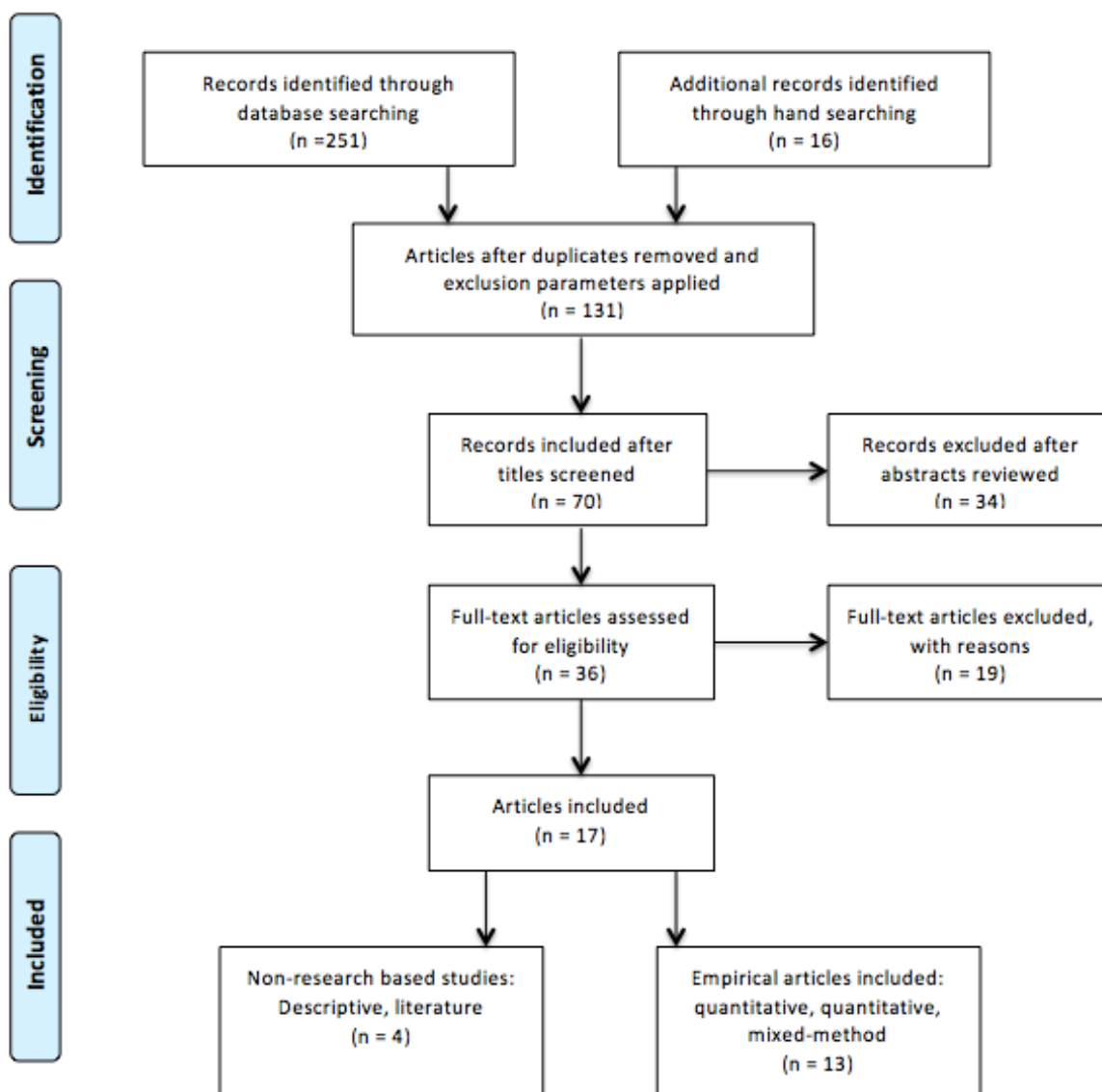
Gamification is purported to have several advantages and has increased in popularity over the past decade. The purpose of this integrative review is to explore gamification in nursing. It seeks to

answer the question: What aspects of gamification have been explored in nursing literature and what aspects require further exploration?

### **Literature Search**

A literature search was completed using the following databases: Cumulative Index of Nursing and Allied Health Literature (CINAHL) Plus with Full Text, Education Research Complete, Education Resource Information Center (ERIC), Academic Search Complete, and MEDLINE. The key terms *gamification* or *game-based learning* were both utilized due to their interchangeable use, and a truncation of *nurse* was then applied to specify results (see Figure 1). The literature search was limited to the English language; full-text, peer-reviewed articles in academic journals, and those published in the last 10 years (2009-2019). The PRISMA diagram in Figure 1 demonstrates how the search was completed. The following exclusion criteria was applied: Gray literature (dissertations, conference proceedings, etc); patient, children, or other non-nursing populations; online student response systems, board games, virtual reality, and simulation. The inclusion criteria required the article to describe an application of gamification to a nursing population. In total, 17 articles were selected and included both empirical and non-research publications.

Figure 1.



## Data Evaluation

The 17 articles meeting the selection criteria comprised of various empirical and theoretical studies, such as quasi-experimental designs using questionnaires, qualitative designs using focus groups and interviews, and also, descriptive articles. General data was then extracted from each article and placed in table format including authors, year of publication, aim, design/methodology, participant type, number of participants, and whether a theoretical framework was identified (see Table 1).

**Table 1***Articles Included in Integrative Review*

<b>Authors</b>	<b>Year</b>	<b>Aim</b>	<b>Design / Methodology</b>	<b>Participants</b>	<b>Number of Participants</b>	<b>Identified or Guiding Framework</b>
Brull & Finlayson	2016	Outlines theory, elements, advantages, and applications for gamification	Descriptive	Nursing educators	-	Self Determination theory
Brull, Finlayson, Kostelec, MacDonald & Krenzischek	2017	Compare effectiveness of 3 teaching methods impact on clinical knowledge	Quasi-experimental, three group pre/post comparison	RNs	115	-
Davidson & Candy	2016	Describe the implementation of a game-based course and impact on student outcomes re: satisfaction, engagement, learning	Questionnaire: Mid-course survey and end-of-course evaluations	Nursing students	30	Mastery pedagogy
Castro & Goncalves	2018	Explore whether gamification impacts development of ICT competencies in nursing and perception of users	Questionnaire and content analysis of narrative comments	Nursing students and professors	15	-
Gallegos, Tesar, Connor, & Martz	2017	To describe learners' experiences with using an online game-based learning platform	Questionnaire using open-ended questions	Nursing students	57	-
Garnett & Button	2018	To determine the relationship between digital badges, motivation, and learner characteristics	Pre/post questionnaire; 3 cohorts of students over 3 years	Nursing students	408, 420, 418 (1246 total)	-
Hopia & Raitio	2016	Explore perceptions of mental health service providers and users towards gamification	Interviews	Mental health service providers and users	42	-



Authors	Year	Aim	Design / Methodology	Participants	Number of Participants	Identified or Guiding Framework
Johnston, Boyle, MacArthur & Manion	2013	Project development to learn how to implement game-based learning and gaming technology in nursing education	Descriptive	Nursing educators and nursing students	-	Cognitive task analysis
Lermeyer & Sadesky	2016	To psychometrically assess a gamified module and explore impact of gamification on engagement and motivation	Questionnaires	RNs	69	Relational practice
Mackavey & Cron	2019	Determine effectiveness of gamified case studies via end-of-program benchmark exam scores	2 group comparison	Advanced nurse practitioner students	522	-
Marques, Gregorio, Penheiro, Pova, da Silva, & Lapao	2016	Explored the use of gamification and automated monitoring systems to assess hand hygiene compliance	Focus group	RNs	4	DSRM, WHO Five Moments of Hand Hygiene framework
O'Neill, Robb, Kennedy, Bhattacharya, Dominici & Murphy	2018	To enhance nursing knowledge, increase engagement via game-based learning, and improve use of technology	Pre/post questionnaires (3 types)	RNs	37	Action oriented learning, behaviour modification
Orwoll, Diane, Henry, Tsang, Chu, Meer, Hartman, & Roy-Burman	2018	To assess if bundling gamification, micro-learning, and digitized best practice impacted engagement	Non-randomized 2 group comparative; self-assessment questionnaires	RNs	105	-
Roche, Wingo, Westfall, Azuero, Dempsey & Willig	2018	Explored the relationship between gamification and engagement; examined student engagement, factors	Two group comparative	Nursing students	133	Adult learning theory

Authors	Year	Aim	Design / Methodology	Participants	Number of Participants	Identified or Guiding Framework
		contributing to attrition, and impact on knowledge retention				
Strickland & Kaylor	2016	To provide a theoretical rationale for gaming in nursing education and how to implement student success game	Descriptive	Nursing students	112	Experiential learning
White & Shellenbarger	2018	Described gamification, relationship to digital badges, and how to implement	Descriptive	Nursing educators	-	-
Wingo, Roche, Baker, Dunn, Jennings, Pair, Somerall, Sommerall, White & Willig	2019	To explore how gaming software affected learner motivation and engagement with material	Focus groups	Nursing and medical students	133	Constructivism/ adult learning theory

### Data Analysis

As each article was reviewed, key findings and main ideas were extracted and categorized by the primary author. Themes were considered based upon identified similarities and relationships, and all authors reviewed this information. Data display tables and text documents were developed to capture and outline the development of the identification of key findings, categorization of main ideas, and development into themes.

## Results

The following themes emerged from the thematic analysis: construct conceptualization, relationship between engagement, satisfaction, and knowledge retention; knowledge translation, motivation, role of technology, and gamification elements.

### Construct Conceptualization

A clear conceptualization of 'gamification' remains murky. This was evidenced by the assortment of terminology used, the variation in description when gamification was defined within the context of a study, and when gamification was described as a singular application of a gaming element such as digital badging (Davidson & Candy, 2016; Hopia & Raitio, 2016; Johnston et al., 2013; Lernermeier & Sadesky, 2016; Orwoll et al., 2018; Roche et al., 2018; Strickland & Kaylor, 2016). For example, other terms included game-based learning, game theory, serious gaming (or serious games), and digital gaming (Davidson & Candy, 2016; Johnston et al., 2013; Orwoll et al., 2018; Roche et al., 2018). The inclusion of serious gaming was a perplexing concept. In one article, serious gaming was defined as games that have been designed mainly for non-recreational purposes, but was simultaneously aligned with game-based interventions; and in another, serious games were placed within the category of digital gaming as well as game-based learning (Hopia & Raitio, 2016; Johnston et al., 2013).

In instances where gamification was described within the context of the study, this included quest-based learning, educational gaming, social gamification, and more (Davidson & Candy, 2016; Orwoll et al., 2018; Strickland & Kaylor, 2016). Depending on the context of the study, 'gamification' was also aligned with various concepts such as motivation, mastery learning, or software application terminology. For example, Davidson and Candy (2016) used 'game-based learning' interchangeably with 'quest-based learning' due to the quest-based nature of the software application used to gamify their course. The role of mastery learning played a significant role in how quest-based learning was

conceptualized, as learners had repetitive opportunities to re-try quests and receive feedback until mastery was achieved. Other examples of contextual conceptualization included: through the philosophy of experiential learning by using the term 'educational gaming'; defining 'social gamification' as the application of gamification in social media to improve engagement and invoke behavioral change; as 'structural gamification', which was described as the application of gaming elements which focus primarily on competition and progression; and last, defined as a 'behavior modification' strategy used to engage learners (O'Neill, 2018; Orwoll et al., 2018; Roche et al., 2018; Strickland & Kaylor, 2016). In each case, the application and definition of gamification was modified as needed.

In some cases, specific gaming elements were selected as a primary means to implement and describe gamification. For example, Foli et al. (2016), Garnett and Button (2018), and White and Shellenbarger (2018) focused primarily on the utilization of digital badges to gamify courses. In addition, Marques et al. (2016) utilized Bluetooth technology to implement a gamified activity to motivate learners. In this case, gaming elements were defined as a 'toolkit' that one could utilize for game design and were based on categories of dynamics, mechanics, and components. The integration of gaming elements was considered a part of the process of game design (Marques et al., 2016). This conceptualization was much more concrete than others.

### **Relationship between Engagement, Satisfaction, and Knowledge Retention**

A key theme was the examination of relationships between gamification and learner engagement, knowledge retention, and satisfaction. While several authors reported positive relationships between gamification and these concepts, including Brull et al. (2017), Davidson and Candy (2016), Orwoll et al. (2018), Lemermeyer and Sadesky (2016), and Roche et al. (2018), others reported a decline in engagement or satisfaction over time, a general negative response to gamification, and identified that the impact on long-term knowledge retention remains to be explored (Garnett & Button, 2018; Gallegos et al., 2017).

In both Brull et al.'s (2017) and Orwoll et al.'s (2018) studies, gamification was implemented as a comparative or adjunct intervention and demonstrated positive relationships. Brull et al. (2017) determined that the gamified module outscored the other two in knowledge retention, whereas Orwoll et al. (2018) utilized social gamification in a bundled intervention (including a mobile application, in-context micro-learning, and digitized best practices) for central line care that resulted in increased engagement and a reduction of central line infections, in comparison to traditional teaching and learning methods. This finding was critical as it demonstrated that utilization of multiple instructional strategies and an increase in learner engagement was related to improving patient outcomes.

In contrast, Roche et al. (2018), Davidson and Candy (2016), and Lemermeyer and Sadesky's (2016), utilized single cohort studies to assess the relationship between gamification and factors such as learner engagement, motivation, attrition, and knowledge retention. For Roche et al. (2018), attrition was inversely correlated with numbers of users and badges earned, meaning that the more the participants engaged, the less likely they were to abandon the experience. Users with higher engagement earned higher final exam scores and improved knowledge retention, when comparing paired responses between the first and second post-intervention assessment. Lemermeyer and Sadesky (2016) administered a survey that examined engagement, motivation, and knowledge retention in relation to participants' experience playing a gamified continuing competence module. A majority (93%) reported feeling engaged with the module, and participants' knowledge scores rose significantly in the post-test. Lemermeyer and Sadesky's (2016) study did not assess long-term knowledge retention. Rather, knowledge was measured shortly after completing the module and responses were dependent on nurses' own affirmation (self-assessment), not actual practice demonstrated in clinical practice. Self-selection bias may have also impacted both Roche et al. (2018) and Lemermeyer and Sadesky's (2016) results due to a lack of randomization. Last, Davidson and Candy (2016) measured engagement via analytics from the gamification platform, 3D GameLab, such as the amount of time spent in each quest,

the number of points achieved, and responses to the Likert questionnaires. The authors determined that students were more satisfied, engaged, and achieved higher learning outcomes when content was gamified, as several participants achieved 'A' letter grades and went beyond what was needed to achieve a passing grade. Despite that this study was limited by a small sample size (n=30), a low response rate (30%), and the lack of a comparison group, thereby restricting generalizability, this pilot study provided insight for future application.

### **Knowledge Translation**

The relationship between gamification and engagement, knowledge retention, and satisfaction is ultimately related to the translation of knowledge into practice (Brull et al., 2017; Lemermeyer & Sadesky, 2016; Marques et al., 2016; Orwoll et al., 2018). Despite the interest for using innovative instructional strategies to enhance patient outcomes, this relationship continues to lack conclusive evidence (Brull et al., 2017). Lemermeyer and Sadesky (2016), Orwoll et al. (2018), and Marques et al. (2016) attempted to assess the potential impact of gamification on patient outcomes, despite that this relationship remains difficult to measure directly. For example, in Lemermeyer and Sadesky's (2016) study, 97% of participants (65/67) responded that their learned knowledge would positively influence their practice, but this finding was based solely upon self-reporting. Most critical was Orwoll et al. (2018), who determined that increased engagement, as a result of a bundled intervention, directly improved patient outcomes through the noted reduction in central line infections. Despite the cost of the bundled educational intervention, the savings to the health care system were significant, and the evidenced knowledge translation was critical in increasing 'operational efficiency' and enhancing patient outcomes (Orwoll et al., 2018, p.26). However, due to the bundled nature of the intervention, it is difficult to ascertain which strategy was most effective. The use of technology to implement gamification and its impact on knowledge translation was further echoed by Marques et al.'s (2016) study which integrated gamification and a Bluetooth information system to combat hospital acquired

infections due to poor hand hygiene compliance. Marques et al. (2016) argued that the use of technology and gamification could have an impact on improving patient outcomes and healthcare delivery by increasing hand hygiene compliance.

### **Motivation**

The relationship between motivation and gamification was a prominent theme, regardless of whether researchers applied a theoretical framework (such as self-determination theory, action oriented learning, or adult learning theory) to substantiate this relationship (Brull & Finlayson, 2016; Castro & Gonçalves, 2018; Gallegos et al., 2017; Garnett & Button, 2018; Mackavey & Cron, 2019; O'Neill et al., 2018; Orwoll et al., 2018; White & Shellenbarger, 2018; Wingo et al., 2019). Whereas traditional teaching and learning methods are considered to focus primarily on extrinsic motivation (such as finishing an assignment to avoid a negative consequence), gamification was thought to potentially intrinsically motivate learners due to the rewarding nature of the activity to spark interest, and that gamified activities allowed the learner to master content through the use of ongoing feedback and ability to re-do learning attempts (Brull & Finlayson, 2016; Marques et al., 2016); however, the results regarding these outcomes varied, and the relationship between gamification and intrinsic motivation remains unclear.

While some authors determined that learners who were intrinsically motivated demonstrated strong performance regardless of the strategy used (even gamification), others discovered that implementation of certain gaming elements resulted in an initial surge of motivation but that this was not sustained as the novelty of gamification strategy wore off (Brull & Finlayson, 2016; Gallegos et al., 2017; Garnett & Button, 2018; Wingo et al., 2019). For example, Garnett and Button (2018) explored whether the use of digital badges motivated learners to come to class prepared, and found that approximately 1/3 of the participants identified as being motivated by the learning badges specifically. However, this change in motivation was more evident among learners who were already academically

inclined and desired to do well in class, and while the use of badges had an initial novel effect, this interest declined over time (Garnett & Button, 2018). Similarly, in Gallegos et al.'s (2017) study, participants felt that gaming elements such as rewards or badges were not purposeful and stated that they were primarily motivated to achieve a higher grade regardless of gamification.

However, in other studies, gamification did appear to increase motivation (O'Neill et al., 2018; Wingo et al., 2019). In O'Neill et al.'s (2018) study, RNs were motivated to participate in the gamified activity because points could be redeemed to purchase food items. But, as gamification was implemented through a bundled intervention, it was difficult to pinpoint whether an increase in motivation was attributed to gamification alone. In contrast, Wingo et al. (2019) ascertained that gamification aided in creating a 'stimulus for learning' through the use of competition and personal challenge, by which gamification inspired learners to take greater accountability for their learning and promoted engagement. Additionally, Orwoll et al. (2018) argued that because the next generation of nurses are familiar with technology and having grown up in a society where games are ubiquitous, this generation of users are motivated to play and to use these principles in everyday life, including patient care. The potential for more gamification in a patient care setting could be a reality in future daily nursing practice, however, the skill required to navigate the gamified activity should not increase one's workload as this will detract from participants' motivation to utilize it (Marques et al., 2016).

Next, White and Shellenbarger (2018) argued that digital badges added a social aspect to the learning process which fostered competition and thus impacted motivation; however, they also acknowledged that the relationship between badging and motivation remains unclear, and that the impact of badges may be contingent on learner characteristics such as whether they are already inadvertently intrinsically or extrinsically motivated to earn badges, which several studies have also identified as having mixed results (Garnett & Button, 2018; Marques et al., 2016; O'Neill et al., 2018). White and Shellenbarger (2018) also cautioned that the superficial application of badges could



negatively impact the learning process; unfortunately, as their article was not empirical, these observations are based on narrative statements.

### **Role of Technology**

The role of technology to create learning experiences in line with the expectations of the digital generation to motivate learners was also a recurring theme (Brull & Finlayson, 2016; Castro & Gonçalves, 2018; Gallegos et al., 2017; Mackavey & Cron, 2019; Roche et al., 2018; White & Shellenbarger, 2018). There was an assumption that the millennial generation, who comprise the majority of undergraduate student nursing populations, have grown up in a digital era, are accustomed to technology, and desire to see these technologies utilized in the post-secondary setting (Brull & Finlayson, 2016; Mackavey & Cron, 2019; White & Shellenbarger, 2018). The argument for gamification was further centered on the ideology that millennial learners demand technology; that gamification will help bridge the gap between education and application; and last, that today's learners have technological aptitude (Brull et al., 2017; Castro & Gonçalves, 2018; Mackavey & Cron, 2019; Roche et al., 2018). The concepts of innovation in gamification are mirrored in the demands of a dynamic and evolving healthcare system that requires nurses who can attend to these needs (Brull & Finlayson, 2016; Brull et al., 2017; Castro & Gonçalves, 2018; Gallegos et al., 2017). The use of technology as a medium for gamification can positively impact learners' engagement and motivation, and educators can also collect data that could uncover areas for improvement or provide insight to students' learning (Roche et al., 2018).

Among the articles, gamification was applied using diverse technologies. Davidson and Candy (2016), Orwoll et al. (2018), and Hopia and Raitio (2016), all utilized a gamification platform or application. Davidson and Candy (2016) used 3D Gamelab, an online quest-based platform, to implement mastery learning via a "series of learning quests" (p. 287), which applied gaming elements and game mechanics to create a personalized learning experience in which learners achieved mastery of

concepts by receiving ongoing and timely feedback. In Orwoll et al.'s (2018) study, RNs used a bundled educational approach via an online application, use of gamification elements, and videos. And last, Hopia and Raitio (2016) explored the role of game play as a means for patients and healthcare workers to interact with one another, as well as creating a sense of escape from the stressors related to mental illness. Hopia and Raitio (2016) argued that gamification could play a significant role in future mental health care as the next generation is digitally savvy and may prefer gaming applications, however, cautioned it should be considered in light of digital privacy and security.

Marques et al. (2016) were unique in their collaboration of technology with gamification. The study examined the impact on hand hygiene when Bluetooth technology and gamification was combined. The ability to monitor compliance with hand hygiene was only possible due to the development of information systems coupled with a gamified strategy to motivate learners. Though participants indicated they were interested in receiving feedback to promote hand hygiene practices, the study was limited by a small sample size.

### **Gamification Elements**

In many of the articles, several gamification elements were identified including graphics, badges, challenges, levels, rewards, feedback, competition, points, and leaderboards (Brull et al., 2017; Davidson & Candy, 2016; Hopia & Raitio, 2016; Marques et al., 2017; Orwoll et al., 2018; Strickland & Kaylor, 2016). However, the role and the impact of specific elements was mixed and most authors did not clearly specify between the categories of gamification dynamics, mechanics, or aesthetics. For example, while Marques et al. (2016) identified that gaming elements fell into one of these three categories, the authors did not specifically identify how they themselves categorized them.

Additionally, certain elements were more commonly used such as digital badges, points, rewards, or leaderboards (Garnett & Button, 2018; Gallegos et al., 2017; O'Neill et al., 2018; Orwoll et al., 2018; White & Shellenbarger, 2018; Wingo et al., 2019). Brull et al. (2017) used images, badges,

challenges, levels, leaderboard, and gifts in the gamified online module, and determined that the participants completing the gamified module had the highest post-intervention scores. However, further investigation as to which elements had the most impact was not explored. Hopia and Raitio (2016) outlined the following elements as pertinent to gamification in the mental health setting: graphics, state of competitiveness, ongoing positive feedback, levelling, rewards, interactivity during play; and the necessity for individualization of play. Gamification allowed networking from all around the world, provided users an escape from the reality of their illness, and was identified as having potential as an assessment tool based on analytics (Hopia & Raitio, 2016). In this context, gamification was implemented in a unique setting that had significant potential for future application. Again, rationale to support the role of specific elements was not explored.

### **Discussion**

This integrative review examined gamification in nursing literature and identified themes of construct conceptualization, relationships between engagement, satisfaction, and knowledge retention; knowledge translation, motivation, role of technology, and gamification elements. It is apparent that gamification is of interest to the nursing profession, however, more research is needed to not only further explore these identified themes, but also the relationships between these thematic concepts. Interestingly, some of these themes were similar to those identified by Gallegos et al. (2017) when describing the ability of a game-based learning platform to engage nursing students such as motivation, technology, and knowledge retention; perhaps these similar findings are the beginnings of a shared understanding.

As a relatively new concept to nursing, the conceptualization of gamification remains unclear creating uncertainty in the field. Gamification was either defined as a technical application, for its ability to influence motivation and/or behaviours, or for its ability to create a positive learning experience; as such, future conceptualization will need to ascertain whether it should focus on one or all components

(Davidson & Candy, 2016; Foli et al., 2016; Garnett & Button, 2018; Hopia & Raitio, 2016; Johnston et al., 2013; Lemermeyer & Sadesky, 2016; Marques et al., 2016; O'Neill et al., 2018; Orwoll et al., 2018; Roche et al., 2018; Strickland & Kaylor, 2016; White & Shellenbarger, 2018). Furthermore, other similarly used terminology also requires its own conceptualization or clarification regarding its alignment with gamification. For example, serious games and digital gaming could be more widely examined within the context of gamification, as there appears to be both differentiation and overlap where these terms are concerned. However, it may be argued that the definition of gamification be given permission to be fluid and dynamic depending on the setting in which it is applied (Lemermeyer & Sadesky, 2016), meaning that an author define it for clarity and within the context of its use in each setting to ensure reader understanding. Unfortunately, this does not dissipate the confusion in this area due to the continued use of various terms in lieu of gamification, such as game-based learning, quest-based learning, digital gaming, and more.

This review also uncovered that the application of a single element can be considered gamification with less discussion regarding the application of multiple elements to create a comprehensive gamified experience, and some elements such as badging or leaderboards were implemented more often than others. For example, Foli et al. (2016), Garnett and Button (2018), and White and Shellenbarger (2018) primarily focused on discussing digital badges as a component of gamification, however, this could lead one to erroneously assume that the mere implementation of one gaming element is wholly gamification. This disparity in application inhibits a broader understanding of what a complete application of gamification should entail and the impact of these elements on the learning process. This inconsistency in application perpetuates the current construct confusion that continues to exist regarding what gamification is and what is not – Is gamification merely the application of gaming elements, or should conceptualization also include the goal to motivate learners or modify

behaviour? In its current state, researchers are encouraged to continue to define gamification in relation to the context of their study to ensure clarification.

The application of some, all, or unique combinations of gamification elements, also require further study as these combinations may have differing impacts on learner motivation, engagement, satisfaction, or knowledge retention. An application of easier employed gaming elements such as point systems, leaderboards, or badges, can demonstrate a temporary rise in interest, but some studies demonstrated a decrease in participation and motivation (Garnett & Button, 2018; Gallegos et al., 2017). Several authors argued for the application of specific elements such as badges to promote motivation levels among learners (Castro & Gonçalves, 2018; Garnett & Button, 2018; O'Neill et al., 2018; White & Shellenbarger, 2018; Wingo et al., 2019), however, the utilization and application of gamification elements, as well as the relationships between various elements and their direct impacts on motivation, is not well understood. This is complicated by the knowledge that the positive impact on motivation due to the use of gaming elements such as badges, points, or leaderboards may not always be sustained (Brull & Finlayson, 2016; Gallegos et al., 2017; Garnett & Button, 2018; White & Shellenbarger, 2018). For example, Marques et al. (2016) argued that pointsification, the act of adding points as a rewards system without assigning any true value to the points, detracts from the overall gamification experience. Therefore, better understanding as to how gaming elements impact motivation is critical to negate the argument that gamification is a 'hype', is distracting, and is not appropriate to a serious workplace or educational setting (Marques et al., 2016). Mere listing of gaming elements does not explicate how these elements align with game-thinking, dynamics, mechanics, or aesthetics which are considered by some as the hierarchal constructs, or 'levels of abstraction' of gamification (Marques et al., 2016; Kapp, 2012). According to Kapp (2012), various combinations of gaming elements and true application of gamification has potential to positively impact motivation, but more exploration is needed to better understand the cause and effect of these relationships. As only some researchers, such as

Davidson and Candy (2016), Roche et al. (2017), or O'Neill et al. (2018), identified a theoretical framework to ground their application of gamification, it may be of future interest to consistently apply theoretical frameworks to ground findings of the role specific elements play in influencing outcomes.

Construct conceptualization was critical to knowledge translation as well. The use of gamification in nursing education and its potential impact on patient outcomes is of significant interest to educators and health authorities alike (Brull et al., 2017; Lernermeier & Sadesky, 2016; Marques et al., 2016; Orwoll et al., 2018). As Orwoll et al. (2018) demonstrated, using a bundled intervention which included a gamified approach resulted in a notable decrease in central line infections among an intensive care patient population which can lead to shorter stays, a reduction in complications, and cost-savings to the healthcare system. Better understanding of gamification in the learning process is significant to providing continuing education opportunities that may demonstrate an improvement in nurse competency and patient outcomes. The potential for gamification to positively impact nursing practice and influence patient outcomes appears to exist and should continue to be of significant interest to the nursing profession. A consistent definition could provide stability and a foundation on which a program of research can spur higher understanding regarding knowledge translation and measuring impacts on nursing practice and patient outcomes.

Ultimately, it was determined that it is the type of learner that affects how motivated that learner will be to engage in a gamified activity (Garnett & Button, 2018; White & Shellenbarger, 2018). In this sense, regardless of which gaming elements are applied, intrinsically motivated learners will be more apt to be engaged; this was seen when learners who were more inclined to earn badges were students who already desired to achieve a high grade (Gallegos et al., 2017; Garnett & Button, 2018). Undergraduate nursing student populations already demonstrate a high level of intrinsic motivation based upon the competitive academic rigor of entry into program (Gallegos et al., 2017). Gamification may not be necessary to improve motivation of undergraduate nursing learners; instead, future

research could examine how gaming elements can be applied in other nursing education contexts, such as in continued education opportunities where practicing RNs may differ in motivational orientation. Additionally, better understanding of the needs and demands of millennial learners in regards to technological preference and innovative instructional strategies is needed. Many teaching and learning experiences continue to reside in traditional, didactic styles, despite ubiquitous use of technology in personal and professional settings. The role of technology in both healthcare and education continues to evolve as technological advancement progresses. Increased use of technologies and an expected adaptation to evolve and stay current is an increasingly common expectation at the bedside and in the educational setting. There is an opinion that as the current generation of nursing students are familiar with technology, they may find traditional teaching strategies to be uninspiring; digital gaming can be used to improve teaching ability and provide learners with an engaging method of learning (Johnston et al., 2013; Roche et al. 2018). The advent of technology has provided an opportunity for gamification to flourish in non-traditional areas such as real-time patient care, mental health, and online nursing education, however, requires more investigation regarding its advantages and disadvantages. While the idea of gaming in education is not new, gamification can now be applied in online modalities and within contexts that were not previously available – mobile phone applications, Bluetooth technology pairing, and an improved esthetic experience due to higher broadband capability (Davidson & Candy, 2016; Hopia & Raitio, 2016; Kapp, 2012; Marques et al., 2017).

### **Limitations**

As the authors performed their own search strategy, a reference librarian was not utilized. The primary author solely completed the publication selection and data extraction process. Once data was extracted, this information was shared with the team for a review of thematic coding and analysis. Furthermore, as with an integrative review, the inclusion of many types of methodologies can result in

biased interpretation and analysis. Due to the lack of concept conceptualizations surrounding the term *gamification*, it is possible that other articles discussing gamification using other terms were missed.

### **Conclusion**

It is evident that the profession of nursing has begun to explore facets of gamification within the nursing context such as the potential relationship with motivation, the role of technology, as well as the possible impact on patient outcomes, however, several areas continue to require further in-depth investigation including the conceptualization of gamification, its relationship with knowledge retention, as well as the differences when using all or some gaming elements. Some articles in this review demonstrated the potential for gamification as an innovative instructional strategy to positively impact patient outcomes but this relationship requires further and more tangible investigation. Additionally, several of the studies examined undergraduate nursing student populations, however, the practicing RN demographic also necessitates further review due to differences in motivational orientation. The influence of gamification on nursing practice, as well as patient care outcomes, are of great interest to educators, health authorities, and nursing regulatory bodies – if gamification can be shown to positively impact patient outcomes, one can anticipate gamification being applied in more settings and among a wider range of users. Gamification may be a promising venture - nurses have begun to wade into the murky waters of gamification, and further evaluation of the benefits and limitations of gamification are needed.



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### Chapter Three:

#### Staying Ahead of the Digital Technological Curve Using Survey Methods

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### **Abstract**

In the early twentieth century, surveys were an innovative and neoteric methodology. Collected in-person or by mail, researchers could ascertain the thoughts and opinions of a small sample, which could then be applied to the general population. Almost one hundred years later, the use of surveys has become pervasive in society due to digital technological advancement. However, while the digital evolution has not only altered the possibilities of how, when, and where surveys may be administered, the threats to this methodology has also evolved. While issues related to previously known errors (i.e. sampling error, non-response error, etc.) remain and have also evolved, new threats regarding confidentiality and privacy, design issues, and others, have emerged in response to this digital advancement. Novice and experienced researchers alike should be cognizant of the impact digital technologies have had on survey data collection to ensure high quality research findings. This paper explores the threats to survey methodology due to digital technological changes and discusses how researchers and students can mitigate these challenges.

### **Staying Ahead of the Digital Technological Curve Using Survey Methods**

Every day, Canadians receive multiple requests to participate in opinion surveys evaluating many interactions or experiences they have in their daily lives. Unfortunately, the ubiquitous prevalence of surveys has fostered a perception that surveys are an easy-to-implement and easy-to-use method of collecting information; in reality, this methodology requires significant consideration and planning (Couper, 2013, 2017; Dillman, 2016; Miller, 2017). At the beginning of the 20th century, the survey emerged as an in-person data collection tool used by government or health agencies for research. Today, the average individual is inundated with surveys to complete online, by text, through email, and via social media platforms such as Facebook, Instagram, Twitter, or other avenues of digital communication, to share their opinions regarding a product, a consumer experience, advertisements, political issues, current events, and more (Couper, 2017; Groves, 2011). It is not surprising that researchers find it more and more challenging to attain adequate survey responses from participants who feel burdened by being over-surveyed.

Surveys can be defined as non-experimental research in which a sample of a population is questioned about their thoughts, opinions, or actions as a representative of the larger population (Greenlaw & Brown-Welty, 2009; Patten & Newhart, 2018; Polit et al., 2001). Differentiated from the pragmatics of survey construction, survey design research is the systematic and intentional method of using surveys to gather data about a predetermined question to create and disseminate knowledge. An exploration of survey methodology reveals that considerable knowledge and effort is required to develop and administer a survey to obtain reliable and valid data. For novice researchers or students, this fact may be surprising because of the widespread presence of surveys in society. Furthermore, the rapid progression of digital technology continues to transform how surveys can be administered, reducing some previous challenges associated with this methodology while simultaneously creating a new set of opportunities and issues to consider. The purpose of this paper is to provide an overview of



potential threats to survey research methods related to the advancement of digital technology, which is critical for those interested in using solid survey methodology.

### **Background**

Rapid digital development in the 21st century has spurred the transformation of surveys from their humble origins in the 1930s to the more robust research method evident today, and this transformation is challenging researchers to continually adapt this methodology to keep abreast of digital advancement (Groves, 2011). Initially, surveys were conducted in-person within a geographically based area and yielded high response rates despite small sample sizes (Dillman et al., 2014; Groves, 2011; Groves et al., 2009). Now, researchers are increasingly being challenged to adapt to new digital technologies that have impacted the delivery and use of surveys as an effective research methodology and method for data collection. Over time, the advent of the computer, Internet, and social media platforms, and the evolution from landlines to mobile phones, have contributed to an evolved survey landscape creating new challenges such as declining response rates, rising costs, and increasing privacy and confidentiality concerns, as well as emerging opportunities including new modes of data collection (e.g., SMS text, mobile) and the use of big data (Couper, 2013, 2017; Dillman et al., 2014; Groves, 2011; Groves et al., 2009; Moy & Murphy, 2016).

Surveys offer many advantages as a research method, including data collection by using a randomly selected sample that can be used to generalize or make inferences about a much larger population; lower cost in comparison to other data collection methods such as interviews or focus groups; fewer barriers from geographic locations; the need for little training for administrators; enhanced possibilities of new multimedia usage through digital advancement (e.g., SMS text, mobile via smart phones); easier access to previously difficult-to-reach populations; and fewer manual entry and numerical errors because of automated data entry and analysis (Couper, 2000; Couper & Miller, 2008; Greenlaw & Brown-Welty, 2009; Hunter, 2012; Jones et al., 2008; Miller, 2017). Despite these

advantages, researchers should also be cognizant of the impact the digital evolution may have on the generalizability, reliability, and validity of survey studies. Traditionally, mitigating issues of sampling error, coverage error, measurement error, and nonresponse error to augment survey design have been emphasized (Couper, 2000; Dillman et al., 2014; Hunter, 2012). Measurement error occurs when the participant does not respond to an item the way it was intended or misinterprets what it is asking, whereas nonresponse errors take place when participants do not respond to the survey or to specific items within the survey (Boyle et al., 2016; Dillman et al., 2014; Moy & Murphy, 2016). Coverage error refers to participants missing from or who are erroneously added to the frame, and sampling error may arise during the process of selecting a sample from the targeted population (Dillman et al., 2014; Hunter, 2012; Moy & Murphy, 2016).

These major errors and their impact on survey design should be re-examined given the influence of new digital technologies to emphasize the strengths of survey design while also understanding the weaknesses of this approach. Increased concerns about privacy and confidentiality, changes in legislation regarding data ownership, the increased need for bandwidth because of improved esthetics and graphics, and the potential for gamified survey design are but a few of the factors impacting survey design that require further examination as a result of digital technology progression (Couper, 2017; Dillman, 2016; Keusch & Zhang, 2017; Miller, 2017; Robinson et al., 2015). Note that this list of impacts is not exhaustive; several other threats exist such as processing error, the increasing use of bots, adjustment error, other issues of validity, and more (Couper, 2017; Dillman et al., 2014; Groves et al., 2009). Readers are encouraged to explore these additional threats to fully understand the impact on survey data collection and results.

### **Discussion**

The following discussion examines several areas of concern that have arisen or have been augmented through the evolution of digital technologies including trust, confidentiality, and privacy

issues; the impact of the digital divide on sampling and response quality; satisficing and survey fatigue; and technical concerns and design issues. “Traditional” threats such as coverage error, measurement error, sampling error, and nonresponse error are discussed within the context of these digitally related issues, and strategies to mitigate these areas of concern are also examined. Aspects of each of these areas may overlap and are enmeshed with one another because of the intertwined nature of digital innovation. We again caution that this list is not exhaustive and recommend that readers examine other factors specific to their own research.

### **Trust, Confidentiality, and Privacy**

Trust is a key element in survey response (Couper, 2017; Dillman, 2016; Jones et al., 2008). Trust pertains to the belief or the sense of security that respondents have about the origin, purpose, or legitimate nature of a survey and can be impacted by how confidentiality and privacy are attended to by the researcher. Although concerns regarding confidentiality are present in all survey types, the security of Web surveys is increasingly questioned by participants, specific to the privacy and confidentiality of their identity and responses, thereby potentially decreasing response rates and increasing the occurrence of insincere answers (Couper, 2000, 2017; Dillman, 2016; Tourangeau, 2018). An advantage of Web survey methodology has been its ability to gather information anonymously; it is especially useful for data collection, which can be impacted by social desirability bias, and in lieu of interviewer-led surveys when collecting sensitive data, which participants may be otherwise reluctant to share, such as information related to HIV status, domestic abuse, or sexual practices (Hunter, 2012; Moy & Murphy, 2016). However, increasingly, individuals now fear the loss of identity through the use of digital cookies; the tracking of IP addresses, which is used by researchers to limit duplicate responses; and other means of tracking electronic footprints left behind from every digital interaction (Couper, 2013, 2017; Hammer, 2017; Hunter, 2012). Even when researchers stipulate within consent forms or instructions that survey software does not track IP addresses and that researchers have no means of identifying participants,

participants remain distrustful, fearful that they will not remain anonymous or that their responses will not remain confidential. This behaviour has contributed to declining response rates over time (DeLeeuw, 2018).

How data is collected and saved is also a source of increasing distrust. In recent years, there has been an increased awareness of how the United States' (U.S.) Patriot Act impacts data collection in Canada and concerns regarding privacy. Because of this Act, researchers using U.S. data collection tools or software must allow the collected data to be stored on a US-based server, subject to US law (Banks, 2012). This has caused considerable concern among Canadian researchers regarding the safeguarding of their participants' privacy and confidentiality of information. The amalgamation of Fluid Surveys with Survey Monkey, which uses a U.S.-based server, highlighted a critical need for a Canadian-based survey software platform (Fluid Surveys, 2017). Canadian researchers can now use software such as Qualtrics (2020) and REDCap (2020), which are locally owned and purchased by educational and research institutions in Canada, to collect data and avoid issues associated with the U.S. Patriot Act since they use Canadian-located servers. Using credible survey software agencies, such as Qualtrics or REDCap, offers less risk related to data breaches by having control of data specific to Canadian laws and specifications. These survey platforms also offer more choice in questionnaire administration where participant information can be confidential, anonymous, or both.

To alleviate fears of privacy or confidentiality violations, researchers should reassure participants by providing them with as much information as possible regarding the method and reasons for the information being collected via surveys and how the responses are being protected; use visuals to increase connection to the subject of the survey; and use follow-up emails or other modes of communication (Dillman, 2016; Jones et al., 2008). Survey researchers should clearly outline their relationship with the participants (such as how involved the researchers will be in the questionnaire administration and data collection) and their relationship with the agency or institution for which they

are collecting this information (if applicable). Also, it is important that researchers indicate that servers housing participant responses are located in Canada and are not aligned with the U.S. Patriot Act.

Researchers may also foster trust with participants through means such as including a picture or video in the email survey invitation to cultivate relational connection between the researcher and the participant (Jones et al., 2008).

Lack of trust can result in high rates of nonresponse, which may result in nonresponse bias. To mitigate this error, researchers are often encouraged to employ follow-up strategies such as interviews to reach out to non-responders. However, DeLeeuw (2018) cautioned that interviews may unintentionally propagate a social desirability effect because of the nature of data collection, meaning that the absence of anonymity may skew the non-responder's responses. Second, depending on the number of non-responders or the expanse of the geographical area, it may not be realistic to follow up with non-responders of a Web survey; therefore, researchers should focus on reducing nonresponse at the start of survey administration by using multiple techniques to increase response rates. These may include sending mail, text, or phone notifications before sending the email invitation (DeLeeuw, 2018).

Ultimately, researchers must weigh the benefits and disadvantages of the type of survey methodology they want to deploy to best instill trust and assure confidentiality and privacy of individual participation and responses. Understanding the reason or reasons for nonresponse rates, and when possible, the true score for non-responders, can provide important insights into ways that the data may be biased as a result of nonresponse error. This impact of nonresponse error is amplified when there is a distinct difference between those who did participate and those who did not, and it is up to the researcher to determine the extent of this impact on the study (Dillman et al., 2014; Groves, 2006; Groves & Peytcheva, 2008). Issues of trust, confidentiality, and privacy have great potential to impact response rates for Web surveys; however, understanding why these concerns exist can aid novice researchers in taking steps to mitigate these concerns.

## The Digital Divide

Web surveys continue to be employed for the many reasons that made them useful to begin with: they are cost-effective, can be administered to vast geographical areas, support automated data entry and analysis, and limit social desirability bias (Couper, 2017; Groves, 2011; Miller, 2017). However, there is a significant concern that the demographics of participants with Internet access may reflect a higher socioeconomic status or advanced computer literacy in relation to the total population being sampled (Dillman et al., 2014; Hunter, 2012).

Demographic factors have continued to expand the digital divide regarding access, Web activity, and social networking site use (Couper, 2017; Haight et al., 2014; Robinson et al., 2015). Furthermore, while the Internet has been normalized across society and is considered an essential service in many countries, the lack of access because a paucity of high-speed Internet services in rural areas and the variability of Web resource use has undermined the ability of some individuals to participate in Web surveys (Haight et al., 2014; Hunter, 2012). For some, access may not be a barrier, however, an inability to carry out Web tasks and activities (e.g. lack of digital literacy), may hinder connectivity or participation (Couper & Miller, 2008; Haight et al., 2014), which may then result in a sampling error and a sampling bias. Robinson et al. (2015) argues that two levels of digital disparity exist, the first being those gaps that prevent users from engaging in full participation in a society that is increasingly tech-dependent, and the second level comprising those who lack skills or access. Despite proliferation of digital technology through smartphones and other smart devices, disadvantaged people continue to lack basic skills and digital literacy to use and access technology to its fullest ability (Robinson et al., 2015). Differences in demographics related to age, race, ethnicity, and socioeconomic status influence Internet use and knowledge, thereby perpetuating social inequalities and further widening the gap (Couper, 2017; Robinson et al., 2015). For example, Africans comprise 14% of the world's population but only 3% of the world's total Internet users (Robinson et al., 2015); and in case of age-related differences, only

one-third of people in the United States over the age of 75 use the Internet, versus over 85% of those ages 18 to 34 (Couper, 2017; Khare, 2016). While Internet access has globally improved, the difference between those who do have access versus those who do not now magnifies this divide even more significantly (DeLeeuw, 2018).

Surprisingly, there has been a growing return to the use of mail surveys in the United States. The U.S. Postal Service compiles a frequently updated list of residential addresses that covers approximately 98% of all the households in the United States, and this list is available for researcher use (Dillman, 2016). Known as address-based sampling (ABS), this has afforded researchers the opportunity to combine multi-modes of data collection such as “Web-push” studies, where participants are contacted via mail first (which provides context and assurance regarding the validity of the survey and researchers) and are then directed to respond via web link or email (Couper, 2017; Dillman, 2016). This mode has demonstrated some success in attaining higher rates of responses than Web surveys alone (Couper, 2017; Dillman, 2016). Still, sampling error is intrinsic to all types of survey design, no matter the mode of data collection (i.e., in person, mail, telephone, Web), and is inherent in any scenario when a researcher surveys a portion of the sampling frame versus the whole target population (Boyle et al., 2016; Dillman et al., 2014). When considering multi-mode data collections, surveyors should be cognizant of the demographic differences between populations (such as those with or without Internet access, or those who have landline phones versus mobile phone owners), as differences in opinions and beliefs between these populations related to politics, social views, behaviours, and other topics do exist (Couper, 2017; Dillman et al., 2014; Groves, 2011).

Sometimes, researchers employ strategies to decrease sampling error that are not always effective. One is assuming that a larger sample size will negate the potential for sampling error (Couper, 2000). Another ineffectual strategy is to use non-probability sample designs, which place a greater emphasis on the number of participants as opposed to the representativeness of the population as a

whole. This strategy can compromise the generalizability of the survey results (Couper, 2000, 2017; Robinson et al., 2015). Luckily, other avenues of recruiting participants have evolved courtesy of digital technology advancement—this includes river sampling, the survey wall, or the open access survey (Couper, 2017). In river sampling, participants are diverted while browsing the Web and guided to complete a survey; in using a survey wall, users cannot access the content they seek until they complete a specific number of survey questions; and in the open access survey, links to the survey are posted or shared through various Web sources such as social media (Facebook, Twitter, Instagram, etc.), word of mouth, or list servers (Couper, 2017). Social media has been increasingly used in both recruitment and survey administration; however, inequity in social media use across populations produces unrepresentative samples—for example, social media accounts can be run by individuals or businesses, and not all social media platforms are used by everyone (e.g., Twitter was used by only 23% of adults on the Web in 2016) (Moy & Murphy, 2016). Furthermore, as these are all forms of convenience sampling, they are subject to issues of coverage error and representation, rendering the results ungeneralizable (Couper, 2017; Robinson et al., 2015).

For Web surveys, researchers should investigate whether those targeted as potential participants have a means to access the Web, such as at work or at a public institution (e.g., a computer at a public library) if personal access is not an option. Researchers can use multiple means of recruitment other than the Internet and computers to administer surveys, such as using postal mail or phone calls as an invitation to participate before the actual administration of the survey. This may increase response rates and also raise awareness that other participation options exist, thereby reducing the ongoing digital divide (Couper, 2000, 2017; Dillman et al., 2014; Groves et al., 2009; Haight et al., 2014; Miller, 2017).



### **Satisficing and Survey Fatigue**

Satisficing is defined as the impact participants' diminished energy has on how accurately they respond to survey items because of a loss of attention, distractions, or feelings of irritation or annoyance (Downes-Le Guin et al., 2012; Keusch & Zhang, 2017). In the age of digital technology, the pervasive use of surveys has led to survey fatigue. Survey fatigue, or respondent burden, is defined as a phenomenon which occurs when participants are unmotivated to participate or become bored while completing a survey, which can lead to issues such as satisficing or straight-lining (when participants choose the same answer down a column of items) (Lavrakas, 2008; O'Reilly-Shah, 2017). Survey fatigue is amplified when the length of time, the effort required, the emotional or cognitive stress endured to complete, or the high frequency of participation is considered to be more than the value of participating in the survey (Lavrakas, 2008; Downes-Le Guin et al., 2012).

Participants may be willing to undergo greater burden if the data they provide is perceived to be valuable or if their experience is enjoyable. Despite digital technological advancement, both satisficing and survey fatigue remain an issue. The length of a survey, inclusion of all possible and appropriate responses, or the use of innovative survey techniques such as gamification should be considered to avoid satisficing (Downes-Le Guin et al., 2012; Keusch & Zhang, 2017; Lavrakas, 2008). For participants to respond to a survey question they must engage in a cognitive process to answer it; hence, survey researchers should ensure that all questions use equivalent rating scales and that the available responses encompass all possible answers, thereby limiting the chance of a participant choosing a non-essential response (Ansolabehere & Schaffner, 2015; Lavrakas, 2008). However, it is important to be mindful that shorter surveys attain higher response rates (Couper, 2013). Additionally, researchers should also consider whether their target demographic has been previously overburdened and put mechanisms in place to limit the questions and number of surveys delivered to the population being invited to participate. For example, in an attempt to prevent coverage error, perhaps the participant has

been targeted multiple times because of their demographics (e.g., individuals with rare disorders). Another area for consideration is the impact of distractions on participants' ability to complete a survey or how they respond to open-ended questions in a survey. Ansolabehere and Schaffner (2015) determined that participants were more distracted when questions increased in cognitive complexity, which could lead to increased rates of satisficing, thereby introducing measurement error into the results. Satisficing in Web surveys is a persistent challenge, and the incorporation of the latest in visual design and other strategies should be considered to minimize satisficing and improve conscientious reporting response (Ansolabehere & Schaffner, 2015; Downes-Le Guin et al., 2012; Keusch & Zhang, 2017; Lavrakas, 2008).

There are additional digital strategies that researchers may use to minimize satisficing and limit survey fatigue. Downes-Le Guin et al. (2012) determined that attentiveness to survey length, topic relevance, study design, and rate of survey requests were most effective for dealing with respondent burden. Multimedia options today can be used to develop an innovative survey experience to limit satisficing and survey fatigue. For example, gamification of surveys has been proposed as a potential strategy to increase engagement and motivation (Keusch & Zhang, 2017). Gamified surveys could lead to more uplifting survey experiences, making them fun and thereby increasing response rates (Keusch & Zhang, 2017). However, it is not without limitations and potential biases. Critics of gamified surveys point to the impact of gamified design on measurement error (how gamified questions are perceived), impacts on validity (if wording or layout is changed because of gamification), and the potential for a skewed positive bias related to the "fun" nature of gamified experiences, which may inhibit future application (Keusch & Zhang, 2017).

Surveys completed through texting are a valid option with many benefits. As an innovative means of survey administration, text surveys use current communication practices, allowing participants to respond at their convenience, as well as allowing for confidential responses resulting in quality data

(Moy & Murphy, 2016). While more time is required to administer text surveys, they have been noted to attain higher response rates and participant satisfaction (Moy & Murphy, 2016). Providing various means of survey data collection via personal communication devices may augment response rates and the quality of data collected; in the future, data blended from various sources may be the norm (Miller, 2017).

### **Technical and Design Issues**

Technical concerns and design issues have been identified as contributing to all types of error including nonresponse, coverage, measurement, and sampling errors. Both survey access and survey administration are influenced by technical and design matters such as Internet access, respondent technical ability, visual design changes across devices, and more. On a positive note, digital advancement in esthetics, speed, abilities such as gamification or multimedia use, and the extent to which individuals can now shop, learn, or play games on the Web is remarkable. Unfortunately, every digital advancement comes with new threats to individual security, which foster distrust. For example, participants might have previously trusted clicking on links to be routed to another site but now need to be aware of phishing scams or that a link may contain a computer virus, malware, or ransomware (Dillman, 2016; Hunter, 2012; Williams & Polage, 2019). Phishing, or the act of sending fraudulent emails to large groups of people, has increased the distrust individuals have with receiving emails asking them to respond to a survey or click on a link from researchers they do not know (Dillman, 2016; Williams & Polage, 2019). People are more apt to trust emails when company logos or copyright statements are displayed (Williams & Polage, 2019). However, fraudulent individuals can easily produce authentic and sophisticated looking emails to entrap people. It is getting more difficult to differentiate between real and ill-intentioned emails, thereby decreasing the overall trust people have regarding survey requests. This distrust is further amplified by those potential participants for whom “technophobia” limits their

familiarity with computers and the Internet, or who may be suspicious of its capabilities, thereby increasing their hesitation to respond to web questionnaires (Hunter, 2012).

In addition to design and technical concerns, inadequate Internet speeds, poor connections, or lack of sufficient broadband width may reduce a participant's motivation and ability to complete a survey (Couper, 2000; Gelder et al., 2010; Robinson et al., 2015). These technical issues create obstacles for researchers in developing a survey with other multimedia formats such as advanced graphics or videos, or gamified surveys (Couper, 2000; Keusch & Zhang, 2017; Robinson et al., 2015). Researchers should be cognizant of the digital divide, its demographic disparities, and the impact on the quality of participant responses (Couper, 2000, 2017). It can be argued that while the availability of Internet access has increased for some, the disparity between those on opposite ends of the digital divide in terms of socioeconomic status, ethnic representation, health, and levels of computer literacy has widened (Couper, 2000; Couper, 2017; Hunter, 2012). To decrease these concerns, researchers should be cognizant of participant demographics and the digital burden that gamification elements, graphics, or videos may place on a participant's ability to download or access material related to bandwidth issues (Hunter, 2012; Keusch & Zhang, 2017; Robinson et al., 2015). Researchers could also assure the validity of a link sent via email by contacting participants with introductory and reminder emails using the same format/design as the email with the questionnaire link in order to promote its validity (Couper, 2017; Gelder et al., 2010; Hunter, 2012). For example, the use of logos from research programs prominently placed on all recruitment- and process-related emails or communications can increase identification of legitimate research materials and requests for participation.

The impact of poor survey design can be considerable for survey outcomes but is often magnified with the implementation of Web surveys. Web survey layout can be impacted by browser settings, user preferences, computer capability, and the channel of communication (audio versus visual, smartphone use, tablets, etc.), which can further impact the occurrence of nonresponse and

measurement error (Couper, 2000, 2011; Moy & Murphy, 2016). Researchers must assume that when they are administering a Web survey, they are also administering a mobile survey, and therefore attention to visual design and functionality is needed (Moy & Murphy, 2016). Poor visual layout, organization, and survey length may promote satisficing, straight-lining, randomized responding, or speeding because of participants' feeling distracted, unmotivated, unengaged, or cognitively taxed, which ultimately impact the quality of responses received (Ansolabehere & Schaffner, 2015; Downes-Le Guin et al., 2012; Keusch & Zhang, 2017). Not only is the impact of question wording increasingly important, but aspects including question placement, overall flow, and text features also have significant influence on measurement and nonresponse errors (Couper, 2000; Dillman et al., 2014). The impact of wording, structure, grammar, or use of colloquial language will not only alter how a question is perceived but may also generate low construct validity that is impactful to measurement error (Couper, 2000; Dillman et al., 2014).

To decrease nonresponse and measurement error, a focus on study design should include reviewing survey questions to remove poorly constructed language or language bias (Dillman et al., 2014; Hardre et al., 2012). When using Web surveys, technical writing issues (i.e., spacing, item wording, question order, etc.) also need to be avoided so that they do not negatively impact participant response to survey items. Researchers should also attend to decreasing the chance for measurement error before administering Web surveys. Measurement error may occur through social desirability bias; low construct validity (also known as specification error, which occurs when the survey item does not measure what it was intended to measure); response bias; or response variance (DeLeeuw, 2018; Dillman et al., 2014; Moy & Murphy, 2016). Measurement error may occur when participants feel restricted or disinclined to select a response because of the wording or order of questions, or when respondents react negatively to the visual arrangement of survey items. Construction issues such as a lack of proper scales may also result in measurement issues, along with the presence of unclear questions or question structure, as

well as data collection anomalies that skew responses (Couper, 2000; Dillman et al., 2014; Gelder et al., 2010; Krosnick, 2018; Rattray & Jones, 2007; Stern et al., 2007).

Both technical and design issues impact the overall quality of survey findings. The impact of Internet connectivity, survey administration, or the differences between responders and nonresponders are reflected within the responses collected and can erroneously lead to skewed interpretations of the results (Miller, 2017; Robinson et al., 2015). Best practice indicates that a survey question ought to be completed as quickly as possible and with the least amount of error possible (Krosnick, 2018). To ensure participants are able to complete a survey quickly and accurately, the researcher needs to ensure that constructs have been clearly conceptualized; that questions are clear, structured appropriately, and ordered logically; and that the visual layout of the survey is compatible across platforms and devices, all of which contribute to the quality and amount of data obtained (Dillman et al., 2014; Downes-Le Guin et al., 2012; Moy & Murphy, 2016). Visual layout of surveys is imperative as screen design impacts respondent engagement. More specifically, aspects such as image use, the number of questions per screen, progress indicators, and text colours impact response rates; ultimately, poor questionnaire design can lead to satisficing or nonresponses (Downes-Le Guin et al., 2012; Mahon-Haft & Dillman, 2010; Stern et al., 2007).

### **Contribution to the Quality Advancement of Nursing Education**

This manuscript is purposeful in providing novice researchers and nursing students interested in surveys with an introductory understanding of the impact, challenges, and benefits that digital technological advancement has had on the evolution of this methodology. The administration of surveys is no simple feat—it requires time, understanding, application, and critical awareness of the advantages and disadvantages that digital technology brings. As digital technology has become ubiquitous in society, the influence on survey administration should be a foundational knowledge provided to future researchers, students, and those interested in this methodology. Specific to nursing education, the

information in this manuscript aides in advancing base nursing knowledge regarding research methodologies so that future nursing scholars and researchers are best prepared to use survey methodology as proficiently as possible.

### **Conclusion**

As with any method, surveys are not without limitations, especially in light of digital technology advancement. Since their inception, surveys have gained significant momentum as a means by which researchers, organizations, agencies, and governments can learn about a specific populace. Simultaneously, several threats to surveys have emerged such as issues of trust, the impact of the digital divide, survey fatigue, and technical and design issues. Keen researchers seeking reliable and valid results must be cognizant of these limitations and seek opportunity to employ some of the strategies outlined in this paper to reduce these threats. While digital technology continues to transform surveys and the emerging possibilities improve survey design (e.g., rising broadband capability, digital media), it remains imperative that researchers stay alert to the challenges that digital technology brings.

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**Chapter Four:****Gamification in Continued Education Modules and the Instructional Materials Motivational Survey**

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### Abstract

**Background:** Gamification has increased in popularity nursing education, owing to its several potential benefits including the ability to positively impact motivation. However, past studies have primarily explored the use of gamification in traditional student environments. Further exploration is needed in the practicing Registered Nurse (RN) population, where many RNs are required to participate in continued education as a part of licensure. It is believed that participation in continued education positively impacts competency, and thereby patient outcomes, and hence, the relationship between gamification and motivation is of significant interest. **Objectives:** The purpose of this study was to ascertain whether there is a difference in motivation between RNs completing gamified and non-gamified online learning modules, and whether the Instructional Materials Motivational Survey (IMMS) is a valid tool to measure motivation in a practicing RN population. **Methods & Design:** A two-group, post-test design was used to compare participants' responses between the gamified versus non-gamified modules of a continued competence program. Participants were invited to complete the IMMS following completion of an online continuing education module. Total motivational scores between the gamified and non-gamified data were compared. To identify which variables were associated with the total motivational scores, Principal Components Analysis (PCA) was completed independently for both the gamified and non-gamified datasets. **Results:** There was no significant difference in motivation between RNs completing gamified and non-gamified modules. PCA determined that the constructs of attention and relevance were primarily supported in a practicing RN population. **Conclusion:** The evidence of the attention and relevance in both datasets highlighted that these constructs might be more important to RNs than material presented in a manner aimed to satisfy or increase confidence. Furthermore, the potential impact of motivational orientation also emerged as an underlying factor. Ultimately, more study is needed to better understand the relationship between gamification and

motivation, and its subsequent impacts on knowledge application and patient outcomes in the practice environment, via randomized and comparative study designs.

### **Gamification in Continued Education Modules for Registered Nurses**

Among health educators, the use of innovative instructional strategies that promote learner motivation and critical knowledge application to improve patient outcomes is at the forefront of discussion (Brull & Finlayson, 2016). One such strategy is gamification, the application of gaming elements to a non-game setting (Deterding et al., 2011). The sharp rise of improved world-wide connectivity and multimedia technologies has propagated the use of gamification in ways that were previously not possible due to limitations in online modality, broadband capability, graphics, aesthetics, and more (Davidson & Candy, 2016; Kapp, 2012). As a neoteric instructional strategy in the nursing discipline, gamification is emerging as a contender with potential benefits for the practicing nursing population such as the ability to motivate learners and impact knowledge retention; this is fundamental to the longstanding belief that participation in continued education positively impacts patient outcomes (Di Leonardi & Biel, 2012; Griscti & Jacano, 2006; Manley et al., 2018; Stobinski, 2019). As the next generation of nursing students are increasingly digitally savvy, contemporary instructional strategies must keep up with learners' technological capabilities to keep them motivated and to promote knowledge retention and critical application (Day-Black et al., 2015; Furdu et al., 2017).

Canadian regulatory bodies require Registered Nurses (RNs) to participate in continued educational opportunities to maintain licensure and to ensure the delivery of safe care to patients. However, for education to be effective, the entirety of the learning process should be considered, as motivational factors and content delivery can impact the learning process (Connolly et al, 2020; Dichev & Dicheva, 2017; Kapp, 2012). Motivation is a significant factor in the learning process, as learners who are motivated may be more apt to engage, recall, and apply knowledge (Dichev & Dicheva, 2017; Kapp, 2012). The potential for gamification to positively impact motivation among nurses remains to be explored. If nursing care and its impacts on patient outcomes can be influenced by an instructional strategy, this begs the question, is gamification a motivating instructional strategy for nurses?



## Background Information

It is important for educators to consider aspects of content delivery and motivating factors, especially in the context of continuing education and the role gamification can play (Dichev & Dicheva, 2017; Kapp, 2012). Arguments for continuing education are that it helps to decrease the disparity between basic education and practice, and enriches knowledge and skill development for continued competence and improved patient outcomes, although this relationship remains inconclusive (Nalle et al., 2010; Stobinski, 2019). Despite the increased availability of a variety of continuing education programmes, knowledge delivery has generally remained unchanged, or primarily didactic, discouraging nurses from engaging in learning, and potentially leading to limited knowledge application (Griscti & Jacono, 2006; Stobinski, 2019).

Strategies and technologies such as software and online applications, as well as a greater understanding of online teaching and learning, are at the centre of educational discussion. Over the past decade, owing to its successes in the corporate sector, there has been a great surge of interest in gamification as an instructional strategy in the education field (Dichev & Dicheva, 2017). Initial studies have reported favourable outcomes in the ability of gamification to improve learner satisfaction, increase motivation, and augment knowledge retention (Brigham, 2015; Chang & Wei, 2016; Faiella & Ricciardi, 2015; Kapp, 2012).

The ubiquitous application of technology across society has promoted the use of games across traditional non-game settings (Nacke & Deterding, 2017). Since gamification emerged in the educational sector, it has enjoyed an exalted status as an up-and-coming instructional strategy that can positively impact student levels of motivation, and it has been credited with increasing grades and knowledge retention (Dichev & Dicheva, 2017; Hamari et al., 2014; Hung, 2017). However, despite its popularity, a growing critique of gamification is that its hype overshadows its actual utility and limitations. Better understanding of the relationships between gamification and variables such as motivation, satisfaction,

knowledge retention, or knowledge application are needed (Hamari et al., 2014; Dichev & Dicheva, 2017). The nursing profession has only just begun to explore these concepts, as evidenced by the emergence of publications related to this topic primarily in the last decade. Further limited is research related to the use of gamification among post-graduate RNs. Hence, this study explored whether gamification influences the motivation of post-graduate nurses, and what tools or models exist that can guide how motivation can be assessed in a practicing RN population.

### **Attention, Relevance, Confidence, Satisfaction Model of Motivation**

The Attention, Relevance, Confidence, Satisfaction (ARCS) model and the Instructional Materials Motivational Survey (IMMS) were developed by John Keller as a tool to determine how instructional strategies impact learner motivation (Keller, 1987). As the ARCS model of motivation was developed in the 1980s when educational instruction was primarily delivered face to face, a modified version of the IMMS was used for this study due to the online modality of the continued education modules (see Appendix A and B). The ARCS model builds upon motivational theories in relation to instructional design, and examines motivation in the context of learning; it contains both a framework for designing instructional strategies and a survey to test these instructional strategies for how motivated students are to utilize them (Keller 1987; 2010).

Keller considered attention, relevance, confidence, and satisfaction as constructs of motivation and these constructs are measured by items in the IMMS. Each of the survey's 36 items represents one of the four ARCS constructs: 12 items measure attention; nine items each measure relevance and confidence; and six items measure satisfaction. Keller (1987) believed that motivation is dynamic and constantly evolving, and is impacted by multiple factors occurring simultaneously (such as the presence of the instructor or the use of appropriate instructional strategies). While the IMMS has been utilized in various educational and learner demographics, it lacks utilization in the nursing field; this study sought to better understand the use of the IMMS in the practicing nursing population.

## Continuing Education Modules

At the time of this study in 2018, the College and Association for Registered Nurses of Alberta (CARNA) provided five online continuing education modules. A third-party vendor specializing in gamification was contracted to gamify two of the modules, while the remainder were developed using a voice-over, didactic instructional design. The modules and the instructional strategy used are identified below:

- Infection Prevention & Control (IPC) (*gamified*),
- Unlock the Leader in You (*gamified*),
- Privacy and Confidentiality (*non-gamified*),
- Nursing Informatics 101 (*non-gamified*), and,
- The Essentials of Nursing Documentation (*non-gamified*)

A distinct design framework for gamification was not identified. However, the following components were considered: The objectives of the project, the target audience, the requirements, content, creative direction, technical direction, task, timelines, and budget. Overall, the gamified modules robustly integrated elements of gamification such as goals, time limits, reward structures, feedback, levels, aesthetics, replay, avatar use, problem solving, safe environment, and a sense of mastery.

## Purpose and Research Questions

The purpose of this study was to ascertain whether there is a difference in motivation between RNs completing a gamified or a non-gamified online learning module, and whether the IMMS is a valid tool to measure motivation in a practicing RN population. The following research questions were posed:

- 1) Is there a difference in motivation between RNs completing a gamified versus non-gamified online module?
- 2) Is the modified IMMS a valid tool to assess motivation among a practicing RN population?

## Methods & Study Design

Ethics approval was obtained from the University of Alberta's Research Ethics Board and the survey was administered via REDCap, a data collection and management tool hosted and supported by the Women and Children's Health Research Institute at the University of Alberta. The survey consisted of two components: demographic information (age range, occupation, sex, nursing area, reason for completing the module, the module completed, duration of time between module and question completion), and the modified IMMS. For items in the IMMS, participants responded using a Likert scale and also had the option to provide narrative feedback. This study utilized a two-group, post-test design by comparing participants' responses to the gamified versus non-gamified modules. Statistical tests used to describe the cohort included the Mann-Whitney U and t-tests for comparison of means. These were used to describe the total motivational scores between the gamified and non-gamified data.

To identify which variables were associated with the total motivational scores, Principal Components Analysis (PCA) was completed independently for both the gamified and non-gamified datasets. The suitability of the 36-item survey for PCA was first examined by assessing the correlation matrix. Each variable in both datasets (gamified and non-gamified) was reviewed for a correlation greater than 0.3 with at least one other variable. A correlation coefficient of less than 0.3 on the correlation matrix signifies a lack of correlation with another variable and therefore, any item scoring below 0.3 was removed from analysis (Laerd Statistics, 2020). Individual Kaiser-Meyer-Olkin (KMO) measures were reviewed, and communalities were assessed for appropriate sample size. A Varimax orthogonal rotation was used in both datasets. Finally, scree plots and eigenvalues were used to determine the number of factors and amount of variance explained for both the gamified and non-gamified groups. Statistical Package for Social Sciences (SPSS) software Version 23 was used to analyze the quantitative data. While open-ended narrative comments were collected, they are the focus of a separate analysis.

## **Participants**

RNs who had previously consented to participate in research opportunities from CARNA were recruited via email and encouraged to complete one of the five online learning modules. An invitation to participate and reminders were sent over a period of three months to groups of 4000 RNs every two weeks. The regulatory body also advertised the online modules on social media accounts and the quarterly online publication. RNs with access to the Internet were included, whereas participants', who identified as other types of healthcare professionals, and those RNs without access to the online modules, were excluded from the study.

## **Results**

### **Demographics**

In total, of the 354 participants who initiated the survey, 231 RNs completed both the demographics portions of the survey and the modified IMMS, following completion of one of the five modules. The demographics of the respondents are presented in Table 2. The Privacy module was the least selected with 17 participants completing the module (7.5%), and the Informatics module was the most popular (29.4%, n=68). Most participants completed the survey the same day they completed their selected module (66.2%, n=153), however, 20.3% of participants completed the survey more than one month after completing the module. The remaining 13.5% participated in the survey within one week to one month of completing the module.

**Table 2***Demographics*

<b>Demographics</b>	<b>%</b>	<b>n<sup>1</sup></b>
<b>Sex</b>		
Female	94.4	218
Male	5.6	13
<b>Profession</b>		
Registered Nurses	98.3	227
Other*	1.7	4
<b>Age (in years)</b>		
+56	35.5	82
40-55	53.3	123
20-34	11.3	26
<b>Area of Practice</b>		
Acute & Critical Care	30.4	70
Specialty	32.5	75
Education/Research/Admin	16.5	38
Other	20.8	48
<b>Module Completed</b>		
IP & C (gamified)	19.9	46
Leadership (gamified)	23.8	55
Privacy (non-gamified)	7.5	17
Documentation (non-gamified)	19.4	45
Informatics (non-gamified)	29.4	68
<b>Time of Survey Completion</b>		
Same Day	66.2	153
Within 1 week	7.8	18
Within 2 weeks	2.2	5
Within 1 month	3.5	8
More than 1 month	20.3	47
<b>Reason for Module Completion</b>		
For yearly licensure renewal	21.7	53
Lifelong learning	61.5	150
To meet conditions placed on license	0.8	2
Other	16	26

**Group Comparison**

Gamified and non-gamified modules were coded for comparison (1= gamified, 2=non-gamified).

Using the Mann-Whitney-U test, the variances of the two groups for overall motivation scores were

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<sup>1</sup> n = number

Other\* = Participants who identified as 'Other' professions included two clinical nurse educators, one occupational health nurse, and one who had returned to school fulltime.

homogenous and assessed by a Levene's test for the equality of variances ( $p = .838$ ). The motivational score was not statistically significantly different between the gamified ( $Mdn = 2.05$ ) and non-gamified ( $Mdn = 2.13$ ) modules:  $U = 6705$ ,  $z = .279$ ,  $p = .780$ . The lack of statistical significance was also confirmed via a t-test, which determined similar findings; there was no statistical difference between total motivational scores of the participants in the gamified versus the non-gamified modules,  $M = 0.04$ , 95%  $CI[-0.09, 0.17]$ ,  $t(229) = 0.640$ ,  $p = .838$ .

### Survey Analysis

Variables 1, 7R, 24, and 31R were noted to have generally low correlations in the gamified dataset; and, in the non-gamified dataset, variables 1, 19R, 24, 25, and 26R were identified as having only one to three correlations slightly above 0.3; as such, these variables were more closely examined during the remaining analysis. Items 1, 7R, 19R, and 25 measured the construct of confidence; items 24 and 31R measured attention, and 26R measured relevance.

Individual Kaiser-Meyer-Olkin (KMO) measures were reviewed and the majority of the values ranged from middling ( $>0.7$ ) to marvellous ( $>0.9$ ) (Kaiser, 1974). As the variables 1, 7R, and 31R were previously identified in the gamified dataset as having low correlations in the correlation matrix, as well as low KMO values, these variables were removed from further analysis. The KMO measures for the non-gamified dataset were all above 0.5; therefore all variables were kept in the analysis. The overall KMO measure was 0.876 (non-gamified) and 0.832 (gamified), indicating good sampling adequacy. A Varimax orthogonal rotation was used in both datasets. Bartlett's Test of Sphericity was statistically significant with  $p < 0.005$  for both the gamified and non-gamified datasets, confirming that the data was suitable for PCA.

Based on the scree plot, three components were retained for the gamified dataset and four for the non-gamified dataset. In the gamified dataset, eigenvalues were significant for only the first 3 components. Both the fourth and fifth eigenvalues, despite being greater than one, demonstrated a very

small difference (1.439 vs 1.303). When more than one eigenvalue of a component is approximately one, it leads to issues with interpretability (Laerd Statistics, 2020). In the non-gamified dataset, only the first 4 components demonstrated at least a 5% variance, despite eigenvalues greater than one. In the non-gamified dataset, the four-component solution accounted for 59.2% of the total variance, and in the gamified dataset, the three-component solution accounted for 54.9% of total variance.

The last but most important criterion is the interpretability criterion, which essentially demonstrates whether the theoretical component structure outlined by the eigenvalue, scree plots, and total variance, makes sense (see Appendix E for additional tables). For both datasets, PCA was run using a Varimax rotation, using forced extraction (the number of components to extract was based on the scree plot) with variables removed if communalities or individual KMO measures were low. Variables were retained if they presented a factor loading  $>0.50$  and other cross-loadings were  $<0.30$ . Additionally, as a component should have at least three factors loaded to be significant, both the gamified and non-gamified dataset dropped the last component as each only loaded two factors.

In Table 3, factors loaded on three components and Cronbach's Alpha demonstrated adequate internal reliability within each component. However, the third component only loaded two factors and was removed from further analysis. The gamified dataset thus retained 11 items. The interpretation of the components was somewhat consistent with the constructs of the original IMMS in that the factors loading on Component 1 were mostly aligned with the construct of attention (4/8) and factors loading on Component 2 were mostly aligned with the construct of relevance (2/3). In Table 4, the non-gamified dataset demonstrated factor loadings on four components; however, again the last component was only supported by two factors and therefore did not meet the minimal requirement to be retained.



**Table 3***Rotated Correlation Matrix with Varimax rotation– Gamified dataset*

Item	Component 1	Component 2
11. The quality of the writing helped to hold my attention.	0.828	
36. It was a pleasure to work on such a well-designed module.	0.796	
8. The design of this module was eye-catching.	0.765	
22R. The amount of repetition in this module caused me to get bored sometimes.	0.762	
10. Completing this module successfully was important to me.	0.743	
14. I enjoyed this module so much that I would like to know more about this topic.	0.709	
2. There was something interesting at the beginning of this module that got my attention.	0.571	
26R. This module was not relevant to my needs because I already knew most of it.	0.548	
13. As I worked on this module, I was confident that I could learn the content.		0.773
18. There are explanations or examples of how RNs use the knowledge in this module.		0.756
6. It is clear to me how the content of this material is related to things I already know.		0.625
<i>Cronbach's Alpha</i>	0.89	0.74

This dataset retained 12 items with the fourth component removed. Components 1 and 2 demonstrated a Cronbach's Alpha of >0.8, whereas the third Component had an internal reliability of < 0.6. Component 1 primarily aligned with the construct of attention (4/5); Component 2 was comprised equally of constructs of relevance and satisfaction (2 each); and Component 3 was primarily aligned with the construct of confidence, however, its Cronbach's Alpha of 0.58 signalled lower internal reliability.

**Table 4***Rotated Correlation Matrix with Varimax Rotation – Non-Gamified dataset*

<b>Item</b>	<b>Component 1</b>	<b>Component 2</b>	<b>Component 3</b>
8. The design of this module was eye-catching.	0.802		
17. The way the information is arranged on the webpage helped keep my attention.	0.797		
28. The variety of reading passages, exercises, illustrations, etc., helped keep my attention on the module.	0.763		
2. There was something interesting at the beginning of this module that got my attention.	0.745		
27. The wording of feedback after the exercises, or of other comments in this module helped me feel rewarded for my effort.	0.509		
6. It is clear to me how the content of this material is related to things I already know.		0.759	
32. It felt good to successfully complete this module.		0.71	
30. I could relate the content of this module to things I have seen, done, or thought about in my own practice.		0.635	
5. Completing the exercises in this module gave me a satisfying feeling of accomplishment.		0.587	
3R. This material was more difficult to understand than I would like for it to be.			0.715
7R. Many of the learning tabs had so much information that it was hard to pick out and remember the important points. [SEP]			0.659
19R. The exercises in this module were too difficult.			0.554
<i>Cronbach's Alpha</i>	0.84	0.80	0.58

### Discussion

The aims of this study were to explore whether there is a difference in motivation among practicing RNs when completing a gamified versus a non-gamified online module, and whether the IMMS is a valid tool to assess motivation among a practicing RN population. Foremost, there was no noted difference in motivation between RNs who completed the gamified and non-gamified modules as determined by the Mann-Whitney U test. This lack of difference could be interpreted to mean that gamification is no more nor less impactful on learner motivation in comparison to a non-gamified

instructional strategy. However, as stated earlier, the learning process is complex and a multitude of factors that impact motivation ought to be considered.

First, as each module varied in content from the other, this may have skewed findings. Further study using modules that share content but differ in the applied instructional strategy are necessary for true comparison, as is a randomized study. Next, as the IMMS has previously been tested in populations such as K-12 children, post-secondary students, or specific subsets (such as older adults) who may have other motivational reasons for engaging in their targeted learning activity, the motivational orientation of the post-graduate nursing population's may vary in comparison. Participation in continued education to promote and positively impact patient outcomes is a worthy goal of continued competence programs. Nonetheless, the motivational reasoning by which learners choose to engage in continued learning opportunities should be considered, in addition to the instructional strategy used to positively impact learner motivation. For RNs, the difference between self-determination and choosing to engage in continued education versus being mandated to participate to avoid a consequence is the difference between intrinsic and extrinsic motivation.

In Alberta, RNs are required to demonstrate evidence of participation in a wide array of self-reflection and learning opportunities undertaken over the course of the year to obtain licensure. Regulatory bodies argue that mandatory participation in continued education advances the profession's development and thereby upholds the principles of autonomy and self-regulation (Stobinski, 2019). However, common criticisms of this regulatory approach include that the risk of punitive measures for not completing continued education is an ineffective method to motivate learning, and second, the assumption that mere participation is effective in demonstrating competence. The relationship between participation in continued education and improved patient outcomes remains inconclusive. Hence, motivational orientation is significant to this discussion and warrants further investigation within the practicing RN population in comparison to the instructional strategy utilized. For further discussion, does

the motivational orientation of practicing RNs impact knowledge retention, knowledge application, or patient outcomes, and does the type of instructional strategy used further impact these relationships? Does gamification have the ability to intrinsically motivate those RNs who may initially be extrinsically motivated to complete a learning activity? In this study, approximately 22% of RNs indicated that they completed one of the online modules only to meet yearly licensure requirements, while 61.5% indicated that their participation was for altruistic reasons. However, as this was not a randomized study, it is not surprising that those keen to engage in continuing education would be represented on a higher scale. Additionally, the varied content of the modules did not allow for a true comparison of instructional strategies (gamified versus non-gamified) and ability of participants to self-select the module of their choice may have also impacted overall results. While gamification is an up-and-coming instructional strategy that has been studied more extensively in other learner populations regarding its ability to positively impact learner motivation, better understanding of the relationship between practicing RNs' motivational orientation and gamification is needed.

Next, while PCA revealed useful information regarding motivation, not all of the constructs of the IMMS were supported in a practicing RN population. Note that Keller originally developed the IMMS to be used in a face-to-face setting among primary and secondary school learners (Keller, 1987; 2010), but it has since been modified and applied in a variety of settings including online modality and other populations such as post-secondary students and older adults. In this study, the original IMMS was modified to assess the online modules in a post-graduate RN population. Between both datasets (gamified versus non-gamified), only two or three constructs were supported. For the gamified dataset, Component 1 and 2 aligned with the constructs of attention and relevance; and in the non-gamified dataset, Component 1 supported the construct of attention; Component 2 was supported by an equivalent number of items related to relevance and satisfaction (meaning that no distinct construct emerged); and the items supporting Component 3 related to the construct of confidence. The

similarities between the two datasets related to attention and relevance could suggest that the items that generally attracted the attention of RNs and those deemed relevant to their ability to learn (such as Item 8 - The design of this module was eye-catching, or Item 6 - It is clear to me how the content of this material is related to things I already know), were more important than those that left the RN feeling satisfied or confident in their abilities (such as Item 1 – When I first looked at this module, I had the impression that it would be easy for me). As practicing professionals with previous foundational education, these findings suggest that RNs desire information delivered in a manner that grabs their attention and is relevant to their goals for learning, and are generally less concerned with material presented in a manner that increases their confidence or satisfaction.

The constructs of attention and relevance are also found to be more prevalent in the reduced version established in this study, which could be related to the fact that the original IMMS also contained a disproportionate number of attention and relevance items (Keller, 2010) and several items supporting the satisfaction construct were removed from analysis. In addition, others argue that a construct such as satisfaction has less association with printed material, which may have been impacted by the online modality of the modules (Keller, 2010; Loorbach et al., 2015). This finding is significant to the future development of continuing education modules, where the delivery of content should emphasize relevance to practice and learning goals, and key use of instructional design to keep an RN's attention is prioritized.

Both the number and the type of items retained in the PCA between both datasets differed from one another. The gamified dataset resulted in 11 items that primarily supported the constructs of attention and relevance, whereas the non-gamified dataset supported all four original ARCS constructs across three components and 12 items. As the constructs of attention and relevance were confirmed in both datasets, it is possible that these two constructs do have significance among the RN population. The constructs of relevance and satisfaction require further review in the practicing RN population as

these constructs were only identified in the non-gamified dataset. It is also possible that as the IMMS was originally designed for a non-gamified setting, that these constructs were more applicable to the participants completing the non-gamified modules.

Last, only three retained items were similar between the two datasets (items 2, 6, and 8). This difference in retained items could be attributed to the content variation between the available modules, as well as the learning needs of the RN and the modules chosen for completion. Other studies have also explored IMMS validation in other populations but not all have clearly outlined the items retained or the rationale for why they were retained. For example, Foli, Karagory & Kirby (2016) utilized an 11-item reduced version of the IMMS and determined that nursing students were motivated by digital badges, whereas Hauze and Marshall (2020) validated the IMMS in an undergraduate nursing student population following the completion of a clinical training simulation. Their study determined that 19 items supported the four original IMMS constructs, however, they also asserted that the environment could have influenced their findings. Their study was tested in a “traditional higher education environment” (p. 9), similar to the original IMMS. Last, Loorbach et al. (2015) validated a reduced version of the IMMS that contained 12 items, which supported all four original constructs, but was tested in a voluntary, older adult population.

This study is one of the first to explore using IMMS among a practicing RN population in a non-traditional setting. Better understanding of motivational orientation of non-traditional learners is also significant to how well the impact of instructional strategies can be assessed. The authors believe that there is a need and a desire for the IMMS to be reduced and utilized more fluidly. The reduced version of the IMMS determined by the gamified and non-gamified datasets primarily validated the constructs of attention and relevance. More study is needed to ascertain whether all the ARCS constructs apply to a practicing RN population.

### **Limitations**

Several factors impacted data collection and limited findings. Foremost, the study was conducted within a Canadian context, which limits generalization to other populations, and utilized a post-test design only. It was thought that having participants complete multiple surveys would inhibit participation, especially during summer months when many RNs are away, hence, only a post-intervention survey was administered. The length of the IMMS may have contributed to lack of interest or respondent fatigue. While 354 participants initiated the survey, only 231 completed it; and it was noted that some respondents began to skip items towards the end of the modified IMMS. The study design lacked random assignment, and as the content within each module varied, a true comparison between gamified and non-gamified modules was not possible. Participants may have selected a module based on the content rather than based on the gamified or non-gamified state. This highlights the necessity of future studies using a two-group, randomized sample, and modules developed with the same content and varied instructional strategies (such as gamification) for true comparison.

### **Conclusion**

The results of this study show that there was no significant difference in motivation between RNs completing a gamified versus non-gamified learning module, and that the IMMS did not support all four constructs of the ARCS model when tested in a practicing RN population. Identifying limitations provides insight for future study. It is still unclear whether gamification is a motivating factor for nurses when applied in continued education modules. Hence, it remains significant to determine the ability of gamification to motivate a practicing RN population using the modified IMMS. While gamification has gained momentum in recent years as a burgeoning instructional strategy, more evidence is required to better establish the relationship between it and its ability to motivate learners, and in turn its impact on knowledge retention, knowledge application and, ultimately, in the nursing profession and patient outcomes.

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## **Chapter 5: Summary and Next Steps**

The purpose of this work was to explore gamification in the nursing population. This included a review of both gamification in nursing literature and of survey methodology; an examination of gamification's ability to motivate RNs when used as an instructional strategy in online continued education modules; and, an exploration of whether the IMMS was a valid tool to measure motivation among the post-graduate nursing population. Three main findings emerged from this work; one, that gamification is a growing topic in nursing literature and continues to require further exploration; second, despite surveys ubiquitous presence in society, the advantages and challenges arising as a result of digital technological evolution must be considered in addition to traditional threats; and third, there was no noted difference in motivation among RNs completing a gamified or non-gamified module, and that the constructs of attention and relevance were primarily supported through IMMS validation for the practicing RN population.

### **Discussion, Implications, and Significance to the Nursing Profession**

Despite that this study did not determine a difference in motivation between RNs completing a gamified or non-gamified module, it contributes knowledge to an understudied area within the nursing profession by examining the use of gamification and the IMMS in a continued education context and among a practicing RN population. I feel that this work has significance beyond the educational context; in particular, these findings can contribute to foundational knowledge regarding future research of instructional strategies and their influence in the patient care setting. The relationship between continued education and clinical practice is of consequence to external stakeholders such as nursing regulatory bodies and healthcare authorities. I believe that ultimately, better understanding of knowledge translation related to gamification has a significant role to play in the validity of continued education programs to influence practice and their impact on patient care outcomes. This study sought to explore whether gamification influenced RNs to be more motivated to learn and whether the IMMS is

a valid tool for use among a practicing RN population. The areas of focus in this study (ex. gamification, motivation, continued education, survey use) have provided a footing for a future program of research to explore additional questions such as – How does the relationship between motivation and gamification impact knowledge retention or learner satisfaction? In turn, how do these impact knowledge application in clinical practice? Can gamification positively impact patient care outcomes? Is the IMMS the best tool to evaluate an instructional strategy's ability to motivate RNs? Are patient health outcomes improved because RNs were motivated to learn? As mentioned in the third manuscript, further research through the use of different research designs and comparison of gamified and non-gamified modules will aide in answering these questions, and can better clarify the relationship between gamification and motivation in the practicing RN population.

One of the main findings from this work resulted from an integrative review that explored gamification in nursing literature. The review determined that gamification was of increasing interest to the nursing profession and of the six main themes that emerged from the integrative review process, it was clear that the lack of construct conceptualization had an effect on the others. This is significant to the nursing profession as it is apparent that construct conceptualization should be at the forefront of consideration to help establish a more concrete foundation on which other areas can build, such as implementation and evaluation strategies. Nurse researchers are encouraged to utilize this opportunity to capitalize on these findings and contribute to ongoing knowledge development. Among the studies reviewed, several identified that knowledge retention was an essential aspect for consideration; however, most assessed immediate recall or an assessment after a short duration. Long-term knowledge retention related to gamification use remains unknown, and yet, if it shows promise, would be wholly significant for its potential ability to improve patient outcomes. The integrative review provided an overview of the current state of knowledge regarding gamification in nursing and identified ongoing gaps in knowledge that require further exploration.

The second manuscript provided an overview of how survey methodology has evolved due to the advancements over time in digital technology. This paper was directed at novice researchers and students to help guide them to understand the breadth and depth of consideration they must undertake prior to survey administration. As stated previously, the prevalence of consumer surveys has created a false perception that surveys are an effortless and informal method of data collection. In addition to considering how to mitigate traditional threats such as measurement or coverage error, one must consider how to foster participant trust and demonstrate how participation will be done in a confidential manner and ensure privacy. Furthermore, understanding the influence of the digital divide, satisficing, survey fatigue, and technical and design concerns, is of utmost importance as the nursing population is not immune to these issues. The review of these issues in light of the digital technological evolution provides researchers with a fresh and comprehensive overview to best consider these factors when surveying the RN population.

Last, the results from the third manuscript demonstrated that there was no difference in motivation between RNs completing a gamified versus a non-gamified module, and PCA revealed that the constructs of attention and relevance constructs were more supported among the RN population than the constructs of confidence and satisfaction. Findings suggested that the motivational orientation of RNs, the variation in the content between the modules, and the lack of randomization might have influenced results. This study did acknowledge several limitations to consider for future study, however, this work also provides a foundation to build upon for future study of gamification in a post-graduate nursing population. The implications of these findings have potential to inform future development of continued education courses (such as potentially focusing on strategies that attract attention and demonstrate relevance) for RNs, and also highlighted a need to trial different research design methods to determine a true comparison between gamified and non-gamified modules. Improved understanding of the relationship between gamification and motivation provides a cornerstone for future knowledge

development related to knowledge retention and knowledge application. Ultimately, RNs participating in continued education opportunities should be able to demonstrate or integrate their newly acquired knowledge in the patient care setting in order to improve patient outcomes.

The practicing RN population is under-studied in literature examining gamification and the IMMS. The mandatory requirement for Canadian RNs to participate in continued education opportunities and the significant role of the RN in Canada's healthcare system, compels the necessity of continuing this research. This work provides a basis for further contributions – it is not enough to understand if gamification can motivate RNs to learn or which items of the IMMS can best evaluate gamification's ability to motivate RNs – rather, research should progress onward to better understand how gamification influences RNs and whether gamification can play a role in knowledge translation.

#### **Next Steps: Future Research**

There are two significant areas for future development. Foremost, data collection also included 10 cognitive interviews with RNs who had participated in completing both the module and the IMMS. While surveys have many advantages, a disadvantage is their inability to provide insight regarding nuances and contextual factors which may impact responses (Desimone & Le Floch, 2004; Hofmeyer et al., 2015); for this reason, cognitive interviewing (CI) was also used to validate the IMMS. Participants may interpret statements differently than what a question intends to ask as word meanings, contexts, and other factors may alter how a participant construes a statement (Hofmeyer et al., 2015; Willis & Artino Jr., 2013). CI helps to establish validity of a survey by providing insight into survey content and the thought processes of the participant (especially if participants' understanding is inaccurate), and also provides opportunity for the participant to ask for clarification, which is not possible when using online self-administered surveys (Hofmeyer et al., 2015; Willis & Artino Jr., 2013). These findings have potential to contribute to IMMS validation in the practicing RN population.

Second, the limitations identified in the third manuscript highlight the necessity for a different research design to respond to the weaknesses of the initial study. Foremost, a randomized, two-group, pre-and post-intervention assessment is required to truly ascertain the influence gamification has on motivation of the post-graduate RN population. This would require the development of a gamified and non-gamified version of an online module that contains the same content/materials but differs in instructional strategy. Ideally, an adequate sample size comprised of RNs from varied professional backgrounds and age groups is ideal to better assess aspects such as motivational orientation. Additional areas of future research include comparison of gamification with other instructional strategies; further examining the relationship between gamification and knowledge translation; and long-term studies exploring the influence of gamification on knowledge retention.

Last, a personal goal is to disseminate my findings at nursing education conferences. This work was accepted at the Sigma Theta Tau Nursing Education Research Conference taking place in Washington, D.C. in March 2020, as well as in Sitges, Spain, for the Nurse Education Today - Nurse Education in Practice (NETNEP) 2020 conference, however, both of these opportunities were cancelled due to the pandemic. In the meantime, I have continued to focus on preparing my manuscripts for publication and I look forward to seeking future opportunities to present my findings.

### **Limitations**

In addition to limitations outlined in the manuscripts, I experienced several challenges throughout my dissertation journey that resulted in either significant learning or alternative planning. This included challenges with technical aspects, design issues, and personal obstacles. Foremost, having obtained ethics approval in June 2018, I was limited to a short three-month window for participant recruitment and data collection, as the modules were potentially being removed from the regulatory body's website after this time period. As recruitment was limited to the months of July-September, which coincided with the summer season and peak months for vacation time, I feel that these factors



contributed to my response rate, as evidenced by the several out-of-office emails I received. In addition, the email lists that were provided by CARNA were not up to date, which resulted in me receiving many emails from RNs who stated they had not consented to be contacted for research purposes.

There were also the added challenges of learning the necessary software applications for both the delivery of my survey and data analysis. This included the REDCap and SPSS software – both with which I had limited previous experience and required significant training and practice. While learning how to use these tools remained challenging, I am immensely grateful for the knowledge and assistance that each of these resources provided. Last, I began this journey very much a research and publication novice; this journey has been wholly informative and I have learned so much about conducting research and the publication process.

### **Conclusion**

Gamification is indeed an exciting venture – a fresh, innovative, and fun strategy that the nursing profession has begun to examine. But, as evidenced by this study, many of its potential benefits remain elusive. Still, this study contributes to the foundation of nursing knowledge by examining what is currently known, what should be considered, and what remains to be explored. Having examined the current state of gamification in nursing literature, assessed considerations of survey methodology in light of evolving digital technology, and an initial utilization of the IMMS in a practicing RN population, the knowledge attained from this work provides a foundation on which the nursing profession can continue to build. There remains a gap in our ability to evaluate the relationship between gamification and motivation, and yet, the significance of identifying this relationship in a tangible manner, especially given its potential influences on patient outcomes, continues to drive this quest forward in the nursing field. While the IMMS is one tool that could be used to demonstrate an authentic relationship between gamification and motivation, there may be other options for future opportunities. The study of motivation, rich in history, remains a worthy venture.

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### Appendix A: Instructional Materials Motivation Survey (IMMS)

1. When I first looked at this lesson, I had the impression that it would be easy for me. [L] [SEP]
2. There was something interesting at the beginning of this lesson that got my attention. [L] [SEP]
3. This material was more difficult to understand than I would like for it to be. [L] [SEP]
4. After reading the introductory information, I felt confident that I knew what I was supposed to learn from this lesson. [L] [SEP]
5. Completing the exercises in this lesson gave me a satisfying feeling of accomplishment. [L] [SEP]
6. It is clear to me how the content of this material is related to things I already know. [L] [SEP]
7. Many of the pages had so much information that it was hard to pick out and remember the important points. [L] [SEP]
8. These materials are eye-catching. [L] [SEP]
9. There were stories, pictures, or examples that showed me how this [L] [SEP] material could be important to some people. [L] [SEP]
10. Completing this lesson successfully was important to me. [L] [SEP]
11. The quality of the writing helped to hold my attention. [L] [SEP]
12. This lesson is so abstract that it was hard to keep my attention on it.
13. As I worked on this lesson, I was confident that I could learn the content.
14. I enjoyed this lesson so much that I would like to know more about this topic. [L] [SEP]
15. The pages of this lesson look dry and unappealing. [L] [SEP]
16. The content of this material is relevant to my interests. [L] [SEP]
17. The way the information is arranged on the pages helped keep my attention. [L] [SEP]
18. There are explanations or examples of how people use the knowledge [L] [SEP] in this lesson. [L] [SEP]
19. The exercises in this lesson were too difficult. [L] [SEP]
20. This lesson has things that stimulated my curiosity. [L] [SEP]
21. I really enjoyed studying this lesson.
22. The amount of repetition in this lesson caused me to get bored [L] [SEP] sometimes. [L] [SEP]
23. The content and style of writing in this lesson convey the impression [L] [SEP] that its content is worth knowing. [L] [SEP]
24. I learned some things that were surprising or unexpected. [L] [SEP]
25. After working on this lesson for a while, I was confident that I would be [L] [SEP] able to pass a test on it. [L] [SEP]
26. This lesson was not relevant to my needs because I already knew [L] [SEP] most of it. [L] [SEP]
27. The wording of feedback after the exercises, or of other comments in this lesson, helped me feel

rewarded for my effort. [L]  
[SEP]

28. The variety of reading passages, exercises, illustrations, etc., helped [L]  
[SEP] keep my attention on the lesson. [L]  
[SEP]
29. The style of writing is boring. [L]  
[SEP]
30. I could relate the content of this lesson to things I have seen, done, or [L]  
[SEP] thought about in my own life. [L]  
[SEP]
31. There are so many words on each page that it is irritating. [L]  
[SEP]
32. It felt good to successfully complete this lesson. [L]  
[SEP]
33. The content of this lesson will be useful to me. [L]  
[SEP]
34. I could not really understand quite a bit of the material in this lesson. [L]  
[SEP]
35. The good organization of the content helped me be confident that I [L]  
[SEP] would learn this material. [L]  
[SEP]
36. It was a pleasure to work on such a well-designed lesson. [L]  
[SEP]

### Appendix B: Modified Instructional Materials Motivation Survey (IMMS)

1. When I first looked at this module, I had the impression that it would be easy for me. [L] [SEP]
2. There was something interesting at the beginning of this module that got my attention. [L] [SEP]
3. This material was more difficult to understand than I would like for it to be. [L] [SEP]
4. After reading the introductory information, I felt confident that I knew what I was supposed to learn from this module. [L] [SEP]
5. Completing the exercises in this module gave me a satisfying feeling of accomplishment.
6. It is clear to me how the content of this material is related to things I already know. [L] [SEP]
7. Many of the learning tabs had so much information that it was hard to pick out and remember the important points. [L] [SEP]
8. The design of this module was eye-catching. [L] [SEP]
9. There were stories, pictures, or examples that showed me how this material could be important to RNs. [L] [SEP]
10. Completing this module successfully was important to me. [L] [SEP]
11. The quality of the writing helped to hold my attention.
12. This module is so abstract that it was hard to keep my attention on it.
13. As I worked on this module, I was confident that I could learn the content.
14. I enjoyed this module so much that I would like to know more about this topic. [L] [SEP]
15. The design of this module was dry and unappealing. [L] [SEP]
16. The content of this material is relevant to my interests. [L] [SEP]
17. The way the information is arranged on the webpage helped keep my attention. [L] [SEP]
18. There are explanations or examples of how RNs use the knowledge in this module. [L] [SEP]
19. The exercises in this module were too difficult. [L] [SEP]
20. This module has things that stimulated my curiosity. [L] [SEP]
21. I really enjoyed studying this module. [L] [SEP]
22. The amount of repetition in this module caused me to get bored sometimes. [L] [SEP]
23. The content and style of writing in this module convey the impression that its content is worth knowing. [L] [SEP]
24. I learned some things that were surprising or unexpected. [L] [SEP]
25. As I worked through this module, I was confident that I would be able to pass a test on it. [L] [SEP]
26. This module was not relevant to my needs because I already knew most of it. [L] [SEP]
27. The wording of feedback after the exercises, or of other comments in this module helped me feel



rewarded for my effort. [L]  
[SEP]

28. The variety of reading passages, exercises, illustrations, etc., helped keep my attention on the module.
29. The style of writing is boring. [L]  
[SEP]
30. I could relate the content of this module to things I have seen, done, or [L]  
[SEP] thought about in my own practice. [L]  
[SEP]
31. There are so many words on each webpage that it is irritating. [L]  
[SEP]
32. It felt good to successfully complete this module. [L]  
[SEP]
33. The content of this module will be useful to me. [L]  
[SEP]
34. I could not really understand quite a bit of the material in this module. [L]  
[SEP]
35. The organization of the content helped me be confident that I would learn this material.
36. It was a pleasure to work on such a well-designed module. [L]  
[SEP]

## Appendix C: Consent Form & Participant Information Letter

### Consent Form for Instructional Strategies & Continuing Competency Learning Modules: Instructional Materials Motivational Survey (IMMS)

Hello – My name is Upinder Singh and I am a PhD Candidate at the University of Alberta. I invite you to provide approximately 20 minutes of your time to complete the following 36-item survey. Your participation is significant to learning more about instructional strategies and their impact on user motivation. I am working in collaboration with CARNA to examine how current learning modules utilize varying instructional strategies and how these instructional strategies impact user motivation. This study has been approved by the Human Research Ethics Board at the University of Alberta. By proceeding with completion of this survey, you are agreeing to the terms of data collection and consent as outlined in this document. Thank you for your time.

#### Study Title:

A Comparison of Gamified and Non-Gamified Learning Modules

#### Research Principal Investigators

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University of Alberta

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You are being invited to participate in a research study. This study seeks to evaluate how differing instructional strategies impact user motivation via the Instructional Materials Motivation Survey (IMMS). This study uses a survey and it will take place online.

#### Background

As a healthcare professional, you are required to participate in ongoing education to demonstrate continuing competence within your profession. Similar to other professions, the College and Association

of Registered Nurses of Alberta (CARNA) has created several learning modules that Registered Nurses (RNs) may access to learn more about topics that are of significant importance to the nursing profession. How content is delivered within these learning modules is of great interest to regulatory bodies, educators and to the Primary Researcher. Content delivery and its impact on learner motivation are wholly significant to knowledge application and knowledge retention. This study seeks to examine how differing instructional strategies impact user motivation. Results from this study may provide a foundation for future investigation of how instructional strategies impact knowledge translation in the clinical setting and its impact on patient care outcomes.

### **Purpose**

The purpose of this study is to evaluate how gamification impacts motivation in comparison to other instructional strategies when utilized in online learning modules within continuing competency programs for healthcare professionals. The following elements are being evaluated:

- (a) Differences in user motivation between gamified and non-gamified learning modules
- (b) Validation of the Instructional Materials Motivation Survey

### **Study Procedures**

The evaluation of each continuing competency learning module will be completed using a survey developed through REDCap. Participants will be provided with an opportunity to complete the survey after completion of the following learning modules: Infection Prevention & Control, Unlock the Leader in You, Privacy and Confidentiality, and the Essential of Nursing Documentation.

### **Benefits**

While there are no direct benefits to you, the participant, your participation will benefit the Primary Investigators, the University of Alberta and CARNA to better understand how specific instructional strategies impact user motivation. This will benefit the development of future learning modules using instructional strategies that motivate users. The data collected in this study will be presented at nursing education conferences and published in scholarly journals. Sharing these results will inform other nursing educators to utilize specific instructional strategies in continuing competency environments to best motivate users.

**Risk**

Participants may be at risk for mental fatigue due to the length of time required to complete the module and the survey. Each module may take approximately 1.5-2 hours to complete and the survey requires 20 minutes of time. To mitigate this risk of mental fatigue, participants have the option of completing the survey on a separate day from when the module is completed. Additionally, some modules also provide an opportunity for the participant to enter and exit the modules as needed, so that it may be completed over a longer period of time.

Due to the online modality of the survey and the learning modules, participants may feel that their confidentiality, privacy or anonymity is at risk. Please note that REDCap does not allow for IP monitoring and no personal identifiers are requested in the survey. Your responses are anonymous and will be grouped together during data analysis and reporting so that anonymity is maintained. CARNA does not have access to your results until shared by the Primary Researcher at which point they will have been amalgamated for increased anonymity.

**Voluntary Participation**

Your participation in this this will not influence your licensing ability in any way. Your decision to participate is voluntary. Both the Primary Researcher and CARNA will not have any access to any data collected until after the data collection period is complete and as no personal identifiers are tracked or collected, you cannot be identified. More information regarding confidentiality and anonymity is presented below.

Your consent for data collection is demonstrated via completion of the survey.

**Confidentiality & Anonymity**

The survey is provided via REDCap, which is a data management tool provided by the University of Alberta. REDCap does not allow for IP monitoring. The survey is set up to obtain anonymous responses only. CARNA will have no access to your responses until the data collection period is complete and results are shared by the Primary Researcher. Only the Primary Researcher can access your responses once data collection is finished and data results will be combined prior to being shared or published to enhance anonymity and confidentiality. Any voluntarily shared personal identifiers will not appear in any publications or presentations.

Responses will not be accessed until after the study's data collection completion date of September 30, 2018. You may OPT-OUT of participating in the survey by closing the survey webpage. Unsaved responses will not be collected. Responses are saved and collected once the 'Submit' button is selected on each page. Opting out after clicking the 'Submit' button or after completion of the survey is not possible as REDCap provides complete anonymity of responses. There is a 'Submit' button on each page and once the data is submitted, the entered data cannot be withdrawn from the study as the Primary Researcher has no way of knowing which responses belong to which participant.

### **Privacy**

Results are collected via REDCap and saved on a local server at the University of Alberta. All data remains in Canada and is subject to Canadian law only. Results will be accessed by the Primary Investigators only after the data collection period is complete. Data will be secured on an encrypted and password protected USB. This USB will be placed in a locked cabinet when not in use. Emails used to contact RNs consenting to participate in research will not be shared.

### **Data Retention & Disposal**

Data will kept for five years in accordance to University of Alberta research data policies. Data will kept on an encrypted, password protected USB in a secured cabinet when not in use. After five years, the data will be deleted and the USB destroyed.

### **Further Information**

- Please contact Upinder Singh at (780) 807 1479 or [usingh@ualberta.ca](mailto:usingh@ualberta.ca), or Colleen Norris, PhD Supervisor, at [colleen.norris@ualberta.ca](mailto:colleen.norris@ualberta.ca) if you have any additional questions.
- If you would like to participate in the interview portion of this research study, please email [usingh@ualberta.ca](mailto:usingh@ualberta.ca) More details will be provided to those interested in participating.
- The plan for this study has been reviewed for its adherence to ethical guidelines by the Human Research Ethics Board at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 493-2615. The office has no direct involvement with this project.

### Appendix D: Additional Tables

**Table 5**

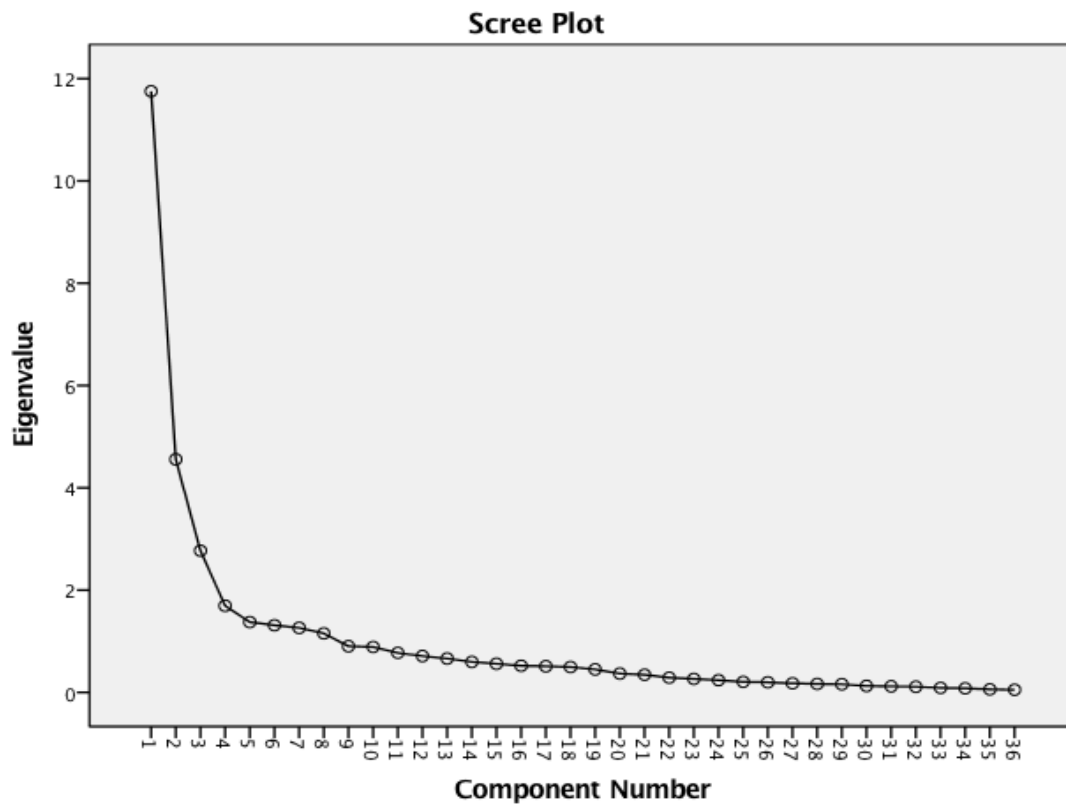
*Percentage of Total Variance*

Gamified			Non-Gamified		
Extraction Sums of Squared Loadings			Extraction Sums of Squared Loadings		
Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
11.753	32.648	32.648	13.228	36.744	36.744
4.558	12.660	45.308	3.500	9.722	46.466
2.771	7.697	53.005	2.543	7.064	53.530
1.695	4.709	57.714	2.033	5.647	59.177
1.375	3.820	61.534	1.407	3.909	63.086
1.314	3.650	65.184	1.190	3.304	66.391
1.262	3.507	68.691	1.008	2.800	69.190

**Table 6**

*Eigenvalues*

Component	Gamified			Non-Gamified		
	Initial Eigenvalues			Initial Eigenvalues		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.753	32.648	32.648	13.228	36.744	36.744
2	4.558	12.660	45.308	3.500	9.722	46.466
3	2.771	7.697	53.005	2.543	7.064	53.530
4	1.695	4.709	57.714	2.033	5.647	59.177
5	1.375	3.820	61.534	1.407	3.909	63.086
6	1.314	3.650	65.184	1.190	3.304	66.391
7	1.262	3.507	68.691	1.008	2.800	69.190

**Table 7***Gamified Scree Plot*

**Table 8***Non-Gamified Scree Plot*