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A RISK-BASED APPROACH TO BLENDED LEARNING DESIGN FOR HEALTHCARE WORKPLACE TRAINING

BY

DEBORAH EXELBY

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Approval of Thesis

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Dedication

To my parents, Betty and Gary Exelby, who have unwaveringly supported me in everything I have attempted. They taught me that I could do anything I set my mind to, at a time when women were hindered from undertaking some streams of education and limited to certain professions. This thesis came to be through their value of ongoing learning and higher education.

To my partner in life and biggest cheerleader, Bryon Longeway, I could not have completed the thesis journey without you.

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Abstract

New employee orientation and ongoing compliance training ensure that healthcare staff are competent and confident to perform their duties and provide safe patient care. There is no industry standard or evidence-informed decision framework that determines when to use in-person, face-to-face, online, or blended learning for healthcare workplace training. This research aims to answer the question: Is there a relationship between perceived risk of the learning content, delivery modes, and interaction techniques in health care workplace training? An online survey and correlation analysis were used to rank the preferences of healthcare workplace instructional designers. Quantitative analysis found statistically significant preferences for: 1) learner-instructor and learner-content interaction for high-risk content, 2) in-person face-to-face delivery via learner-content interaction for high-risk learning content, and 3) learner-content interaction for medium-risk learning content. This study enabled a proposed risk-based training and orientation planning support (RB-TOPS) matrix for instructional design decision-making that aids healthcare operational readiness.

Keywords: instructional design, workplace training, risk-based, healthcare, operational readiness, quantitative.

AI Disclaimer

The information provided in this thesis is the author's original work, and no content was created using generative artificial intelligence technologies.

Preface

I started my instructional design learning and thesis journey as an operational readiness consultant, working with several large health authorities to open new hospitals. At the time, I was responsible for managing the learning and performance support component of these projects, to prepare healthcare staff to open the new facilities safely. These capital projects, with budgets in the range of $600M or more, involve modern high-tech buildings that are very different from the old workplace; with a much larger footprint, different workflows, and new equipment, systems, policies, and procedures.

All clinicians, staff, and physicians, numbering in the thousands, require workplace training and orientation as close to opening day as possible, which presents a complex logistical challenge that impacts the entire organization. Though these projects have substantial training and orientation budgets, the lack of staff resources is the rate-limiting step for training and orientation in the healthcare workplace. Large numbers of staff cannot be available for training at one time because of a lack of capacity to backfill.

In my experience, there is a long and entrenched tradition of in-person, face-to-face, instructor or clinical educator-led training in the healthcare workplace, which is difficult, if not impossible, to provide in an environment where staffing issues limit the ability to allow staff to attend in person. The problem I encountered, and the motivation for my thesis research, centres around determining the best method of training and orientation in the healthcare workplace while balancing the ethical dilemma related to knowingly reducing the time, budget, emphasis, and perhaps the quality of some elements of the needed learning content and its potential impact on patient safety.

New employee orientation and workplace training are costly endeavours, and generally, training needs far outweigh the training budget, making it imperative that training departments and instructional designers can justify training time and cost. The ability to demonstrate a return on investment is essential in workplaces such as healthcare, where patients’ lives depend on staff using equipment and building systems correctly and who struggle with chronic staff shortages and turnover that prevent time-consuming training that takes staff away from the bedside.

When we need medical care, we assume that healthcare providers are competent and confident to perform their duties, especially for procedures or the use of equipment that presents a risk of injury, if used incorrectly. How do we know that healthcare workplace training is provided in a way that balances efficiency and effectiveness while ensuring patient safety? Surprisingly, we don’t; there is no standard. It is the responsibility of instructional designers to identify when to include in-person, face-to-face, online synchronous, and online asynchronous, or a blend of these learning modalities in their training plan and how to justify the training costs to senior leadership. This study aims to address these organizational problems and decision issues.

Table of Contents

List of Tables

List of Figures and Illustrations

List of Symbols, Nomenclature, or Abbreviations

ADDIE	Analysis, Design, Development, Implementation, and Evaluation training model
BL	Blended learning delivery mode
CABLS	Complex adaptive blended learning system
COI	Community of inquiry
EQuiv	Interaction Equivalence Theorem
FMEA	Failure modes effects analysis
H_0	Null hypothesis
H_1	Alternative hypothesis
HFMEA	Health failure modes effects analysis
ID	Instructional design(er)
ISD	Instructional system design
LC	Learner-content interaction
LI	Learner-instructor interaction
LL	Learner-learner interaction
OR-NEO	Operational readiness – New employee orientation
RB-TOPS	Risk-based Training & Orientation Planning Support
SME	Subject matter expert

Online or In-person: A Risk Based Approach to Blended Learning Design for Healthcare Workplace Training

Chapter I. Introduction

Introduction

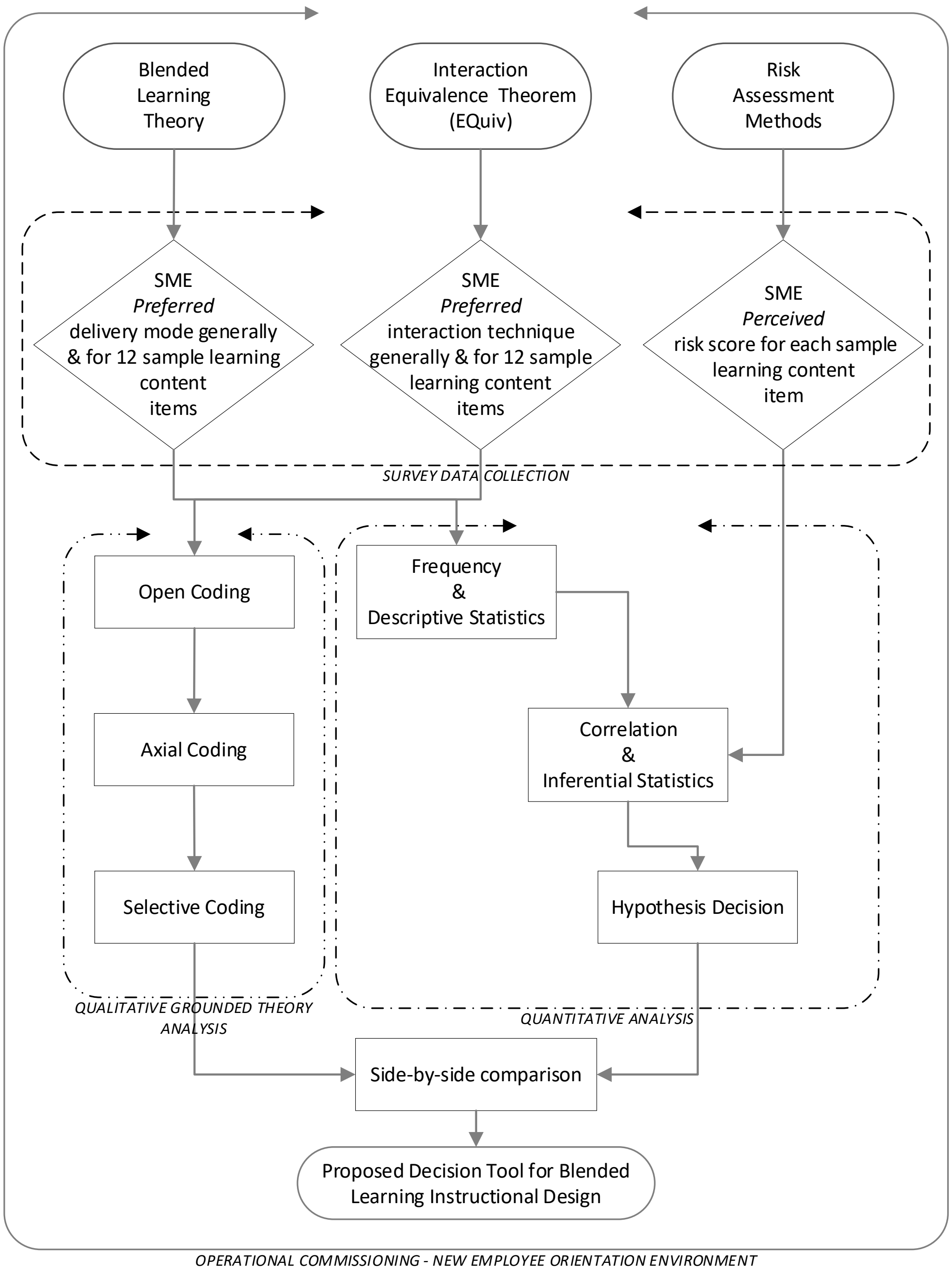
Corporate training has adopted blended learning as a solution to cost, time, and resource-constrained learning environments, yet the decision-making process for its instructional design remains unreported in the literature (Kim et al., 2008). The instructional designer's perspective in corporate learning environments has been largely overlooked in favour of students' perceptions and achievements concerning blended learning curricula in higher education (Bozkurt, 2022). Through the instructional designer's lens in the healthcare context, this study will investigate the optimal blend of learning interaction techniques and delivery modality that supports the initial design of high-level learning for workplace training. An exploration of risk-based learning interaction and delivery system (online or in-person face-to-face) design decisions will be undertaken.

This study has two primary purposes: 1) to better understand and report instructional designer's preferences for interaction techniques and delivery modes, and 2) to propose a decision tool that will aid instructional designers in justifying, standardizing, and improving the efficiency and effectiveness of corporate training programs. The high-level steps and processes by which this study will achieve its purpose are outlined in Figure 1 – Conceptual Thesis Framework and Research Strategy.

Anderson's (2003) interaction equivalence theorem (EQuiv) serves as a blueprint for examining instructional design from the designer's perspective in the corporate learning context to determine if there is a relationship between three components: interaction technique, risk to patients if learning is not at a high level, and online and/or in-person face-to-face training modality. This study expands on the utility of EQuiv by exploring its application from the previously ignored instructional designers' perspective in corporate training to determine what interaction technique (learner-learner, learner-content, learner-instructor) should be used and how the chosen techniques should be provided (online, in-person, and/or blended), from a risk-based stance. A strong positive correlation between risk, interaction technique, and delivery modality enabled the development of the 'RB-TOPS' (risk-based training and orientation planning support) decision framework.

Figure 1

Conceptual Thesis Framework and Research Strategy



Note. This conceptual framework outlines the high-level steps that will be taken to complete the study. SME = subject matter expert – study participant.

Background – Past Research

Moore (1989) first presented the imperative of instructional designers choosing interaction techniques and delivery modes best suited to the learning content for maximizing a learning program's effectiveness and efficiency. This study will address Moore's call for determining the best interaction design by examining course designers' perceptions about learning interaction techniques and modes of delivery for designing training for the healthcare workplace.

Anderson (2003) added to Moore's premise by introducing the interaction equivalence theorem (EQuiv), comprised of three equal and interchangeable interaction techniques deemed crucial for high-level online learning: learner-content interaction (LC), learner-learner interaction (LL), and learner-instructor interaction (LI). Though Anderson's interaction equivalence theorem reflects the online learning context (i.e., an interactive synchronous or learner-driven asynchronous training delivery mode that is accessible anywhere via computer-based technology), the application of EQuiv in the corporate learning context is poorly reported in the literature and does not identify relationships between the instructional designer's perception of the most beneficial interaction treatments for risk-stratified online and in-person learning content. The application and optimization of EQuiv's mix of interaction dyads have not been sufficiently studied for the corporate healthcare environment, where time and resource constraints influence the form of interaction (LC, LI and/or LL) and delivery mode (online and/or in-person) used (Graham & Massyn, 2019).

The healthcare workplace training environment is traditionally a constructivist context where collaborative tasks and workflow are designed to be interactive among peers, reflecting a need for appropriately programmed learner-learner (LL) interaction, in addition to learner-content (LC) and learner-instructor (LI) interaction. The EQuiv is an appropriate foundational organizing element (conceptual framework) in this study, representing a constructivist perspective (Dewey as cited in Anderson 2003). Evaluation of how EQuiv's three learning techniques are used in this potentially blended learning environment is predicated on the assumption that there is no significant difference between the effectiveness of online and in-person learning (Bernard et al., 2009).

Statement of the Problem - Issues and Deficiencies

The existing blended learning literature does not capture how instructional designers determine course/program design decisions for corporate training regarding the use of delivery mode and interaction techniques, nor does it outline how a risk-based approach may be helpful (Horton, 2016). This study topic was selected to address instructional designers' struggle to find a harmonious balance between online and in-person delivery systems and interaction techniques (Osguthorpe & Graham, 2003).

Empirical studies of interaction techniques and delivery mode preferences have focused on the learner's perspective concerning satisfaction and achievement in the higher education online environment, not the instructional designer’s preferences and decision-making in the corporate blended learning context (Graham & Massyn, 2019). The applicability and use of Anderson’s (2003) EQuiv theorem in corporate, blended learning, design decision-making have not been reported. In addition, the use of risk analysis in instructional design has been reserved for determining learner profiles to identify learning needs, outcomes, and effectiveness, not reported in the literature as a tool to assess and choose the most effective and efficient delivery of content to be learned (Horton, 2017).

Purpose of the Study

The purpose of this study is to expand the use of the interaction equivalence theorem (EQuiv) and Horton’s (2012) risk-based decision-making logic to contribute to the field of instructional design and blended learning in the corporate environment. This study aims to fill a research gap and identify a context-specific blended-learning instructional design framework. The intent is to develop a decision framework that predicts delivery mode(s) and associated learning interaction techniques, using a risk-based learning needs approach that aids designers in determining the learning content best suited for online delivery (Bernard et al., 2009). This study will contribute to the research on effective and efficient instructional design in cost, resource, and time-constrained contexts.

The goal of this study is to understand and enable effective utilization of available training resources by:

- Examining the instructional designer’s general preference for the use of interaction (LL, LC and/or LI) and delivery mode (online and/or in-person) in association with the perception of content risk (high, medium, or low).
- Evaluating the instructional designer’s perceptions and preferences about instructional design in the corporate training context.

- Verifying Anderson's (2003) interaction equivalence theorem in practice, by determining what levels of interaction instructional designers perceive as crucial for quality learning.
- Examining the relationship between 1) content type (skill or knowledge-based) and delivery mode, 2) content type and interaction techniques, 3) interaction techniques and delivery modes, 4) interaction technique and learning content risk, and 5) delivery mode and learning content risk.
- Determining if the findings/principles as reported by Graham and Massyn (2019) are supported by instructional designer preference:
  - LL interaction is best suited for skills-based or socially-oriented types of learning content.
  - LL interaction can substitute for LI when subject matter expertise is not needed.
  - LC and/or LI interaction are preferred for online delivery.
  - LL is the least preferred interaction.
  - LC, not LL or LI, are used in combination.
  - LI is preferred for face-to-face learning.
  - Complex content to be learned (high-risk content) requires LI interaction and/or more than one interaction technique.

This study explores a 'grounded approach,' described by Hirumi (2013), where theory, research, and practice alignment are used to identify a framework that helps instructional designers make design decisions that facilitate learning. Development of a grounded design framework that is rooted in risk assessment, learning modality (online versus face-to-face), and interaction (Equiv) theories will be established based on healthcare instructional designer's preferences. An attempt will be made to validate and extend the concept of risk-based decision-making for learning, which may prove to be generalizable to any workplace with training and orientation learning content that can be risk-stratified (Hirumi, 2013; Horton, 2016).

Research Question and Sub-questions

Question

This study explored the question: Is there a relationship between the risk score of learning content and online or face-to-face delivery of healthcare workplace training?

- The null hypothesis (H_0) to be tested: There is no relationship between instructional designers' preference for interaction technique, delivery mode, and perceived risk score for healthcare workplace training content.
- Alternative hypothesis (H_1): There is a correlation between the risk score of healthcare learning content and the decision to use online training and interaction techniques in a healthcare blended learning environment:
  - H_1.A: High-risk competencies correlate positively with instructor-mediated in-person face-to-face training.
  - H_1.B: Low-risk competencies correlate positively with asynchronous learner-driven online training.

Sub-questions

Three sub-questions have been identified.

- What interaction and delivery mode combinations are valued/used most often by instructional designers for blended learning knowledge-based content? Skill-based content?
- What is the relationship between the perceived quality of interaction (high or low level), the quantity of interaction (multiple modes), and the preferred delivery mode (online or in-person) of blended learning?
- When do instructional designers perceive that online and in-person delivery modes are required?

Significance of the Research

This study will add to the literature about what and how instructional designers apply blended learning in a corporate learning environment (Giacumo & Breman, 2020). The impact of this research, through the creation of a risk-based decision tool, is to support instructional designers to justify blended learning delivery modes in a cost-, resource-, and time-constrained context. Instructional designers' perceptions of risk, delivery modality, and optimal interaction design for workplace training in the healthcare learning environment may aid in developing a standard approach for competency-based training in other corporate environments.

An adaptation of the 64-interaction EQuiv (Interaction Equivalency Theorem) design model will be used to evaluate the patterns of interaction used by instructional designers to design blended learning (Anderson & Miyazoe, 2012). All combinations of the EQuiv interaction techniques associated with delivery mode and risk analysis will be explored to determine the optimal design for healthcare workplace training and thereby verify Anderson's (2003) theorem in practice. An evaluation of instructional designer's perceptions of the use of interaction includes answering the following questions:

- What interaction techniques do instructional designers perceive as valuable/necessary for high-quality learning?
- Do instructional designers use all three interaction techniques in combination, or is only one interaction provided at a high level?

In addition, this research will build on Anderson's theorem by:

- Evaluating instructional designers' perceptions of interaction techniques in combination with delivery mode and content risk level, and
- Identifying the relationship between content risk, delivery mode, and interaction technique.

Limitations

The conditions and influences in this study that the researcher cannot control include snowball recruitment, self-selection to participate, the number of survey responses, completion of all survey questions, a questionnaire provided in limited languages, and researcher bias. (Creswell & Creswell, 2017).

Delimitations

Factors under the researcher's control include the sample demographic - those surveyed will be limited to persons who self-identify as instructional designers (i.e., clinical educators, workplace instructors, project managers, and consultants) who design workplace training for healthcare. The findings of this study will potentially be generalizable to blended learning instructional design for training in corporate environments other than Canadian healthcare.

Definition of Key Terms

Terms that may be unfamiliar or unique to this study are listed in Appendix A. A complete list of symbols, nomenclature, and acronyms is listed on page xi.

Chapter II. Review of the Literature

Introduction

Research Topics and Context

This literature review examines three topics that have emerged from the scholarly literature and are presented in the following order: healthcare workplace training environment and new employee orientation, risk-based decision-making, and blended learning instructional design modes of delivery and interaction (Creswell & Creswell, 2017). These topics provide a rationale for the research study: exploring risk-based blended learning instructional design for workplace training in healthcare. The research context is specific for employee training and orientation to new, different, and compulsory learning content: processes (i.e. workflows), procedures, systems, and equipment that will ensure the safe delivery of healthcare by providing the correct training interaction (LL, LC and/or LI) and delivery mode (online and/or in-person), via "the right information, at the right time, to the right people" (Bahlis, 2008; Mubayrik, 2018; WSBC, 2020).

This research topic interests corporate leadership, trainers, and instructional designers who must provide compliance training within cost, time, and human resource availability constraints. Though substantive, relevant literature is available regarding risk analysis, blended learning modes of content delivery, and interaction techniques, there is a clear gap in the literature that aligns these concepts together for instructional design decision-making. The seminal articles by Moore (1989) and Anderson (2003) provide the foundation of this study. The interaction equivalence theorem (EQuiv) guides the study's conceptual and methodological framework, as outlined in Figure 1. Though the topics that comprise this literature review are broad and potentially overwhelming, the context within which this study is focused (healthcare workplace training) is sufficiently narrow to enable targeted data collection and findings that may potentially apply to employee orientation and training in other workplaces. The healthcare context was purposely selected as the best workplace environment to ensure risk analysis would include content to be learned that spans the entire range of low, medium, and high risk.

Research Goal

The goal of this thesis research is to create a risk-based decision tool for workplace blended learning design in alignment with (see Appendix B) the Community of Inquiry framework (https://www.thecommunityofinquiry.org/coi) and Interaction Equivalence Theorem

(Anderson, 2003; Garrison & Arbaugh, 2007). This research aims to develop a predictive analysis model or methodological framework for use by instructional designers as a decision tool to analyze and select the best interaction(s) and delivery mode(s) to develop impactful (meets the learning outcomes) and efficient (cost and time effective) blended learning plans for the workplace (Bahlis, 2008; McMeekin et al., 2020).

Research Assumptions

In the context of healthcare curriculum development, this study assumes a workplace training need has been established based on compliance with health and safety regulations and the introduction of new staff, workflows, systems, and/or equipment. The most cost-effective methods related to staff training time, training delivery, administration, and maintenance over time are required, and enhanced staff and patient safety underlie all workplace learning outcomes (Bahlis, 2008). This study also assumes that the instructional designer has completed a learning needs assessment that includes the engagement of appropriate subject matter experts (i.e. clinicians, vendors, and/or instructors), thereby enabling the instructional designer to complete a risk assessment of the content to be learned.

Concept One – Healthcare training and new employee orientation

Operational readiness, also known as activation planning, operational commissioning, or transition planning, is the component of capital projects (new builds or renovations) that involves preparing staff to occupy a new workspace (Reno, 2014). An essential part of operational readiness is training and orientation to the new workplace environment’s footprint, workflows, equipment, building systems, and building equipment. This thesis research will approach operational readiness (OR) as a context-specific form of new employee orientation (NEO).

Workplace Orientation

New employee orientation (NEO) and ongoing compliance training are indispensable to maintaining healthcare staff competency in an ever-changing workplace environment; however, significant confusion exists in the literature. NEO is described as a ‘transition programme’ for newly graduated staff (typically nursing), new-to-setting, socialization, or an orientation programme that offers structured professional development (Peltokoski et al., 2016, p. 93). Effective onboarding and socialization programmes are linked to lowered employee turnover and improved performance of routine work assignments (Baker & Feldman, 1991). This research will focus on and engage workplace training and orientation professionals who identify as instructional designers, to explore training planning for healthcare workplace learning.

The tactics included in a healthcare workplace training program include competency-based; periodic; general and unit/department specific; and process training based on goals, responsibilities, standardized content, and varied methods of implementation and evaluation using a mix of online or in-person learning components (Baker & Feldman, 1991; Peltokoski et al., 2016). It is rationalized that if patient safety is the goal, a risk-based approach is appropriate for determining the orientation competencies and delivery methods relevant to the learning content and the training aims (Baker & Feldman, 1991). The focus of this research is to investigate how general and unit-specific content ought to be taught, specifically which content items are amenable to online learning in a blended learning format.

Successful staff transition into a workplace is facilitated by reducing uncertainty using a variety of training methods (i.e., using a blended learning framework), including formal (i.e., planned online or in-person instruction) and informal (i.e., unscheduled online or just-in-time performance support) channels (Bauer et al., 2007; Kotey et al., 2011). There has been significant exploration of graduate and advanced nursing transitions; however, research regarding orientation programs for new-to-setting clinical and clinical support staff has been inadequate. Exploration of the learning processes and content design of healthcare's high-risk context will provide valuable insight that is generalizable to any of the three kinds of new employee orientation: new graduate/recruit staff (e.g., organizational socialization), new to the organization (i.e., onboarding or induction), and staff transitioning to a new role in the organization (e.g., re-socialization), and perhaps to the broader corporate compliance and new employee orientation context (Bauer et al., 2007; Srimannarayana, 2016).

Workplace Orientation Gaps

Peltokoski et al. (2016) concluded in their integrative literature review that there is a clear link between hospital orientation, nursing retention, and cost savings; however, they found a lack of evidence-based research regarding hospital orientation processes and strategies. Significant literature supports new graduate nurse transition to practice, though there are no evidence-based methods to provide competency-based support for new-to-setting transitions nor the role of online learning as part of a blended curriculum for clinical and clinical support staff (Chicca, 2019). Research is needed to determine what facilitates a successful new-to-setting transition and what support and training modalities best meet the learning needs of all transitioning staff, not just nursing (Chicca & Bindon, 2019). Literature specific to workplace transition training (i.e., operational readiness – new employee orientation) is absent, and the ideal mix of in-person versus online learning has not been established (Peltokoski et al., 2016). The literature is scant on the recommended blend of online and in-person delivery or a decision tool in this context (Horton, 2012), with numerous gaps and suggestions for future research about blended learning implementation in the workplace. Because blended learning is perceived to be "more effective, low cost, flexible and scalable for workplace training," a practice guideline or framework for optimal utilization of blended learning in healthcare workplace training is needed (Mubayrik, 2018, p. 249).

Why Workplace Training Research is Important

The learning outcome of interest in healthcare workplace training is to improve patient care and staff safety by proactively reducing a sentinel event, harmful incident, or near miss through successful transfer of training to the workplace (Chaeruman et al., 2020). Blended learning aims to provide an instructional design to meet this need in the most efficient manner possible. The practical application of this research will aid instructional designers in making cost-appropriate and justifiable decisions about instructional design and ensure a standard of training delivery is utilized to develop a blended learning curriculum in contexts where safety is paramount. Developing a healthcare-specific best practice framework for blended learning implementation will aid instructional designers in improving the workplace learning experience and transfer of training (Mubayrik, 2018). The extension of this study will be to use the findings for employee training design in other workplace contexts.

Concept Two – Risk-based decision making

Human Error Management

Most patient safety incidents are attributed to human error; 80% or more of incidents result from workers' actions or behaviours (Mullins-Jaime et al., 2021). The purpose and focus of healthcare workplace orientation and training are two-fold, ensuring staff are able to: 1) work safely, confidently, competently, and autonomously in a new, uncontrolled, and frequently changeable environment; and 2) verify the workplace (i.e. new building or workflow) itself has no process, design, or system failures (Mullins-Jaime et al., 2021).

Healthcare workplace training utilizes a human performance safety management approach to prevent unsafe acts by including behavioural-based safety and safety management system approaches as components of patient incident prevention (Mullins-Jaime et al., 2021). Reduction in patient safety incidents through the human performance approach entails the implementation of training or retraining to remove/reduce risk factors or error precursors, which are responsible for causing adverse events related to lacking policy, procedure, process, and task knowledge and skill (Mullins-Jaime et al., 2021).

Utility of Risk Analysis

The literature has mentioned a need to identify high-risk content requiring targeted training curriculum; however, no information was found about how to systematically identify or classify high-risk learning competencies and content for inclusion in blended learning curriculum, other than subject matter expert (SME) judgement (Dale-Tam & Thompson, 2021). An approach to this problem proposed by Renn and Klinke (2002) involves spending the fixed training budget proportionately on the skills/tasks linked to the highest risk and concluded that the standard risk assessment approach via probability and impact analysis is appropriate for solving risk problems. Alam (2016) concurs, suggesting that a proactive approach to risk assessment and mitigation is reasonable. This thesis proposes that the learning outcome, providing safe care, should drive the design of blended learning training based on the risk and criticality of failure of the content to be learned.

Risk Management Approaches & Models

Root Cause Analysis.

Training to work in a new healthcare facility, known as operational readiness – new employee orientation (OR-NEO), is crucial to patient and staff safety, provided it is delivered in a manner focused on eliminating, preventing, and minimizing high-risk patient care errors and adverse events. Root cause analysis, popular in healthcare settings for investigating unsafe acts and incidents, seeks to identify a singular root cause after an incident occurs. The retrospective root cause analysis approach is irrelevant to the newly built healthcare facility OR-NEO and insufficient to aid in the prospective planning of a blended learning program (Mullins-Jaime et al., 2021). Instead, assessing the potential consequences or impacts of poorly trained staff as an error precursor must be used to determine and prioritize the optimal interaction type and mode (online versus offline/in-person) of training content delivery (Mullins-Jaime et al., 2021).

FMEA/HFMEA Hazard Risk Analysis.

The structured and stepwise hazard risk assessment approach of failure mode effect analysis (FMEA) and healthcare FMEA (HFMEA) are widely used techniques for preventive risk management. These risk assessment techniques use a hazard score as a risk priority number to identify and prioritize the criticality of an identified risk based on the mathematical product of probability (likelihood) and severity (impact) of occurrence (Liu et al., 2020; VA, 2018). Though HFMEA has been widely used in healthcare quality improvement as a prospective risk assessment and harm prevention tool, the use of any hazard/risk analysis methodology to assign limited training resources to the most serious risks in blended learning instructional design for the workplace has not been reported (Liu et al., 2020; Rah et al., 2016; VA, 2018). To bridge the gap in the literature, Liu et al. (2020) suggest that future research should include the following:

- Utilize large numbers of experts from different departments or organizations in healthcare risk analysis to enhance the effectiveness of FMEA (i.e., a broad survey of healthcare OR-NEO training instructional designers);
- Explore the development of a consensus hazard scoring matrix within a methodological framework for blended learning design in the workplace training context; and
- Utilize different, added, and/or weighted risk factors to comprehensively rank the risk of failure modes.

The HFMEA risk assessment tool is not directly applicable in the healthcare OR-NEO context because no data regarding the likelihood of a risk parameter is available in a workplace that has not been occupied or used. An adaptation to HFMEA is required because no frequency data are available for a risk that has not been realized (Pascarella et al., 2021). To overcome the lack of available incident likelihood data for determining the hazard score, sub-criteria such as task frequency and task complexity may be used as proxies for likelihood and impact, respectively, when determining the risk score of learning content (Liu et al., 2013; Liu et al., 2020; PAC, 2011; Parsons & Capka, 1997; VA, 2018). This proposed use of two-factor hazard scoring is advocated for inclusion in a methodological framework for risk assessment (Prochazka & Melichar, 2017; VA, 2018).

Risk Matrix Utilization for OR-NEO Planning.

A risk matrix may be used as a semi-quantitative decision support tool that standardizes the risk assessment process when determining the priority ranking of corrective measures

(Pascarella et al., 2021). In the case of blended learning instructional design, a methodological framework formulated from a risk matrix provides a 'see this – do that' protocol as a standardized, predefined, decision support tool to determine the training modality (online or in-person) and interaction techniques (learner-learner, learner-instructor, or learner-content) associated with the training content risk (see Appendix B) (McKeekin et al., 2020; Prochazka & Melichar, 2017). In short, the hazard score based on the impact and frequency of risk (e.g. 3 x 3 risk matrix with scores ranging from 1-9) the blended learning modality and interaction technique to be used (Prochazka & Melichar, 2017).

The Center for Health Care Design (2017) provides a risk matrix that evaluates the likelihood and consequence of harm as part of its safety risk assessment toolkit that assesses the built design for new healthcare facilities. Though this risk matrix is specifically for evaluation in healthcare design, not healthcare training, it provides a rationale for utilizing risk assessment as a systematic analysis approach to curriculum development in the healthcare context. A novel risk management approach not found in the blended learning literature is proposed - using a risk matrix to determine the most appropriate interaction technique(s) and delivery mode for the development of a blended learning curriculum for healthcare workplace training.

Concept Three – Blended Learning Design: Modes of Delivery and Interaction

Modalities Used in Workplace Training & Orientation to Develop Competency

Experiential reports about OR-NEO can be found that outline training activities such as simulations, scavenger hunts, in-person 'day-in-the-life' practice, guided tours, peer mentor coaching, online materials for just-in-time training, and vendor subject matter expert didactic sessions; however, no literature identified how the decision was made to choose online or in-person delivery and interaction techniques for specific learning activities (Helman et al., 2016; Reno, 2014; Salas & Burke, 2002).

Methodological Framework for Developing a Decision Tool

Bahlis (2008) suggests a six-step model to prioritize and assess a corporate problem or opportunity, confirm training needs, evaluate the feasibility of implementation, forecast costs, and prioritize recommendations in a training plan; a process that implies a risk-based approach to training needs assessment. A three-phase risk-based process, outlined by McKeekin et al. (2020), provides an ideal process for developing an instructional design tool for determining blended learning content: 1) undertake a literature review to identify previous frameworks and foundational guidance in addition to gathering subject matter expertise and experience (i.e., engage instructional designers) to inform the development of the framework, 2) incorporate collected data and guidance to adapt and build on an existing framework to develop a draft new framework, and 3) use an iterative process such as Delphi to evaluate and refine the draft framework. In addition, the methodological framework for developing an instructional design model should be based on four components: function, origin, source, and analysis scheme, thereby developing a conceptual and procedural model that incorporates the instructional designer's opinions that connect context variables and learning activities (Chaeruman et al., 2020; Lee & Jang, 2014).

Blended Learning

Instructional Design.

Instructional system design (ISD) models act as process guidelines for systematically developing a training program. They are considered relevant only for the context where they are to be used and should be designed in that environment (Chaeruman et al., 2020). The learning context considers the learner, learning content, and learning outcomes to determine the specific learning objectives, interaction types, delivery modes, and activities for inclusion in the instructional design (McGee & Reis, 2012). According to Cleveland-Innes and Wilton (2018), ISD models provide guidance in determining the right blend of interaction, delivery, and activities that result in high-quality blended learning.

In practice, there are two problems with ISD models. First, though healthcare ISD models such as the Carewest (2022) learning modality decision framework for long-term care and the Paramedic National Occupation Competency Profile (2011) have been developed for their specific contexts, they are not transferable to other workplace training environments. An ISD specifically for healthcare operational readiness/new employee orientation has not been reported in the literature, leaving room for research to develop a new methodological framework for workplace training planning in this environment. Second, the well-known ADDIE design model, used by instructional designers for technology-based teaching, is too focused on learner-content design (Bates, 2014). Constructivists have criticized ADDIE's analysis phase for not considering learner-instructor and learner-learner interaction, nor how to decide between interaction techniques or online and in-person delivery modes (Bates, 2014).

Definition and Purpose of Blended Learning.

The blended learning terminology remains somewhat confusing (e.g., also known as hybrid, technology-mediated/enhanced learning, or mixed-mode learning) and is distinguished by its delivery modes; its combination of in-person face-to-face (offline), online (technology-mediated distance education) and synchronous or asynchronous instruction (Ashraf et al., 2021; Bozkurt, 2022; Cleveland-Innes & Wilton, 2018; Kim et al., 2008; Mubayrik, 2018; Wang et al., 2015). Blended learning utilizes changing pedagogies based on unique learning needs and the nature of the learning content to balance and maximize the benefits of online and in-person face-to-face delivery (Osguthorpe & Graham, 2003). In workplace training, blended learning typically provides a mix of instructor-led in-person and technology-based online learner-driven instructional delivery modalities, which build on each other to achieve better transfer of training and cost-effective training results (Lee et al., 2008). It is essential to carefully mix the various interaction types and delivery modes that best fit the learning content and context (Cleveland-Innes & Wilton, 2018).

Blended Learning Theory.

The Complex Adaptive Bended Learning System (CABLS), Community of Inquiry (COI) framework, and Interaction Equivalence Theorem (EQuiv) are learning systems applicable to the operational readiness – new employee orientation (OR-NEO) learning context (Cleveland-Innes & Wilton, 2018; Miyazoe & Anderson, 2010). Wang et al. (2015) found that none of the blended learning literature studied the one-to-many or many-to-many relationships between the six subsystems of the CABLS theory. Likewise, the COI framework has not been thoroughly investigated from a systems perspective to determine the impact of teaching, social, and cognitive presence interplay (Garrison & Arbaugh, 2007). Miyazoe and Anderson (2010) found a similar gap in the literature, where only pair-wise interactions have been evaluated between the three interaction dyads (learner-content, learner-learner, and learner-instructor) of the Interaction Equivalence Theorem.

Of the learning system theories applicable to OR-NEO blended learning, Anderson's (2003) Interaction Equivalence Theorem, which succeeded Moore's 'Three Types of Interaction' model, provides a method to analyze and decide which interaction design will be most effective and efficient for a specific context. The EQuiv proposes two theses: 1) the learner experience will be high quality provided that at least one form of interaction is provided at a high level, and 2) a more satisfying learning experience may require high levels of more than one interaction mode (Anderson & Miyazoe, 2010; 2011). Research by Bernard et al. (2009) and Miyazoe and Anderson (2010) supports the use of three types of interaction in blended learning and the concept of combined or layered interaction for higher-order achievement in high-risk skills training (see Appendix B).

With Anderson's (2003) Interaction Equivalence Theory as the underlying theoretical structure, this study will investigate the relationships and priority order of the interaction dyads in combination with delivery mode to determine a decision tool for blended learning curriculum development in healthcare workplace training. By investigating instructional design practice in healthcare workplace training development, this research will test the application and validity of the EQuiv in the workplace learning context and perhaps facilitate the development of a decision tool that instructors and designers can reference to determine the optimal blended learning design (Anderson & Miyazoe, 2011).

Utility of Blended Learning.

Instructional Effectiveness.

Blended learning has the advantage of linking learning and transfer of learning to workplace performance through the inclusion of a more convenient, customizable, media-rich, and engaging online learning environment, providing more learner-instructor and learner-learner interaction than in large in-person or online classrooms; improved accessibility, flexibility, efficiency, and opportunities for diverse learners; and enhanced learning satisfaction and outcomes (Cleveland-Innes & Wilton, 2018; Kim et al., 2008). Blended learning overcomes the limitations and inefficiencies of traditional classroom instruction by using the best of distance/online education's 'naïve constructivism' through access and interaction with the online learning environment (i.e. content, instructor, and students) and the collaborative constructivism of traditional in-person learning (Garrison, 2009).

Instructor-mediated in-person face-to-face training in combination with self-directed (online asynchronous) training is reported as the most effective training method for enhancing retention and transfer of learning to the healthcare workplace (Benson, 2004). Effectiveness stems from the support of learner control, interaction, and scaffolding; for regulatory, mandatory, and orientation topics, especially where there are challenges such as staff shortages, 24/7 operations, frequently changing content, and a need for dissemination of updated material (Ashraf et al., 2021; Benson, 2004). Online learning provides cost-effective pre-study opportunities for a flipped classroom approach and post-study performance support for just-in-time training (Fisher et al., 2020). The blended learning format resolves some barriers in healthcare workplace training and allows instructors to focus on facilitating only the in-person, face-to-face delivery of critical and high-risk department-specific topics.

Cost Effectiveness.

Applying blended learning in the higher education clinical context has been reported as a solution to resource-limited situations where online learning is used to augment a lack of bedside training opportunities (Lala et al., 2021). The appeal of blended learning in the corporate environment is its solution to the high cost of in-person training, where staffing shortages prevent cost-effective class sizes and back-fill of staff to attend. Replacing some in-person interaction components of a learning programme with online or distance education is a cost-effective way to provide learning opportunities (Anderson, 2003; Bozkurt, 2022; Cleveland-Innes & Wilton, 2018; Fisher et al., 2021). Where appropriate, online learning helps ensure the training budget is available for in-person training of high-risk competencies.

Blended Learning Models.

An essential consideration for blended learning design is the needs assessment, which determines the right blend of content delivery mode and interaction, separate from identifying specific learning activities. Though Lee et al. (2008) do not provide a method or strategy to determine the ideal learning content blend, they do identify this as a gap in the literature and offer key factors to consider:

- The degree to which the online and in-person face-to-face instruction will be integrated together in a layered delivery format; and
- In-person face-to-face delivery and instructor presence should be reserved for learning outcomes that require live demonstration, practice, discussion, coaching, and timely (i.e. immediate) corrective feedback to enhance learning outcomes and ensure safety.

An almost endless variety of blended learning designs is possible; however, the instructional designer should consider the learning context and content when deciding what should be delivered online or in-person face-to-face (Lakhal & Belisle, 2020; Lee et al., 2008). Understanding how to implement blended learning was found by Ashraf et al. (2021) to be problematic for instructional designers and remains a challenge, in part due to the lack of knowledge about blended learning models.

Blended Learning Delivery in HealthCare Workplace Training.

Models or methodological frameworks have been reported, as described by Cleveland-Innes & Wilton (2018), requiring instructional designers (i.e., clinical educators) to determine which clinical skills and competencies are best learnt online and which are best learnt at the bedside (in-person face-to-face), but have not detailed how the blend is determined other than ranking competencies based on the amount of practice needed to achieve competence (Lala et al., 2021). A ranking based on the time necessary to become competent suggests that complex, high-risk skills may require a layered approach, including online pre-read, hands-on bedside practice, and post-training performance support (Lala et al., 2021). In practice, healthcare workplace training often includes a flipped classroom and layered approach of asynchronous online activities completed as a prerequisite to in-person face-to-face synchronous activities. Ashraf et al. (2021) found that the flipped model type of blended learning design, as described by Cheng et al. (2019) and Fisher et al. (2020), was used most frequently in healthcare training where in-person class time is used for practical exercises where learners require hands-on practice to enhance skill acquisition and retention, while traditional lecture-type content was provided online as the pre-in-person face-to-face learning content.

The literature reports extensively on blended learning use in higher education and sparingly in the corporate training environment. In the workplace, teamwork and business process training (i.e., workflow) is strongly correlated with informal workplace training facilitated by internal coaches and peer mentors, not the formal in-person instructor-led classroom, while specialist training providers are preferred for the delivery of higher levels of skill instruction (Kotey et al., 2011; Smith et al., 2004). For blended learning curriculum development, it is suggested that less complex workflow simulations are best taught via learner-learner interaction facilitated by peer mentors/coaches. In contrast, complex skills are taught by subject matter experts (i.e., external vendor SMEs and/or internal clinical educators). Lee et al. (2008) and Smith et al. (2004) suggest training content that represents the highly skilled and teamwork tasks that, if completed incorrectly, correspond to high-risk incidents in the healthcare context, should be via in-person face-to-face delivery.

Blended Learning for OR-NEO Learning.

Blended learning is useful in healthcare education (Benson, 2004; Lala et al., 2021). Online learning has been adopted in healthcare to familiarise new employees with the skills, knowledge, and resources they need to meet job competencies (Shih et al., 2013). A shift from healthcare workplace training based mainly on in-person face-to-face didactic and experiential learning to a blended format that includes online learning has become accepted practice, in conjunction with peer mentor/preceptor ‘buddy shifts’ that provide context, learner-learner interaction, and practice applying newly learned knowledge and skills. This shift was well entrenched in workplace training practice; however, was accelerated by the COVID-19 pandemic and the ongoing need to orient healthcare staff when in-person face-to-face interaction was restricted (Dale-Tam & Thompson, 2021). Online learning modules in advance of in-person small group skill stations for high-risk or accreditation-required training provide a flipped classroom style of blended workplace training (Cheng et al., 2019; Dale-Tam & Thompson, 2021; Fisher et al., 2020). Case-based virtual (online) discussion is another learning modality that could be included in the training design to enhance transfer and consolidate learning through learner-learner discourse (Dale-Tam & Thompson, 2021). As part of blended learning, the specific combination of interaction and delivery modalities to be included in virtual healthcare training, warrants further exploration.

Gaps in the Blended Learning Literature.

According to Halverson et al. (2012), the seminal work in blended learning has not been empirical and requires research regarding pedagogy and design specific to contexts, disciplines, and learners. Most blended learning research has been focused primarily on higher education, educational technologies, and comparison to the ‘gold-standard’ in-person face-to-face training using qualitative measures (Ashraf et al., 2021; Bozkurt, 2022). No original or scholarly research, only grey literature, was found specific to the use of blended learning for operational readiness training – new employee orientation in the healthcare workplace, nor the particular form (online or in-person mode or interaction techniques) of training for specific competencies, skills, or tasks (Benson, 2004; I. Tamminen, personal communication, September 20, 2022; Reno, 2014). Directions for future research have been suggested to fill the literature gap and better understand workplace blended learning:

- improvement and empirical solutions to the blended learning approach rather than comparison to other educational delivery modes (Bozkurt, 2022),
- focus on understanding blended learning components and methodological diversity (Bozkurt, 2022),
- curriculum development, including instructional design strategies strictly for blended learning at the institutional or organizational level (Bozkurt, 2022),
- focus on determining a model or framework to determine the optimal blend, for use by instructional designers (Kim et al., 2008), and
- investigate quantitative implementation methods and how to design blended learning's mix of online and offline content for corporate and workplace curriculum development.

Further research to explore and evaluate what healthcare training instructional designers prefer and how they perform their work (i.e., how healthcare instructional designers and instructors are designing workplace training and how they determine the content blend) is needed to determine an appropriate decision tool for blended learning interaction. The question remains: when exactly is online learning appropriate in the healthcare workplace training environment?

Justification for Blended Learning Research.

Empirical research in the context of corporate training and medical education has not been well studied to determine the most effective combination of blended learning strategies. Only 12.5% of the top-cited blended learning publications focused on corporate and organizational training, of which few studies have evaluated the design process used by instructional designers (Halverson et al., 2014**).** Exploration of risk-based blended learning in the healthcare context provides a key research advantage; studying the analysis phase of training needs assessment in an environment with a wide variety of skills and tasks, some benign and some, if done poorly, are likely to impact people negatively, allows a robust context for studying the extremes of risk assessment for learning design**.**

Today, there continues to be a gap in the literature focusing on instructional design models for determining the right mix of interaction and delivery modes (online or offline) for workplace blended learning training (Chaeruman et al., 2020). Research is needed to investigate and develop new models for effectively blended instructional design in the healthcare workplace that best improves learning outcomes, as evidenced by reduced critical incident rates (Halverson et al., 2014). Though blended learning emerged as a viable learning delivery mode more than 20 years ago, a methodological framework has not been identified in the literature that provides a standardized step-by-step process by which skills and competencies are evaluated to determine online versus in-person or bedside learning activities, as part of the training needs analysis (Halverson et al., 2012).

Application of Learning Theory in the Healthcare Workplace Training Research Context.

Learning theories are essential for directing the practice of teaching and learning and conducting quality research (Reyes, 2013). Theories for distance education include Peter's "industrialized process" of autonomous, self-directed learners (learner-content interaction/cognitive presence) and Garrison and Shale's ideal of two-way communication (learner-learner interaction/social presence) and learner-instructor interaction/teaching presence that highlights a constructivist approach to collaborative learning and improvement in learning outcomes through interaction, support, and dialogue (Garrison, 2009). The Community of Inquiry framework links presence and interactivity at a high level; however, it does not provide a straightforward decision tool for blended learning curriculum design applicable to the healthcare workplace training environment (Cleveland-Innes & Wilton, 2018; CoI, n.d.). Anderson's (2003) Interaction Equivalence Theorem (EQuiv) connects the three dyads of learner interaction (learner-content, learner-learner, and learner-instructor) by rationalizing that 1) substituting the type(s) of interaction can be used by instructional designers without negatively impacting educational effectiveness, provided that one form of interaction is included at a high-level and, 2) more than one form of high-level interaction will provide an enhanced educational experience (p. 4). The Interaction Equivalence Theorem provides the theoretical foundation for developing a blended learning decision tool for healthcare workplace training design.

A simple heuristic (see Appendix B) uniting EQuiv with risk analysis provides a basis to explore and make inferences about the relationship between content to be learned, the types of learning interaction, and what delivery mode should occur, in-person or online (Anderson, 2003). Risk analysis is proposed as 1) a bridging tool to understand the non-linear equilibrium of the one-to-many and many-to-many relationships between the system of learning interactions and delivery modes of blended learning, and 2) a novel addition to the training needs analysis process that guides the selection of situation-specific learning activities for blended learning curriculum (Cleveland-Innes & Wilton, 2018; Wang et al., 2015). This thesis research explores blended learning curriculum development through the constructivist lens to study the balance between interactivity of the learner with content (cognitive presence), other learners (social presence), and the instructor (teaching presence) via the question: Can a risk-based assessment of content to be learned be used as a framework for determining the elements of interactivity and modes of delivery in blended learning instructional design for the healthcare workplace?

Conclusion

Based on personal experience, healthcare workplace training (i.e., operational readiness – new employee orientation [OR-NEO]) needs analysis is accomplished in two phases: 1) a team of clinical subject matter experts (SMEs) identifies the new and different building systems, equipment, procedures, and workflows as items for inclusion in the staff training and orientation program (the content to be learned), and 2) an instructional designer in collaboration with these same SMEs then determines, using experience, expertise, and available data, the most appropriate training modality and interaction techniques for inclusion in the overall learning plan. The healthcare OR-NEO-specific training needs analysis process is based on instructional designer and subject matter expert judgement, not on a documented best practice or methodological framework in the literature.

There is no known formal standard with which OR-NEO is structured (D. Erickson – Facilities Guidelines Institute (FGI) CEO, personal communication, December 17, 2021). The Facility Guideline Institute for Design and Construction, the most widely recognized standard for planning, designing, and constructing healthcare and residential care facilities, does not include OR-NEO training guidance (FGI, 2022). Similarly, the Centre for Healthcare Design (CHD) advocates for risk-based and evidence-based design but does not acknowledge the need for evidence-based training to implement building design standards (CHD, 2017). It is unclear what is being used by instructional designers in the healthcare workplace training context for blended learning curriculum development. We do know that workplace training and new employee orientation is essential for patient safety (Baker & Feldman, 1991; Peltokoski et al., 2016), risk-based assessment is an integral component of safe healthcare delivery (Liu et al., 2020; Rah et al., 2016; VA, 2018), and blended learning is engaging, cost-effective, and educationally sound (Cleveland-Innes & Wilton, 2018; Mubayrik, 2018), yet the application of a risk-based process to identify the best method of healthcare workplace training delivery has not been empirically studied.

Chapter III. Methods

This study explores how instructional designers determine course/program design for workplace training. The focus of this study was on the designer's perspective specific to blended learning in the healthcare context, to better understand the choice and balance between interaction type and online or in-person delivery modes of learning content. Risk-based decision-making is examined as a potential tool for assessing and determining the most effective and efficient instructional design relative to delivery mode and interaction types.

The following research questions were used in this study.

Main Question

1. Is there a relationship between the risk score of learning content and online or face-to-face delivery of healthcare workplace training?
   - The null hypothesis (H_0) to be tested: There is no relationship between instructional designers' preference for interaction technique, delivery mode, and perceived risk score for healthcare workplace training content.
   - Alternative hypothesis (H_1): There is a correlation between the risk score of healthcare learning content and the decision to use online training in a healthcare blended learning environment.
     - H_1.A: High-risk competencies correlate positively with synchronous instructor-mediated in-person training.
     - H_1.B: Low-risk competencies correlate positively with asynchronous learner-driven online training.

Sub-questions

1. What interaction and delivery mode combinations are valued/used (preferred) most often by instructional designers for blended learning knowledge-based content? Skill-based content?
2. What is the relationship between the perceived quality of interaction (high or low level), the quantity of interaction (multiple modes), and the preferred delivery mode (online or in-person) of blended learning?
3. When do instructional designers perceive that online and in-person delivery modes are required?

A mixed methods convergent design was employed to answer the research questions using an online survey, as outlined in the study's conceptual framework (see Figure 1). The quantitative and qualitative data were intended to be gathered simultaneously and analyzed independently. The plan was to merge the qualitative and quantitative data to better interpret, understand, and clarify the quantitative data; however, the qualitative data were minimal and did not require analysis or integration (Creswell & Creswell, 2017).

Philosophical Assumptions

The general orientation that typifies the philosophical position for mixed methods research is not based on one worldview that is best for the study context (Creswell & Plano Clark, 2018). Instead, a pragmatic worldview demonstrates the best fit for this study because it is typically associated with mixed methods as a blend of postpositivism and constructivism and "includes employing 'what works,' using diverse approaches, and valuing both objective and subjective knowledge" (Creswell & Plano Clark, 2018, p. 90).

Epistemology

Using the scientific method, we test that our beliefs are consistent with the postpositivist epistemology, where reality is determined via objective observation to gain knowledge of what we know is waiting to be discovered. Postpositivism research begins with a proposed theory or question, collects participant data, and seeks to either support or refute the theory by objectively identifying correlational relationships (Creswell & Creswell, 2017). The constructivist paradigm is also represented in mixed methods research as the researcher's intent to identify patterns and create meaning in an inductive manner, rather than verifying other's ideas or theories in a postpositivist fashion (Creswell & Creswell, 2017). This study combined postpositivist (quantitative) and constructivist (qualitative) approaches by using a tentative theory to organize the research. A hypothesis was formulated, then proven or disproven via data gathered from subject matter experts and used to generate a new decision support model. A claim is made, and then data are used to describe any correlational relationships and develop new conclusions about the situation of interest.

Ontology

Realist ontology is the study of being, where, separately from our own ideas and beliefs, there is an objective 'real world' (Creswell & Plano Clark, 2018). This study sought to find the one singular reality of what is assumed to be real in the world by testing a hypothesis to uncover and report the instructional designer's collective truth (Moon & Blackman, 2017).

Axiology

The role values play in this research focuses on the neutrality and objectivity of the researcher to engage in value-free research that seeks to understand the participant's (instructional designer) perspective. Independence from the data are maintained to help ensure the researcher's experience with the subject matter does not impact the interpretation of research findings. By employing research design methods that suit the subject matter, such as structured quantitative measurement, an unbiased and open-minded approach is fostered as foundational values, allowing the researcher to act and write in a manner that demonstrates congruence with the stated realist ontology and postpositivist epistemology (Aliyuy et al., 2015).

Methodology

The core assumption of this non-experimental mixed methods inquiry is that quantitative and qualitative data, in combination, result in findings that are more robust than either can provide independently (Creswell & Creswell, 2017). In this case, a foundational theory was identified, and key variables were translated into research questions (see Appendix C – Figure C1). Data were collected and tested using a hypo-deductive approach to determine if the theory was supported or refuted. The hypo-deductive stance uses a tentative explanatory model or theory, thought to explain the phenomena or issue under study, to direct the research study's design (Creswell & Creswell, 2017).

Role of Researcher

The researcher in this study is meant to set aside their personal assumptions and background (i.e. gender, history, culture, religion, and socioeconomic) to interpret findings (Creswell & Creswell, 2017). It is through self-reflection, reflexive journaling, and recognition of potential bias that the researcher aims for neutrality and objectivity.

By leaning more on quantitative methods, utilizing computer-assisted quantitative (IBM Statistical Package for Social Sciences [SPSS]) and qualitative data analysis software (NVivo), reflexive journaling, and data triangulation in this mixed methods study, accuracy was to be enhanced, and personal bias may be minimized (Braun & Clark, 2006; Candela, 2019; Carter et al., 2014; Mertens & Hesse-Biber, 2012; Zamawe, 2015). It was planned, but not actualized due to a lack of qualitative data, that bias would be further controlled through the use of an inductive analysis process that allows the data to tell its story without influence from the researcher's ideas or a preconceived codebook, through the rigorous application of systematic qualitative analysis that follows a structured six-phase coding method and a 15-point quality checklist (Braun & Clark, 2006).

Personal Lens

This topic is of interest and importance to me, the researcher, who works as an independent consultant for instructional design, operational readiness, and employee orientation projects in the healthcare sector. This study explores and perhaps validates my novel risk-based approach to employee training and orientation projects. In addition, there is an opportunity to support improved healthcare quality and safety by providing empirical evidence for standardization and development of best practices for health facility implementations, which is currently a missing component in healthcare facility design (D. Erickson – Facilities Guidelines Institute CEO, personal communication, December 17, 2021).

Ethical Considerations

Conflict of Interest

I am uniquely interested in the study results for consulting work purposes. To control conflict of interest and participant privacy, a purposive sample of survey participants was identified from instructional design colleagues and snowball recruitment to complete an online anonymous survey instrument. To a negligible amount, the anonymized qualitative data were collated and interpreted to enhance understanding of the quantitative data (see Findings Section question 9), not replace, influence, or change the respondents' quantitative survey results (Stevens & Pituch, 2016).

Financial interest

The development of a model for blended learning design for use in paid consulting projects may be considered a financial interest in the study outcome. No compensation from consulting clients or any other source has been received for undertaking this research.

Ethics Approval

The Tri-Council Core ethics training was completed, and Athabasca University ethics approval was obtained before this research project started (see Appendix D).

Participants

Participant Demographic Breakdown

Section 1 of the survey asked participants to answer four demographic questions:

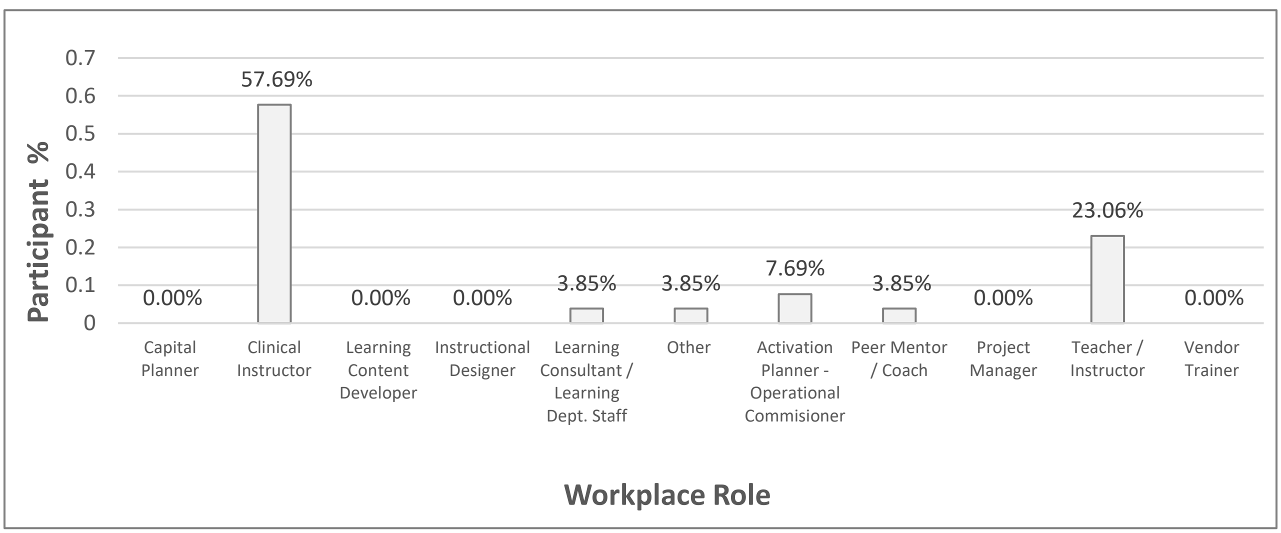
1) current workplace geographical location
2) current workplace instructional design role,
3) current workplace setting, and
4) years' experience in a workplace instructional design role.

Workplace Training Role (Survey Question 1)

The 26 participants who answered survey questions five to nine worked in Canada in various healthcare instructional design roles. In Figure 2, most (22/26 or 85%) identified as clinical educators/mentors or teacher-instructors in the healthcare workplace, and the minority (4/26 or 15%) indicated they currently worked in academic and online healthcare-related workplaces.

Figure 2

Participant's Workplace Training Role



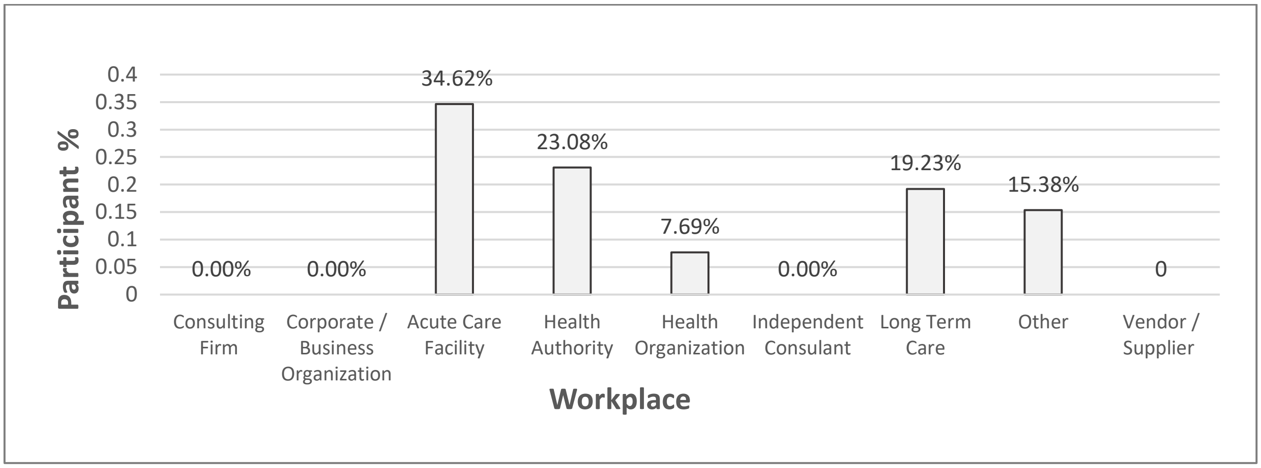
Note. Other represents a healthcare workplace learning department manager.

Workplace Location (Survey Question 2)

The majority (22/26 or 85%) of participants (see Figure 3) currently work in diverse health care settings. Four of 26 participants (15%) indicated they now work in either an academic or online workplace related to healthcare training.

Figure 3

Participant's Workplace Setting



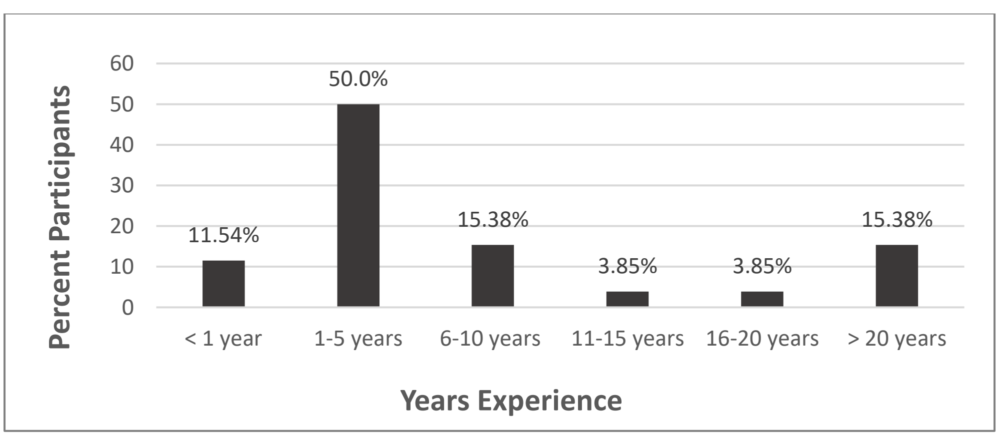
Note. Other represents university and online workplace locations.

Workplace Training Experience (Survey Question 3)

The participants' experience in healthcare workplace instructional design roles (Figure 4) spanned the entire experience strata, from less than one year to greater than 20 years. Most participants had one-to-five-years' experience (50%), followed by the 6-10 years (15%) or greater than 20 years (15%) experience ranges.

Figure 4

Participant's Instructional Design Experience



The most experienced participants were in the clinical instructor and teacher-instructor categories (see Table 1), with experience spanning from novice (less than one year) to seasoned veteran (greater than 20 years). Clinical educators and instructors were the two participant groups with more than ten years of experience. All workplace roles were represented by the one-to-five-year experience range.

Table 1

Participant's Years Experience by Current Workplace Role

Years Experience	Other	Clinical Educator	Teacher - Instructor	Learning Consultant - Learning Dept Staff	Operational Commissioner - Activation Planner	Peer Mentor - Coach
> 20 years		✓	✓			
16 - 20 years			✓			
11 - 15 years		✓				
6 - 10 years		✓	✓		✓	
1- 5 years	✓	✓	✓	✓	✓	✓
< 1 year		✓	✓			

Note. Other represents a workplace learning department manager.

Data Collection

Sampling Frame and Location

After ethics approval was obtained, prospective participants were invited to participate (see Appendix E) and a consent statement (see Appendix F) via email. Data were collected using an anonymous online questionnaire (see Appendix G) made available between 24 June and 30 September 2023, via a link, allowing access to the questionnaire from any geographical location.

A total of 36 people responded to the request to participate by accessing and initiating the questionnaire. Eight persons only opened the questionnaire, and two persons did not continue past the demographic questions. Twenty-six participants (N = 26) answered all questions except the final question (question 10), and nineteen participants (n = 19) or 73% completed the entire questionnaire (Field, 2018). No other missing data were detected. The data from 26 participants was used to analyze the first nine survey questions, while the data from 19 participants were used to analyze question 10 only. Missing data were handled by omitting the missing responses from the final question (question 10) analysis. The total number of possible participants is unknown; thus, a response rate is not reported.

All anticipated quantitative data were collected. When participants indicated 'other' to categorical questions, a short answer was requested. Negligible qualitative data intended to aid in clarifying their quantitative responses were provided by the participants. The questionnaire did not collect any detailed qualitative data that required analysis or integration with the quantitative results. A statistician was consulted before data analysis, and then data gathering and analysis were completed without assistance from others or generative artificial intelligence.

Sampling Plan

Inclusion and Exclusion Criteria.

A designer centred research approach was utilized to identify the study participants. The profile of the ideal study participant included working professionals meeting the following criteria.

- Persons who are currently or have previously been involved in healthcare workplace training projects, including staff, faculty, and students of Athabasca University; and
- Identify as an instructional designer such as, a clinical educator, workplace instructor/teacher, learning content developer, vendor trainer, operational readiness – activation planner, learning consultant, project manager, or peer mentor/coach.

Sampling Procedure.

Non-probabilistic purposive sampling and snowball procedure were used to collect data between 24 June and 30 September 2023 after Athabasca University (AU) Research Ethics Board approval (see Appendix D) was obtained (Bui, 2020; Kalkenbrenner, 2022). Participants were identified and recruited using a two-step sampling process.

1. The researcher's known industry contacts (persons who are or were in healthcare instructional design roles) were emailed with an invitation to participate (see Appendix E), a consent statement form (see Appendix F), and a request to forward the invitation to colleagues fitting the target demographic.
2. An advertisement to participate was provided by the AU research office via an email blast to the AU community: staff, administration, and faculty members.

Because the first step snowball method of recruitment resulted in a small number of returned questionnaires, a revision of the ethics approval was undertaken to enable recruitment via step two above, from within the AU community.

Sample Size

An a priori sample size was determined using three techniques: 1) rule of thumb, 2) formula, and 3) G*Power® analysis. Based on the rule of thumb, to meet sample size requirements for this study that includes correlation analysis, at least 30 participants are required for comparison groups, while the minimum size of the total data set should be at least 100 (Huck, 2011; Creswell & Plano-Clark, 2018).

Alternatively, the parameters outlined in Table 2 may be used to determine the sample size of an unknown population using the following formula (Charan & Biswas, 2013).

$$\text{Sample size} = \frac{Z^2\, p(1-p)}{d^2}$$

Table 2

Sample Size Calculation Example

Parameters	Z = z-score = 1.96 (0.05 significance level) p = expected proportion in population = 0.10* d = absolute error or precision = 0.05
Calculation	(1.96 x 1.96) x [0.10 (1 – 0.10)]/(0.05 x 0.05) = (3.8416 x 0.09)/0.0025 = 0.3457/0.0025 = 138.3
Sample size needed	138

Note. Adapted from (Charan & Biswas, 2013). *The expected proportion of instructional designers that work in the healthcare workplace was based on the percent of healthcare-related businesses in Canada (Stats Canada, 2022).

The third method of sample size determination, G*Power analysis, was used to estimate the minimum sample size based on maximum Type I and Type II error rates and the minimum effect size (difference or strength of a relationship) that would be meaningful in this study (Field, 2018; Kang, 2021; Kyonka, 2019, as cited in Creswell & Creswell, 2017). Power analysis was explored to control for and interpret non-significant results and the probability of rejecting a false null hypothesis (Mayr et al., 2007). An a priori power analysis [Exact -

Correlation: Bivariate normal model] was conducted using G*Power version 3.1.9.7 (Faul et al., 2007, 2009) for sample size estimation (Mayr et al., 2007). The results revealed (see Appendix H) that to achieve an 80% power estimate, with Cohen's suggested large effect size of .5 and significance $\alpha = .05$, a minimum sample size of n = 29 is required. Alternatively, a sample n = 84 would be needed for a medium effect size of .3 (Kang, 2021). Because I wanted to detect an effect that is practical while simultaneously detecting differences of the naturally variable dependent measures (interaction and delivery mode), I chose to use the large effect size (.5) to minimize not identifying a meaningful effect or result (Kyonka, 2019).

The post hoc power analysis (see Appendix I), based on an n = 19 sample size, revealed an underpowered study with too few participants, resulting in low-level power (0.24 for effect size 0.3 to 0.61 for effect size 0.5) to detect statistically significant correlations and the probability of rejecting the null hypothesis in favour of the alternative hypothesis (Kyonka, 2019). To draw conclusions about whether the data supports the null or alternative hypothesis for this low-powered study, an "error-statistical…severity testing approach" was taken to evaluate the data using a series of tests (see Appendix C) that assess the evidence for or against the null hypothesis with the goal of minimizing the combination of Type I and Type II errors (Kyonka, 2019, p. 135).

Because G*Power does not present a correlation testing option that exactly matches the parameters of the study variables, a second set of G*Power tests was conducted using an alternative test [X^2 goodness-of-fit test: Contingency tables] to confirm the applicability of the exact test output (Mayr et al., 2007). The results revealed almost identical results. To achieve an 80% power estimate, with medium effect size .3, significance $\alpha = .05$, and 1 degree of freedom, a minimum sample size of n = 88 is required. Again, the post hoc analysis for n = 19 indicated very low power (0.26).

Instrumentation

Two types of instrumentation were used: a questionnaire for collecting data; and measurement scales for denoting interaction types, delivery mode preference categories, and risk ranks as outlined in Appendix C1.

Survey Instrument

The survey tool described by Anderson and Miyazoe (2011) was the inspiration for data collection in this study. A 10-question survey was developed and composed of five sections: 1) participant demographics (section 1, questions 1-4), 2) general preference for instructional interaction types (section 2, questions 5 & 6), 3) general preference for delivery modes (section 3, questions 7 & 8), 4) blended learning design practices (section 4, question 9) and 5) preference for interaction type and delivery mode based on the perceived risk of learning content (section 5, question 10). The closed-ended questions used a categorical or rank scale, while the open-ended questions were used to gather clarifying information about the quantitative responses. Survey data were stored on Athabasca University's instance of the LimeSurvey web server and downloaded in Excel format for importation into IBM's Statistical Package for Social Sciences (SPSS) for quantitative data analysis. Qualitative data analyses were planned but not required due to a lack of qualitative data collected.

The questionnaire was pilot-tested by two individuals with experience in blended learning instructional design to determine clarity and utility; the extent to which the questionnaire collects what it is intended to collect; whether it is sensible, appropriate, and relevant to those that will be completing the questionnaire (i.e., "establish face validity"); and whether it encompasses the needed data collection appropriately (i.e., "content validity") (Connell et al., 2018, p. 1893-4; Rodriguez & Armellini, 2013, p. 483). After pilot testing and subsequent editing were completed, the online survey was made available for 14 weeks (24 June - 30 September 2023) to gather data from respondents. An invitation to participate (see Appendix E) and a consent statement (see Appendix F) preceded the questionnaire (see Appendix G).

Measurement Instrumentation

Section 1 of the survey gathered participant demographic information as listed in Appendix C and explained previously in the participant demographics section.

Section 2 includes two questions (5 & 6) that asked participants about their instructional interaction preferences and practice. Participants were asked to rank their general preference of interaction types (learner-instructor, learner-learner, and learner-content interactions) for 1) knowledge-focused learning and 2) skill-focused learning. The study participants were asked to rate their interaction technique preferences from one (high/most important) to three (low/least important). This rating provided a rank scale for overall interaction preference.

Section 3 includes two questions (7 & 8) about the participants' general preference for delivery modality and interaction type. Participants were asked to rank order their general preference for instructional delivery modes (in-person/face-to-face, online asynchronous, online synchronous, and blended) from one (high/most important) to three (low/least important). Then, in a three-part question, participants were asked to rank order their preference of instructional types (learner-instructor, learner-learner, and learner-content interactions) for 1) in-person face-to-face, 2) online asynchronous, and 3) online synchronous delivery methods.

Section 4 includes one question (9) about participants' blended learning preferences and practice. Participants were asked if and what tools they use when designing blended learning.

Section 5 includes one 12-part question. The participants were asked to assess 12-sample learning content items that typically require training in the healthcare workplace. The sample learning items were included in the questionnaire based on their potential risk when not learned correctly or actioned/completed correctly in practice. The 12 sample learning items were assessed for 1) learning interaction preference, 2) delivery modality preference, and 3) risk score as outlined in Appendix J).

Scientific Rigor

Reliability

The degree to which the participant's responses were stable or consistently measured what was intended to be measured was accomplished by including scoring criteria for determining rank, interaction technique, and delivery mode (see Appendix J).

Because the study data did not meet the assumption for use of Cronbach's alpha or Cohen's kappa, Krippendorf's alpha (k-alpha) was utilized to evaluate composite reliability (internal consistency or agreement among participant's responses) within the data (Hayes & Krippendorf, 2007; Huck, 2011; Kalkbrenner, 2022; Zapf et al., 2016). The k-alpha measured the extent to which there was agreement in the rank coding of the interaction techniques, risk scores, and delivery modes (Huck, 2011). Total agreement by survey participants responses is indicated by a k-alpha value (reliability coefficient) of +1.00, strong agreement is indicated when the k-alpha statistic is greater than 0.8, and weak agreement is indicated with a k-alpha value between 0.67 and 0.8 (Hazra & Nayak, 2011). Tests of internal consistency were computed to test the reliability of scores between the participants (see Appendix K).

Validity

The measure of accuracy, which requires consistency, indicates that the instrument measure what it is intended to (Huck, 2011). For this study, four types of validity were considered and assessed.

1. Content validity can be partly established based on the survey instrument's roots. The questionnaire was inspired by Miyazoe and Anderson’s (2010) study that ranks interaction techniques from the learner's perspective. To verify the extent to which scores in the questionnaire succeed in measuring what it was designed to measure, thereby enabling meaningful interpretation of the survey responses, the questionnaire was pilot-tested by two workplace instructional designers (one with healthcare content expertise and one with questionnaire design experience), to gain feedback on clarity and relevance (Bui, 2020; Huck, 2011).
2. Construct validity (also known as quantitative validity) is a characteristic of the data produced (not the instrument) and may be used in this case to confirm that the participants and conditions under which the measurements were taken are similar (Creswell & Plano-Clark, 2018; Huck, 2011). Construct validity was demonstrated by reporting significant correlational data that provided convergent (high correlation) and divergent (low to moderate correlation) evidence related to the theoretical construct being studied, a risk-based instructional decision tool (Kalkenbrenner, 2022). In addition, the correlation findings were meaningfully woven together to create a framework for instructional design decision-making.
3. Confidence in the generalizability of the results (external validity) to the participant population, setting, and time was demonstrated through purposive sampling based on a particular instructional designer demographic (Stevens & Pituch, 2016).
4. Confidence in the degree to which the causal relationship being tested is trustworthy and not influenced by other factors or variables (internal validity) has been managed in this study by including participants that do not differ substantially and cannot be compared; thus, a purposive sample was sought (Creswell & Plano-Clark, 2018).

Strength

Because the Chi-square test of independence only indicates whether a relationship exists or not, but not its strength, several tests were utilized to quantify the statistically significant findings. The tests selected to validate findings were specific to small sample sizes and nominal variables with multiple categories. Cramer's V, Bayes Factor, and bootstrapped confidence intervals were used to test and verify the strength of the Likelihood Ratio findings (see Appendix L).

Procedure

A two-person supervisory committee approved the research procedure via submission of a thesis proposal document, a subsequent 15-minute online face-to-face (Teams) presentation, and a 30-minute verbal defence. Once the supervisory committee approved the study, AU Ethics Review Board approval was sought and obtained (see Appendix D) before implementing the data collection procedures outlined next.

Data Collection Procedures

A purposive, homogenous, non-probabilistic (convenience) and snowball sampling process was utilized to gather data (Creswell & Plano-Clark, 2018). Participants who identified as currently being or having past experience as workplace instructional designers in the healthcare environment were included in the study. People involved in academic or K to 12 instructional design, with no experience in workplace training were excluded.

Industry and academic contacts were used to acquire appropriate participants through an email request to complete and pass the survey invitation, explanatory video, consent statement, and questionnaire web link to other colleagues who fit the participant inclusion profile. Participants were recruited from health authorities, hospitals, clinical inpatient facilities, and healthcare workplace learning departments.

Prospective participants were provided with an invitation to participate (see Appendix E) and a consent statement (see Appendix F). Participants indicated their voluntary consent to participate by proceeding to access and complete the online questionnaire. An AU-hosted LimeSurvey tool was utilized for data collection. The 10-question survey (see Appendix G) was made available from 24 June to 30 September 2023. Once the survey closed, data were downloaded in Microsoft Excel spreadsheet format to IBM SPSS (Statistical Package for the Social Sciences for data analyses.

Participants who completed the survey and who submitted their contact information (anonymously and unlinked to their survey responses) were entered into a random draw for one of six gift card prizes: one $200, two $75, and three $50. Each individual who entered the draw was assigned a sequential number, and a random number generator was used to identify the winners. Each winner was contacted by email to advise that they had won a prize and provided with a list of e-gift cards to choose from. All six prizes were distributed via email.

Data Analysis

The study included one categorical, ordinal, independent variable and two categorical, nominal, dependent variables. The independent variable, risk, consisted of three levels: low, medium, and high. The first dependent variable, interaction technique, consisted of three levels: learner-learner, learner-content, and learner-instructor interactions. The second dependent variable, delivery mode, consisted of six levels: asynchronous online, blended, in-person/face-to-face, synchronous online, any, and none. Because the data are categorical, non-parametric statistical analysis was utilized, and the data were not examined for the statistical assumptions related to normality, outliers, or variance (Field, 2018).

The unexpectedly small sample resulted in a need to select data analyses testing for small samples. For example, the 'bootstrap' resampling method was selected where possible in IBM SPSS instead of the asymptotic method for determining confidence intervals for the small sample size (Zapf et al., 2016).

The significance level, or alpha (α), for this study ($p < .05$) was set in advance of data collection as the threshold for statistical significance. Where multiple significance tests were applied to the data, the Bonferroni correction was used to adjust the significance level to control for Type 1 (false positive) error (Field, 2018).

Quantitative Data Handling

Quantitative data were managed based on the research design, as outlined in Appendix C – Table C1 and Appendix L, and the specific research methods outlined here (Bui, 2020).

The data collected in LimeSurvey were downloaded in MS Excel format and imported into IBM SPSS for analysis. The raw SPSS data were then reviewed for missing data. Of the 36 participants who opened the survey, a total of N = 26 completed all but question 10. Eight persons opened the questionnaire but did not complete it; two completed only the demographics questions. A subset of n = 19 participants completed the entire survey. No other missing data were identified.

All collected data were categorical, either nominal or ordinal (data that can be ranked, such as high, medium, or low-risk ratings); thus, evaluating normality is nonsensical and unnecessary (Field, 2018). Because the data are not necessarily normally distributed, non-parametric tests were needed to assess the data for the presence, strength and direction of relationships and statistical significance (Field, 2018). The specific non-parametric data analyses techniques were selected based on categorical variables and small sample size constraints. The data analyses included descriptive statistics (frequencies) and correlation analysis (i.e., log-linear and crosstabs) with significance testing (i.e., Chi-square - Likelihood Ratio), effect size testing (i.e., Cramer's V and Bayes Factor) and reliability testing (e.g., Krippendorff Alpha) to establish the presence and strength of relationships between the risk, interaction techniques, and delivery modalities as outlined in Table 3. How the specific tests were applied for each study question is described in detail in the Chapter IV - Results section.

Table 3

Overview of Hypothesis Testing Process

Step	Title	Description
Step 1	Hypothesis	Null Hypothesis (H_0): There is no relationship between the preferred online delivery mode, risk score, and/or interaction technique. Alternative Hypothesis (H_1): Risk score predicts the preferred delivery mode and/or interaction technique for blended learning content to be learned (There is a relationship between risk score, interaction type, and delivery mode). Risk score is the independent (predictor) variable. Interaction type and delivery mode are the dependent (outcome) variables.
Step 2	Measure Significance	$\alpha < 0.05$ Significance indicates if there is a relationship between the variables, not the strength.
Step 3	Gather Sample	Purposive, snowball sampling of the instructional designer population in the healthcare corporate training context was used. Participants self-selected to participate. Data gathering was accomplished via a survey instrument. Upon receiving an invitation to participate in the study, participants self-selected to participate and complete the questionnaire.
Step 4	Obtain *p* value	IBM SPSS tests were selected (Crosstabs correlation via Likelihood [Chi-square] ratio exact test of independence and Krippendorf alpha reliability) to analyze data for significant relationships. The IBM SPSS *p* value output indicates the odds that the finding is due to chance. If $p < 0.05$, we reject the null hypothesis that there is no association between the variables. • Likelihood Ratio less than 1 = H_1 is less strongly supported than H_0. $p < 0.05$ to reject H_0 (Perneger, 2021). Chi-square is always

Step	Title	Description
		positive. 0 = independence/no association/ and there is no max value (larger value = more relationship. $p < 0.05$ to reject H_0. Likelihood Ratio test is used for > 2x2 crosstab correlations. (McHugh, 2013; Perneger, 2021). • Krippendorff alpha: k-alpha > 0.8 = good interrater reliability, 0.67 to 0.8 = low reliability (Hayes & Krippendorf, 2007; Zapf et al., 2016).
Step 5	Decide Significance	*p* value ≥ 0.05 = accept the null hypothesis – there is no relationship between risk score, delivery mode, and/or interaction type. Bonferroni corrected *p* values will be used as required (Field, 2018). *p* value < 0.05 = reject the null hypothesis – a relationship exists between risk score, delivery mode, and/or interaction type.
Step 6	Decide the Strength of Relationship	The following tests were used where appropriate: • Cramer's V tests the effect size of a relationship [1 = strong, 0 = weak] (Akoglu, 2018). • Bayes Test indicates the strength of the Likelihood Ratio (Jarosz & Wiley, 2014; Rosenfeld & Olson, 2021).
Step 7	Confirm Significance	Check 95% confidence intervals (CI) to confirm the interpretation of the relationship (Bewick et al., 2003). Note: Bootstrapped CIs were used where possible due to the small sample size.

Note. Adapted from Petty, n.d. See Appendix L for a detailed description and interpretation of the statistical, effect size, and reliability tests.

Qualitative Data Handling

The anticipated process for handling the qualitative data from the survey's open-ended questions was via evolved grounded theory methods as described below; however, this analysis was not completed because no qualitative data were captured that required analysis.

Either by hand or using computer-assisted qualitative data analyses software (e.g., NVivo), the participant's comments were to be open-coded; categorized using axial coding; and then selectively coded to connect categories, build a storyline that conceptualizes the categories, and produce a set of overarching themes (Tie et al., 2019). The six-phase process, as described by Braun and Clarke (2006), was to be utilized to complete the thematic analysis.

In a convergent parallel mixed methods design with a quantitative emphasis, the quantitative and qualitative data are gathered concurrently, analyzed sequentially, and then compared side-by-side to determine coherence, convergence, and divergence between the two data sets (Creswell & Creswell, 2017). Quantitative methods were used for testing and describing relationships, showing patterns and idiosyncrasies, while qualitative methods were used to discover and clarify the quantitative results (Mertens & Hesse-Biber, 2012). The goal was to use the qualitative data to build on the quantitative results. The qualitative data were to be evaluated by developing code categories and themes that can be linked to the quantitative data (Mertens & Hesse-Biber, 2012). Key findings were to be reported in the discussion section of the thesis document to enhance understanding of the participant’s views and the quantitative results.

The validity of qualitative analysis was to be managed using four processes.

- The survey instrument was pilot-tested to ensure 1) valid data acquisition is not impeded by the participant’s inability to understand the survey questions, and 2) open-ended survey questions that allow narrative responses are provided to deal with any potential for participant confusion (Locke et al., 2013).
- Participant demographics were recorded in the survey instrument to ensure that descriptions of participants and context were accurate and complete (Locke et al., 2013).
- Structured thematic analysis was to be used to analyze iteratively and inductively to generate an explanatory theory for learning interaction and delivery use that is grounded in the data provided by the instructional designer’s opinions and preferences (Braun & Clarke, 2006; Tie et al., 2019).
- Three forms of triangulation were planned to verify the trustworthiness of the data and minimize personal biases: 1) method triangulation by “cross-checking” qualitative with quantitative findings for the same phenomenon (multiple data sources); 2) theory triangulation using multiple questions and hypotheses to assist in supporting or refuting the findings; and 3) data source triangulation by gathering data from a homogenous group of instructional designers with multiple perspectives and opinions (Candela, 2019; Carter et al., 2014).

Expected Outcomes

As a result of this study, it is anticipated that understanding instructional designer’s current preferences, perceptions, and design processes will lead to developing a risk-based blended learning instructional design framework. Further research will be required to member-check and validate the findings of this study (Candela, 2019).

Summary

This study utilized a mixed methods research design plan, including quantitative data that will be used to identify what interactions and modalities instructional designers prefer based on the risk of failure to understand, retain, and apply the learning content. In addition, qualitative data were to be used to elaborate on how and why the instructional designers' decisions are made for blended learning instructional design. Combining rigid quantitative measures with flexible qualitative grounded theory provides a balanced approach to the complex questions surrounding blended learning design decisions.

Chapter IV. Results

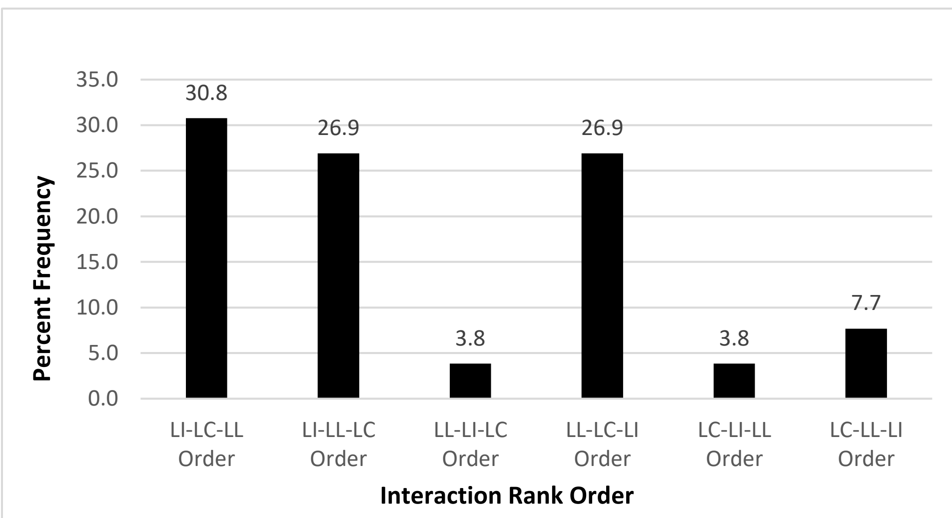
The results from the questionnaire section one, questions 1-4 (participant role, experience, workplace setting, and geographical data) were reported previously in Methods Section 3.4 – Participant Demographics. The remaining results for questions 5-10 are organized in the order that the questions were posed in the online survey.

Survey Section 2 - Instructional Interaction Preferences (Questions 5-6)

Questionnaire section 2 asked participants to provide their preference about the order of importance of three interaction types (learner-learner [L-L], learner-instructor [L-I], and learner-content [L-C]) for knowledge-focused and skill-focused learning. The most frequent order of interaction preference for knowledge-focused learning (Figure 5) was LI-LC-LL (30.8%), followed closely by LI-LL-LC (26.9%) and LL-LC-LI (26.9%). Most participants (57.5 %) indicated LI was the most important, while 30.7% indicated LL was the most important. LC interaction was perceived as least important, chosen by 11.5% of the participants.

Figure 5

Frequency of Interaction Preference Order for Knowledge-Focused Learning (Question 5)

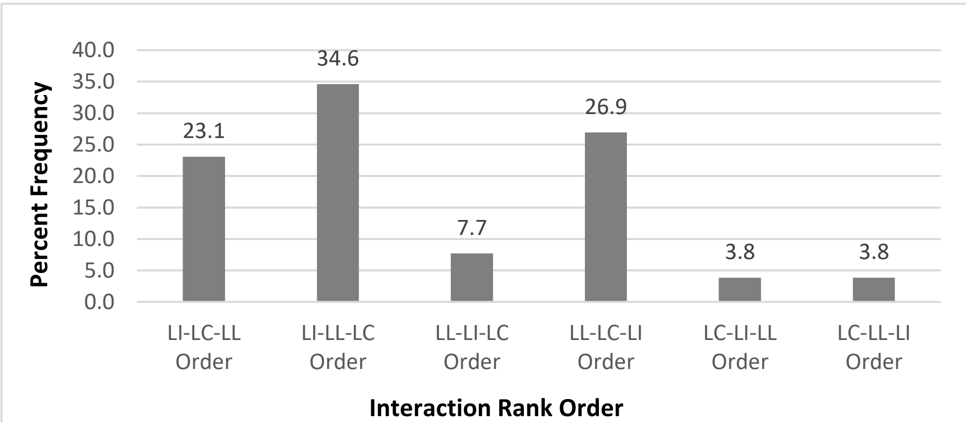


Note. LL = learner-learner, LI = learner-instructor, and LC = learner-content interaction.

In contrast, for skill-focused learning, the interaction order (see Figure 6) preferred most by participants was LI-LL-LC (34.6%). Again, 57.7% of participants indicated that LI interaction is most important for skill-focused learning. Participants indicated LL-LC-LI (26.9%) and LI-LC-LL (23.1%) interaction orders ranked second and third in importance, respectively. Similar to knowledge-focused learning, more preference emphasis was placed on LL (30.7%) interaction than the least preferred LC interaction (7.6%).

Figure 6

Frequency of Interaction Preference Order for Skill-Focused Learning (Question 6)



Note. LL = learner-learner, LI = learner-instructor, and LC = learner-content interaction.

The same general rank order trend was observed for knowledge-focused (see Figure 7.) and skill-focused (see Figure 8) learning interaction preferences. A preference for LI was observed as the most important interaction type for both knowledge and skill-based learning. Learner-content interaction ranked second as the preferred interaction type for knowledge and skill-based learning. There was little discrimination between LI, LC, and LL as the third-ranked interaction type.

Figure 7

Ranked Preference of Interaction Type for Knowledge-Focused Learning

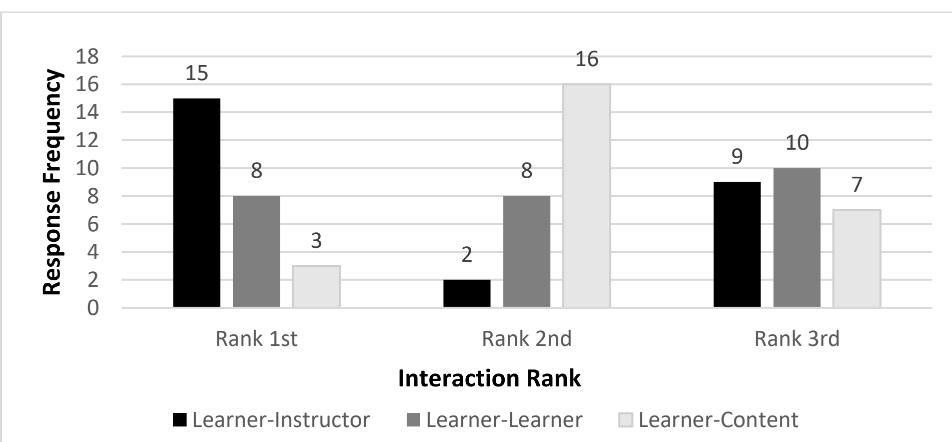
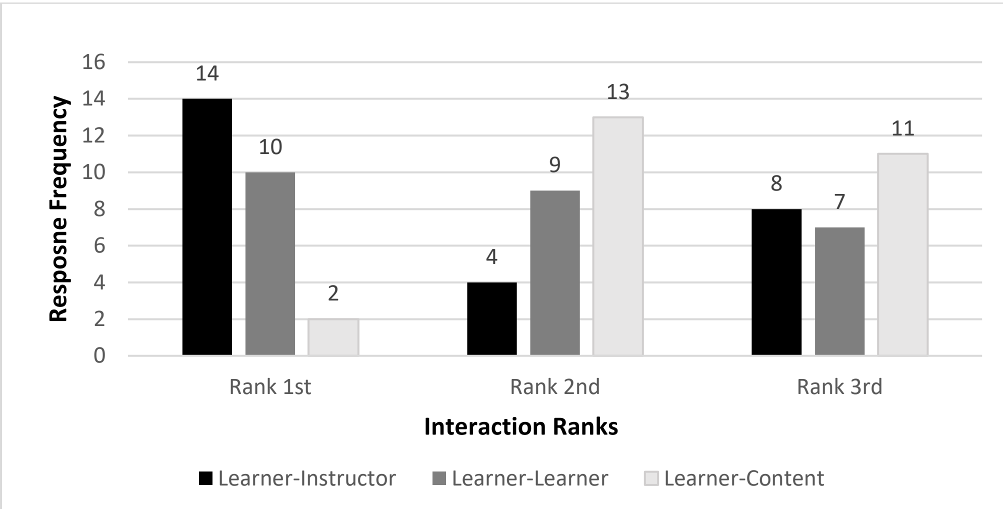


Figure 8

Ranked Preference of Interaction Type for *Skill-Focused Learning*



The observed interaction frequencies revealed that the skill-focused and knowledge-focused preference orders were very similar (see Figures 7 & 8). If there is no difference between the participants' interaction technique preference for skill and knowledge-focused learning (null hypothesis - H_0), we expect equal proportions of participants to select the same order preferences. The chi-square test (X^2) of independence was performed to examine the relationship between knowledge and skill-focused interaction preference orders. The analysis resulted in X^2 (25, N = 26) = 27.009, p = 0.355. These results ($p > .05$) indicate that we cannot reject the null hypothesis and conclude that no statistically significant difference exists between skill and knowledge-focused interaction preference.

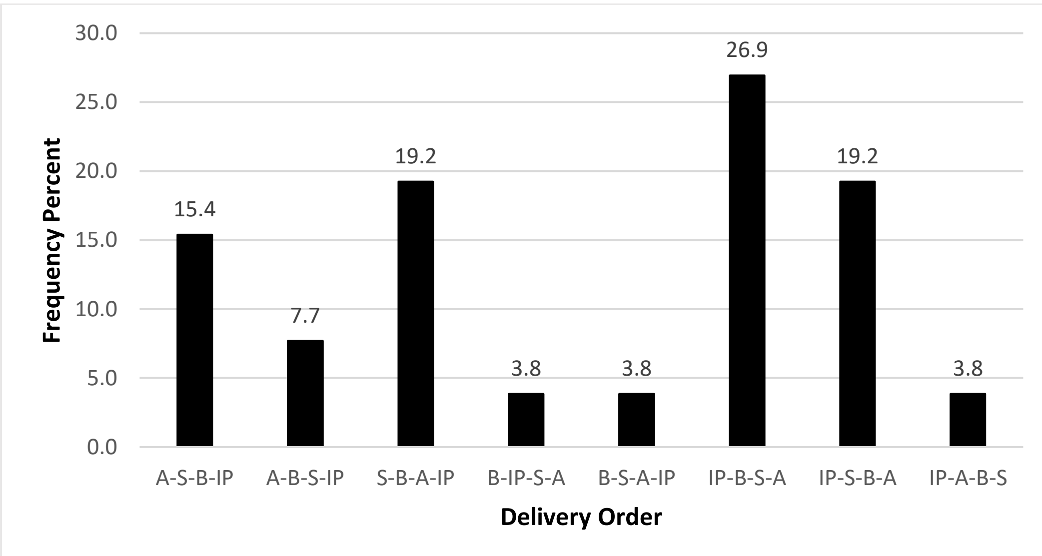
Survey Section 3 – Instructional Delivery Methods Preference (Questions 7-8)

Question 7

Section 3 (question 7) asked participants to rank their general order of preference for instructional delivery methods (in-person face-to-face, online asynchronous, online synchronous, and blended). Of the possible 36 orders of preference, only eight were chosen by the participants (see Figure 9). Most participants (49.9%) preferred the in-person, face-to-face delivery mode. Online delivery mode preference was similar, where 23.1% of the participants preferred asynchronous online delivery and 19.2% preferred synchronous delivery. Few participants (7.6%) preferred blended learning. If there was no difference in preference between the delivery orders, the various orders should be equally chosen, where each order should be selected by 12.5% of the participants.

Figure 9

General Preference for Delivery Mode Order



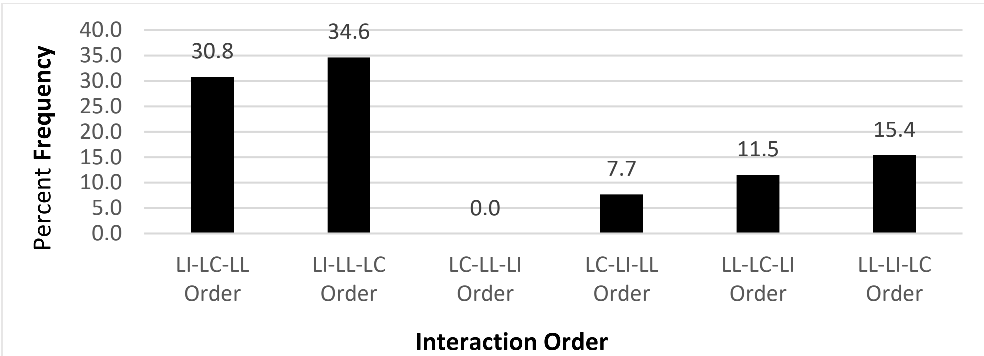
Note. A = Asynchronous Online, S = Synchronous Online, B = Blended, IP = In-person face-to-face

Question 8

Question 8 was a three-part question asking participants to consider and rank their interaction methods preference for in-person/face-to-face (question 8.1), online asynchronous (question 8.2), and online synchronous (question 8.3) delivery methods. For in-person face-to-face delivery, 65.4% of participants preferred learner-instructor (LI) interaction, while 26.9% of participants preferred learner-learner (LL) interaction, and 7.7% preferred learner-content interaction (see Figure 10). For online asynchronous delivery, learner-learner interaction (65.4%) was preferred by participants, compared to 15.4% who preferred learner-content (LC) interaction or 19.3% who preferred learner-instructor (LI) interaction (see Figure 11). Synchronous online delivery via learner-instructor (LI) interaction was preferred by 69.3% of participants, in comparison to 15.3% of participants who preferred either learner-content (LC) interaction or learner-learner (LL) interaction (see Figure 12).

Figure 10

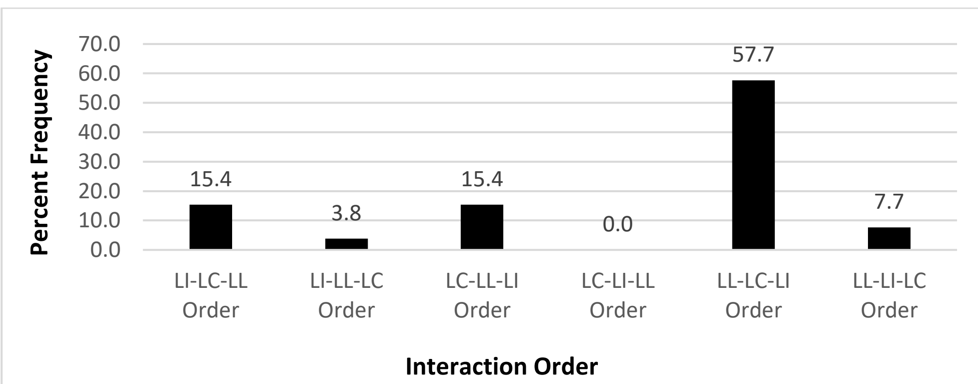
Preferred Interaction Order for <u>In-person Face-to-Face Delivery</u> (Question 8.1)



Note: LI = Learner-Instructor, LC = Learner-Content, LL = Learner-Learner Interaction.

Figure 11

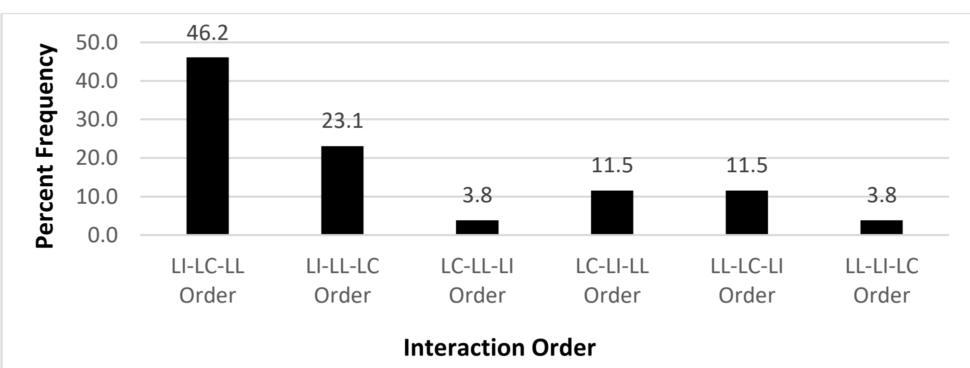
Preferred Interaction Order for <u>Online Asynchronous Delivery Mode</u> (Question 8.2)



Note. LI = Learner-Instructor, LC = Learner-Content, LL = Learner-Learner Interaction

Figure 12

Preferred Interaction Order for <u>Online Synchronous Delivery</u> (Question 8.3)

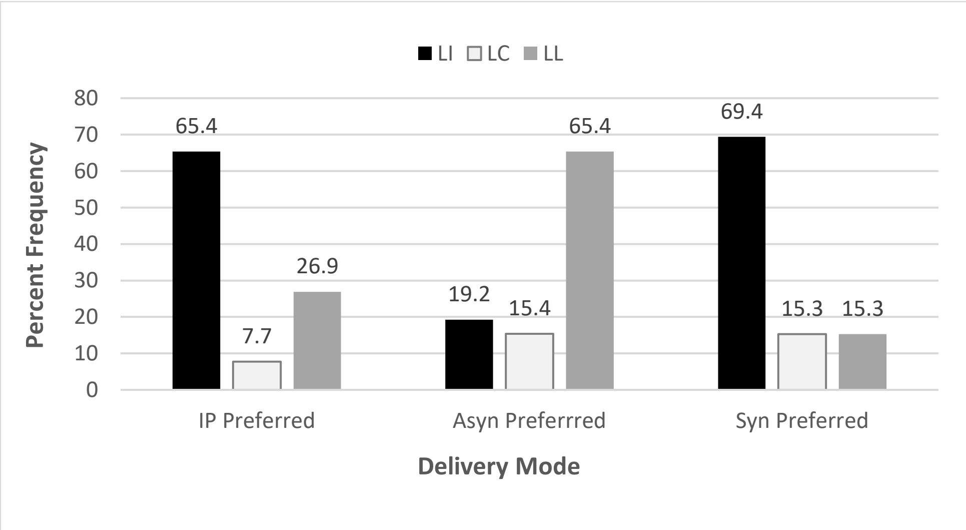


Note. LI = Learner-Instructor, LC = Learner-Content, LL = Learner-Learner Interaction

Overall, participants preferred LI interaction (65.4%) for in-person face-to-face and synchronous online (69.4%) delivery, while LL interaction (65.4%) was preferred for online asynchronous delivery (see Figure 13A).

Figure 13A

Preferred Interaction

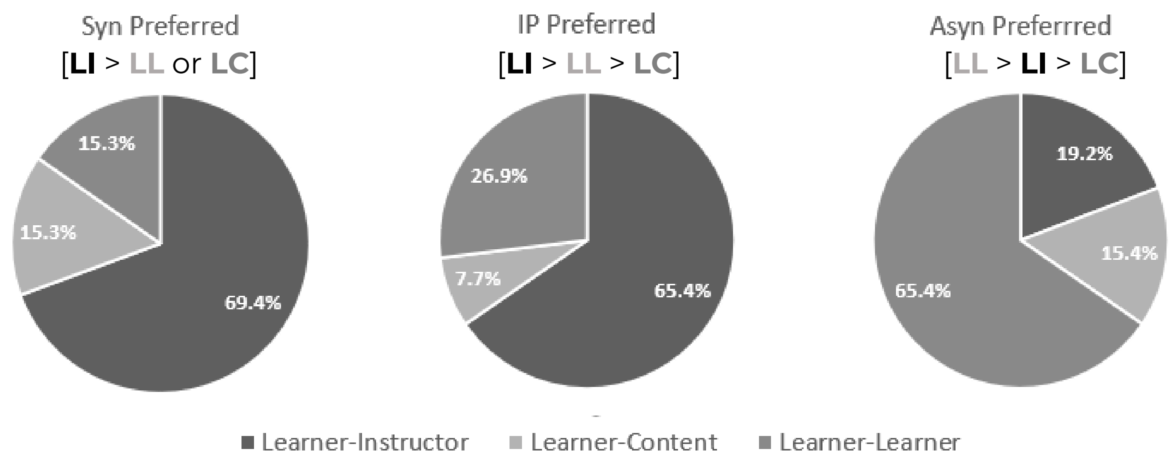


Note. LI = Learner-Instructor, LC = Learner-Content, LL = Learner-Learner Interaction. IP = In-person face-to-face, Asyn = Asynchronous online, Syn = Synchronous Online Delivery.

Concerning the general (non-risk rated) interaction preference orders, for the in-person face-to-face delivery mode (see Figure 13B), the participants prefer the following order of importance: learner-instructor, then learner-learner, and lastly, learner-content [LI > LL > LC]. Interaction orders for in-person face-to-face delivery starting with learner-instructor interaction are preferred over interaction orders starting with learner-learner interaction [LL > LC > LI and LL > LI > LC] and learner-content interaction [LC > LI > LL]. For synchronous online delivery, the learner-instructor, and then learner-learner or learner content order [LI > LC or LL] is selected most frequently by participants. In contrast, the learner-learner, learner-instructor, then learner-content [LL > LI > LC] interaction order is selected most frequently for asynchronous online delivery. The interaction preference order of non-risk-rated learning content differs for each delivery mode (see Figure 13B). Clearly, the participants indicate a difference in preferred interaction order for the different delivery modes, which aligns with the findings that risk-rated learning content has a unique preference order for interaction and delivery (see Table 7).

Figure 13B

Preferred Interaction Order by Delivery Mode



A series of chi-square tests were used to evaluate the significance of the interaction preferences for the three delivery modes (in-person face-to-face [IP], asynchronous online [Asyn], and synchronous online [Syn]). The chi-square null hypothesis (H_0) indicates no significant difference or relationship/association between the variables in question, and the alternative hypothesis (H_1) indicates a significant difference or association. The significance of the interaction preference and delivery mode relationships across questions 8.1, 8.2, and 8.3 were evaluated.

The results of the first test of the most preferred LI (learner-instructor) interaction for delivery modes produced the following Likelihood Ratio results via IBM SPSS bootstrapped three-by-three crosstab analysis:

1. IP (Q8.1) versus Asyn (Q8.2): X^2 (4, N = 26) = 4.918, p = .296
2. Ayn (Q8.2) versus Syn (Q8.3): X^2 (4, N = 26) = 5.794, p = .215
3. IP (Q8.1) versus Syn (Q8.3): X^2 (4, N = 26) = 13.003, p = .011. The effect size was calculated using Cramer V, which was found to be 0.486, (p = .015) with a 95% CI [0.357, 0.841].

This chi-square analysis indicated that there is evidence to reject the null hypothesis and conclude a statistically significant and very strong relationship between IP (in-person face-to-face) and Syn (synchronous online) delivery modes with LI (learner-instructor) as the most preferred interaction type (Akoglu, 2018).

The significance of LL as the second most preferred interaction was evaluated using the same process outlined above. The following Likelihood Ratio results were found via IBM SPSS bootstrapped three-by-three crosstab analysis:

1. IP (Q8.1) versus Asyn (Q8.2): X^2 (4, N = 26) = 8.530, *p* = .074
2. Ayn (Q8.2) versus Syn (Q8.3): X^2 (4, N = 26) = 8.075, *p* = .080
3. IP (Q8.1) versus Syn (Q8.3): X^2 (4, N = 26) = 12.220, *p* = .016. The effect size was calculated using Cramer V, which was found to be 0.530, (*p* = .006) with a 95% CI [0.284, 0.739].

This chi-square analysis indicates evidence to reject the null hypothesis (Syn [synchronous delivery] is not independent of IP [in-person face-to-face delivery]) and conclude there is a statistically significant and very strong relationship between IP and Syn delivery modes, with LL (learner-learner) as the third most preferred interaction type.

Lastly, the significance of LC (learner-content) as the least preferred interaction was evaluated using the same process outlined above. The following Likelihood Ratio results were found via IBM SPSS bootstrapped three-by-three crosstab analysis:

4. IP (Q8.1) versus Asyn (Q8.2): X^2 (4, N = 26) = 2.772, *p* = .596
5. Ayn (Q8.2) versus Syn (Q8.3): X^2 (4, N = 26) = 3.947, *p* = .413
6. IP (Q8.1) versus Syn (Q8.3): X^2 (4, N = 26) = 10.262, *p* = .036. The effect size was calculated using Cramer V, which was found to be 0.430, (*p* = .048) with a 95% CI [0.271, 0.666].

This chi-square analysis indicates evidence to reject the null hypothesis and conclude there is a statistically significant and very strong relationship between IP (in-person face-to-face) and Syn (synchronous) delivery modes, with LC (learner-content) as the second most preferred interaction type.

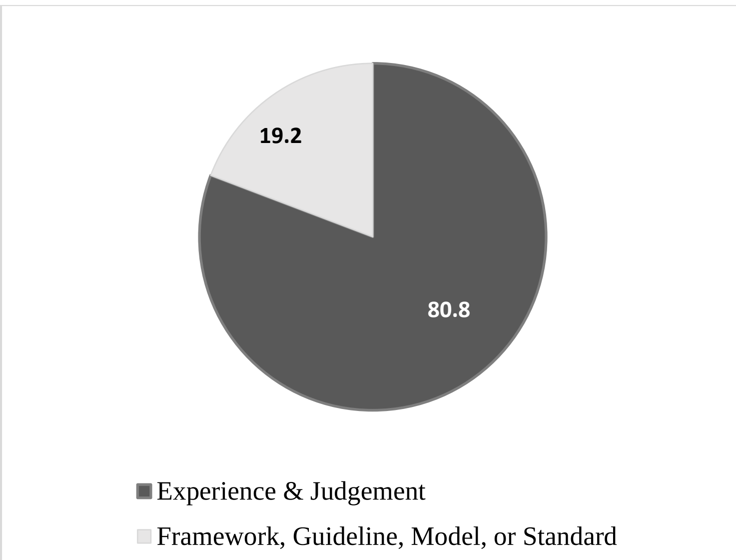
In summary, question 8 has provided evidence that the interaction order preference for IP and Syn delivery is not due to chance, and in general, LI is preferred, followed by LC and then LL. No statistically significant evidence was found to indicate any interaction preferences for the asynchronous delivery mode.

Survey Section 4 – Blended Learning Design Preference (Question 9)

Section 4 asked the participants how they designed blended learning; whether they used a guideline and framework, or experience and judgment. Most participants (80.8%) stated they utilize experience and judgment for blended learning instructional design decision-making (see Figure 14).

Figure 14

Participant's Preferred Blended Learning Design Methods



The participants' preferred blended learning design methods were evaluated for correlation with years of experience. A chi-square Likelihood Ratio test to determine if there was a statistically significant relationship between experience and the methods used to develop blended learning resulted in: X^2 (5, N = 26) = 4.25, p = .514. The null hypothesis (no relationship) cannot be rejected, and we conclude that the participant's experience and their preferred blended learning methods are independent. More than one-half (53%) of participants who indicated they had less than five years of instructional design experience, also indicated they use experience and judgment to make blended learning design decisions (see Table 4).

Table 4

Frequency of Blended Learning Design Method by Years of Design Experience

		Years Experience					
		< 1 yrs	1-5 yrs	6-10 yrs	11-15 yrs	16-20 yrs	> 20 yrs
Participant Frequency	Use Framework, Model, Guideline, or Standard	0	2	1	0	0	2
	Use Experience & Judgment	3	11	3	1	1	2

Note. N = 26

All five participants who indicated they use a tool for designing blended learning included a unique comment about their blended learning instructional design process and the tools used, as summarized below. No tools identified by participants for designing blended learning appear to include any risk-based assessment methods.

- Universal Design Standards for Learning.
- Kern's Model for Curriculum Development.
- Kirkpatrick Evaluation Model.
- Templates and guides previously created for the department which follows a flow/framework for team collaboration and education design.
- A framework altered to match participant’s experience, judgement of the learning audience, learning abilities/capabilities of the audience, time allowed for training, and the complexity of what they need to learn.
- Knowledge translation through the use of the knowledge-to-action framework which includes: 1) Identifying the problem; 2) Identifying the gap; 3) Determining what knowledge is needed to be implemented; 4) Identifying the method and tools for knowledge integration; 5) Planning, designing, and adapting the education based on steps 1 – 4 related to instructional designers experience and judgement; 6) Implementing the education; and 7) Gathering immediate feedback on the education.
- Consider the field of study with the learning goals and objectives.
- Guideline for blended learning, then interactions of evaluation and revision.
- Community of inquiry framework to encourage interaction and scaffold learning, whether it be online or face-to-face.

Survey Section 5 – Learning Content Assessment (Question 10)

Section 5 presented a complex, twelve-part question to gather risk, learning interaction, and learning delivery preferences for 12 samples of learning content typically found in the healthcare operational readiness – new employee orientation context. The sample learning content was selected and intended to represent the three risk levels: low, medium, and high. For each of the twelve learning content samples, participants were asked to select: a) the risk level; b) the learning interaction priority from highest to lowest for learner-learner (L-L), learner-instructor (L-I), and learner-content (L-C) interaction; and c) delivery mode preference (asynchronous online, synchronous online, in-person face-to-face, blended, none, or any/no preference) for all three possible learner interactions. Results of the three question 10 sub-questions, 10A, 10B, and 10C, will be presented separately.

Of the 26 participants who completed survey questions one through nine, only 19 completed question 10. The demographics of question 10 participants (n = 19) are slightly different than the N = 26 participants (see Table 5). There were three notable changes in the participant demographic for question 10:

1. Removal of the learning-consultant/learning department role representation, and
2. Removal of the participants with 16-20 years' experience, and
3. Removal of healthcare organization participants.

Ideally, the sample demographic would remain consistent; however, these changes are not thought to negatively impact the findings of question 10.

Table 5

Comparison of N = 26 and n = 19 Demographics

Demographic	Categories	N = 26 % Participants	N = 19 % Participants	Percent Change
Roles	Peer Mentor/Coach	3.8	5.3	1.4
	Operational Commissioner-Activation Planner	7.7	10.5	2.8
	Learning Consultant – Learning Department	3.8	**0.0**	-3.8
	Teacher - Instructor	23.1	21.1	-2.0
	Clinical Instructor	57.7	57.9	0.2
	Other	3.8	5.3	1.4

Demographic	Categories	N = 26 % Participants	N = 19 % Participants	Percent Change
Experience	< 1 year	11.5	10.5	-1.0
	1 to 5 years	50.0	52.6	2.6
	6 to10 years	15.4	15.8	0.4
	11 to 15 years	3.8	5.3	1.4
	16 to 20 years	3.8	**0.0**	-3.8
	> 20 years	15.4	15.8	0.4
Current Workplace	Acute Care	34.6	26.3	-8.3
	Long Term Care	19.2	26.3	7.1
	Health Authority	23.1	31.6	8.5
	Health Care Organization	7.7	**0.0**	-7.7
	Other	15.4	15.8	0.4

Note. Roles Other = Manager of a learning department and a blended learning researcher. Workplace other = University instructors and researchers with workplace training experience.

Question 10.A

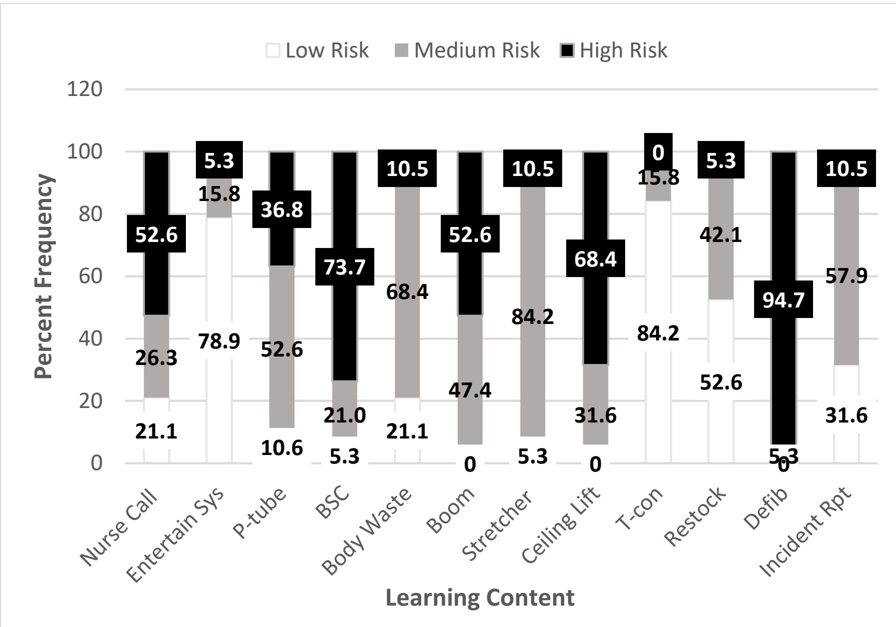
The first part of question 10 required participants to rate the risk level of 12 learning content samples representing a broad range of learning items (i.e. building systems, equipment, and workflow processes) and learning focus (i.e., knowledge-based and skill-based). It was intended and expected that the 12 learning content samples equally represented each risk category: four low, four medium, and four high-risk learning items. Based on the highest frequency of risk ratings in Figure 15, most (42%) of learning content (nurse call bedside communication system, biological safety cabinet, operating room equipment boom, ceiling lift, and cardiac defibrillator/code blue process) were rated as high risk, 33% of the learning content were rated medium (pneumatic tube system, body fluid waste system, stretcher, and incident report process) and 25% were rated low risk (entertainment system, teleconference equipment, and supply restock process). Therefore, the risk-assessed learning content, as listed above, was deemed by the participants to represent a broad range of risk levels, thereby ensuring that the study could evaluate participants’ preferences for interaction type(s) and delivery mode(s) across all three risk levels.

Observed (Participant) Risk Ratings.

A high percent frequency in Figure 15 indicates a high level of agreement between participants’ risk ratings and consensus or association between participant's perceived risk of the learning content (Liu et al., 2016). Risk rating agreement within and between 'observed' (participants') and 'expected' (researcher's) risk assessments were determined based on the following parameters: > 70% = strong agreement, 41 - 70% = moderate agreement, and < 40 % = weak agreement.

Figure 15

Participant Risk Ratings – Response Frequencies



Note. P-Tube = Pneumatic Tube System, BSC = Biological Safety Cabinet, T-con = Teleconferencing Equipment, Defib = Cardiac Defibrillator/Code Blue

From Figure 15, the strong (> 70% frequency) and moderate (41-70% frequency) levels of agreement <u>between participants' risk ratings</u> were determined.

- Low-Risk Content
  - Strong agreement was seen for the entertainment system (78.9%) and teleconference equipment (84.2%).
  - Moderate agreement for the restock process (52.6%).
- Medium-Risk Content
  - Strong agreement was seen only for the transport stretcher (84.2 %)
  - Moderate agreement was found for the pneumatic tube system (52.6%), body waste system (68.4%), boom (47.4%), restock process (42.1%), and incident

report (57.9%).

- High-Risk Content
    - Strong agreement was identified for the biological safety cabinet (73.7%) and the cardiac defibrillator/code blue (94.7%).
    - Moderate agreement was seen for nurse call (52.6%), boom (52.6%) and ceiling lift (68.4%)

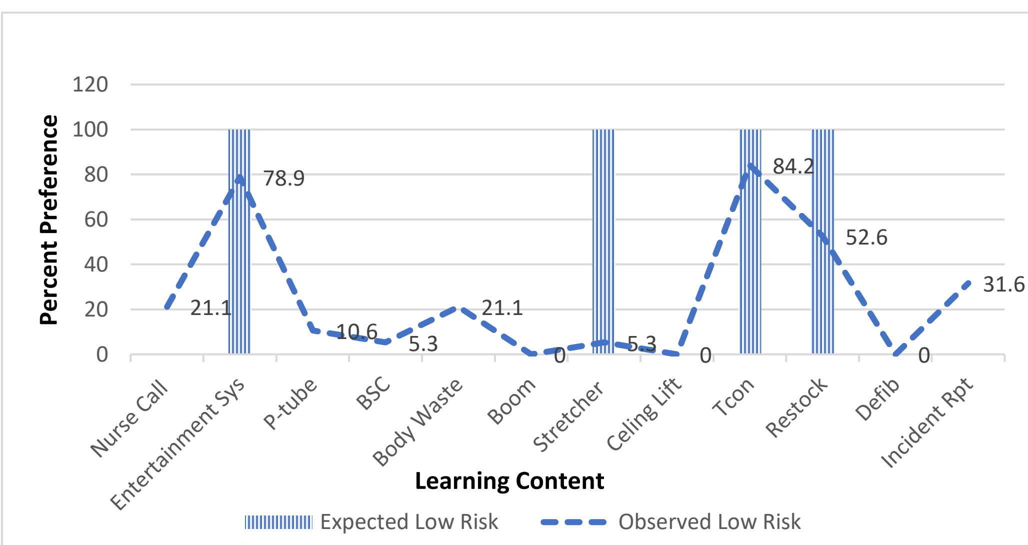
Observed (Participant) versus Expected (Researcher) Risk Ratings.

Because the expected (researcher's prediction) and observed (participant's perception) risk ratings measure the same variable, no correlation can be examined; however, the frequency of expected risk thought by the researcher to be inherent in the learning content was compared to the frequency of observed risk selected by the study participants, as outlined in Figures 16 – 18.

For low-risk learning content, (see Figure 16), 50% (entertainment and teleconference equipment) of the observed risk ratings agreed with the expected low-risk rating at a strong agreement level, and 25% (restock process) of the observed risk ratings agreed with the expected high-level risk rating at a moderate level. The transport stretcher showed the largest gap between expected and observed risk rating, as it was expected to be ranked as low risk, but 84.2% of participants ranked it as medium risk, and 10.5 % ranked it as high risk. The low-risk category displays the least agreement between expected and observed risk ratings.

Figure 16

Expected versus Observed Percent Risk Frequency for Low-Risk Learning Content

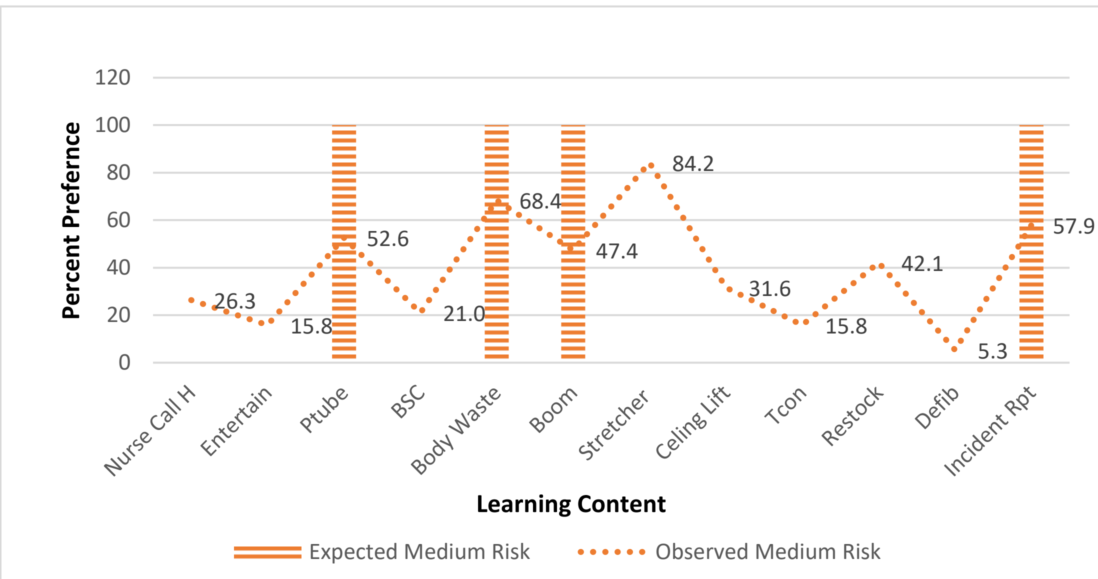


Note. P-Tube = Pneumatic Tube System, BSC = Biological Safety Cabinet, Boom = Operating Room Boom, T-con = Teleconferencing Equipment, Defib = Cardiac Defibrillator/Code Blue

For medium-risk learning content (see Figure 17), the pneumatic tube system (52.6%), body waste disposal equipment (68.4%), operating room boom (47.4%), and incident report process (57.9%) were expected to be rated medium risk; however, displayed a moderate level of agreement between observed and expected risk ratings. Approximately one-half to two-thirds (47.4 – 68.4%) of participants agreed on the medium risk ratings. There was no strong (> 70%) or weak (< 40%) level agreement between expected and observed risk ratings for moderate-risk learning content.

Figure 17

Expected versus Observed Percent Risk Frequency for Medium-Risk Learning Content

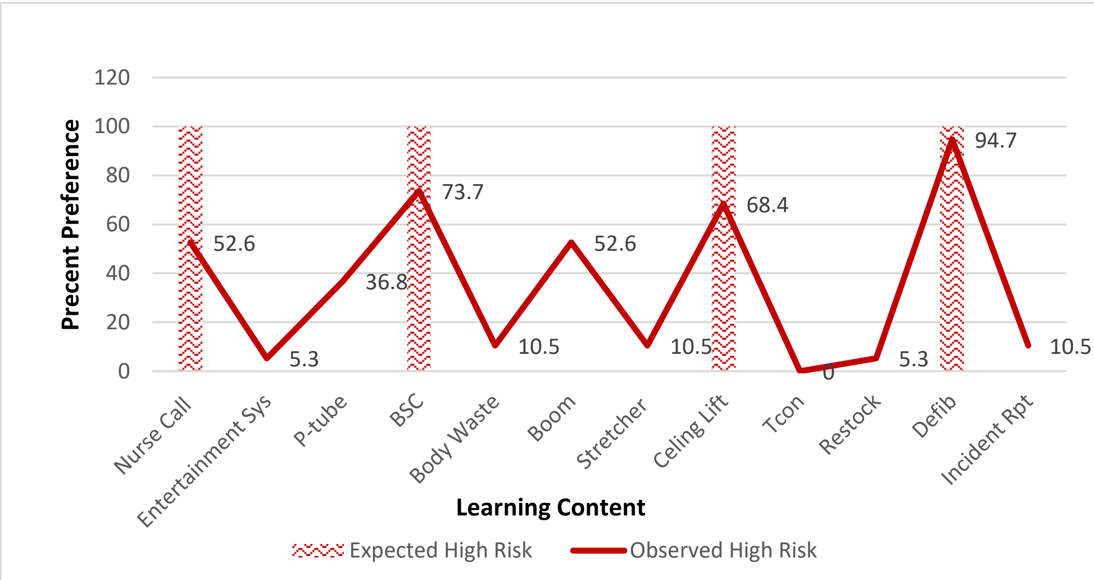


Note: P-Tube = Pneumatic Tube System, BSC = Biological Safety Cabinet, Boom = Operating Room Boom, T-con = Teleconferencing Equipment, Defib = Cardiac Defibrillator/Code Blue

For high-risk learning content (See Figure 18), the nurse call system, biological safety cabinet, ceiling lift, and cardiac defibrillator/code blue were expected to be rated high risk; however, only the biological safety cabinet (73.7%) and cardiac defibrillator/code blue (94.7%) met the criteria for strong level agreement between observed and expected risk ratings. The high-risk learning content category showed the highest level of agreement (52.6 – 94.7%) between expected and observed risk ratings.

Figure 18

Expected versus Observed Percent Risk Frequency for High-Risk Learning Content



Note: P-Tube = Pneumatic Tube System, BSC = Biological Safety Cabinet, Boom = Operating Room Boom, T-con = Teleconferencing Equipment, Defib = Cardiac Defibrillator/Code Blue

The inter-participant risk ratings were analyzed to evaluate if there was statistically significant agreement, concordance, or reproducibility between the participant's risk ratings. The small sub-sample size (n = 19) required special consideration and techniques for analysis as outlined below:

- Krippendorf alpha (K-alpha) was used in IBM SPSS to estimate the intercoder reliability or assessment of agreement because K-alpha can be used for any number of raters and variables with greater than two categories (Hayes & Krippendorf, 2007; Liu et al., 2016).
- The IBM SPSS 'bootstrap' method was used to derive an estimate of the confidence intervals (CI) for the correlation coefficients of non-parametric tests (IBM, 2021).
- Interpretation of K-alpha ranges from 0 (no reliability) to 1.0 (perfect) as follows (Hayes & Krippendorf, 2007; Ranganathan et al., 2017).
    - > 0.8 = good reliability
    - 0.67 to 0.8 = low reliability
    - < 0.67 = very low reliability

  - < 0.60 = a significant level of disagreement

The interrater reliability estimate (K-alpha = .4880) for overall intercoder reliability was extremely low, indicating that the 19 participants did not agree on the learning content risk ratings. Similarly, when participants were grouped by years of experience, role, or organization type, the interrater reliability or agreement among the participant risk ratings was also extremely low. In addition, interrater reliability tests based on grouped years-experience for junior (K-alpha = .5691), mid-career (K-alpha = .2988), and senior (K-alpha = .3096) participant groups resulted in a 100% chance that the risk ratings (see Appendix K) did not agree within each experience group. At best, only very low interrater reliability was identified between the two participants who identified in the operational readiness role (K-alpha = 0.6270) and between the six participants who work in the health authority environment (K-alpha = 0.6585).

Question 10.B

The second part of question 10 asked participants to rank their preference for interaction types (learner-instructor [LI], learner-learner [LL], and learner-content [LC]) as high, medium, and low importance for the learning content under consideration. The frequencies of interaction importance for each risk level (from Appendix M) are plotted relative to one another to identify an overall order of interaction preference (see Table 6). Several key findings regarding learning content risk and the importance of interaction types were identified.

- LC interaction was rated medium to highly important for all learning content risk levels.
- LC interaction is ranked as the most important for low-risk levels.
- LL interaction importance is of greater importance than LI for low-risk learning content.
- LL was rated low importance for high and medium-risk learning content.
- LL interaction is ranked as medium importance for all risk categories.
- LI interaction preference is greater than LL interaction for high and medium-risk learning content.
- LI interaction is preferred for high-risk content but is of low preference for low-risk content.

Table 6

Summary of Interaction Importance Preference for Risk-Rated Learning Content

	Interaction Type		
Learning Content Risk Level	Learner-Content	Learner-Learner	Learner-Instructor
High	**Medium-** High importance	**Low -** Medium importance	**High** - Medium importance
Med	**High** - Medium importance	**Low -** Medium importance	**Medium** - High importance
Low	**High** importance	**Medium** – Low importance	**Low** importance

Note. Bold indicates the majority importance frequency per cell.

To enable crosstab analysis of interaction with the learning content's risk rating selected by the participants in question 10A, the interaction rank data were transformed into 'preferred' and 'not preferred.' For each of the 12 learning content samples, the participants' risk score was analyzed against the three possible interaction types. A total of 36 crosstab comparisons were completed (see Appendix N) using a bootstrapped crosstab analysis in IBM SPSS. The SPSS 'bootstrap' method was used to derive an estimate of the confidence intervals for the correlation coefficients of non-parametric tests and to confirm valid findings based on the presence of a relatively narrow CI that does not contain zero (Heidel, 2024; IBM, 2021). The Likelihood Ratio and Cramer's V output were selected for effect size analysis because the small sample of data were composed of categorical and nominal variables (Akoglu, 2018; Field, 2018; IBM, 2024; Perneger, 2021). For the statistically significant ($p < .05$) Likelihood Ratio output, a further SPSS analysis step was completed to calculate the Bayes Factor to confirm alternative hypothesis (H_1) probability and allow magnitude conclusions about the likelihood that the null hypothesis (H_0) was not true (Jarosz & Wiley, 2014; Rosenfeld & Olson, 2021). There were three relevant findings.

1. There was a significant relationship between high-risk rated learning content and preference for learner-instructor interaction for the 'nurse call' bedside communication device (skill-based building system) training (LR (2, n = 19) = 9.54, $p = .008$). The effect size based on the Cramer's V value was significant (Cramer's V = 0.639, $p = .021$), and

it indicated a strong strength (see Appendix L) of association (Akoglu, 2018; IBM, 2024). The Bayes Factor (.049) confirms that the alternative hypothesis (there is an association between risk and interaction type) is 20.8 times more likely than the null hypothesis (Jarosz & Wiley, 2014; Rosenfeld & Olson, 2021).

2. There was a significant relationship between high-risk rated learning content and preference for learner-instructor interaction for surgical boom (skill-based equipment) training (LR (1, n = 19) = 19.585, *p* = .000). The effect size based on the Cramer's V value was significant (Cramer's V = 0.899, *p* = .000) and it indicated a very strong strength (see Appendix L) of association (Akoglu, 2018; IBM, 2024). The Bayes Factor (.000458) confirms that the alternative hypothesis (there is an association between risk and interaction type) is 2183 times more likely than the null hypothesis (Jarosz & Wiley, 2014; Rosenfeld & Olson, 2021).
3. There was a significant relationship between medium risk-rated learning content and preference for learner-content interaction for incident reporting (knowledge-based process) training (LR (2, n = 19) = 8.5741, *p* = 0.014). The effect size based on the Cramer's V values was significant (Cramer's V = 0.579, *p* = .041), and it indicated a moderate strength (see Appendix L) of association (Akoglu, 2018; IBM, 2024). The Bayes Factor (.172) confirms that the alternative hypothesis (there is an association between risk and interaction type) is 5.8 times more likely than the null hypothesis (Jarosz & Wiley, 2014; Rosenfeld & Olson, 2021).

Question 10.C

The third part of question 10 asked the participants to indicate their delivery mode preference for each of the three interaction types (LI, LL, and LC). Based on the delivery-interaction preference frequencies (see Appendix O - Table O2, O3, and O4), several key findings regarding delivery and interaction type importance were made for each risk level, and the overall order of interaction preference in question 10C agrees with the results in 10B, as outlined below.

High-Risk Content

- The overall order of interaction preference was LI > LC > LL.
- LI interaction was preferred via in-person face-to-face.

- LC interaction was preferred via blended delivery.
- LL interaction was preferred via asynchronous online delivery.

Medium-Risk Content

- The overall order of interaction preference was LC > LI > LL.
- LC interaction was preferred via asynchronous online or blended delivery.
- LI interaction via in-person face-to-face was preferred over in-person face-to-face via LL.

Low-Risk Learning Content

- The overall order of interaction preference was LC > LL > LI
- LI interaction was preferred via blended delivery.
- LL interaction was preferred via in-person, face-to-face delivery.
- LC interaction was preferred via asynchronous online delivery.

A crosstab analysis was completed using IBM SPSS to identify any correlations between the risk score and the combined interaction-delivery preferences for each learning content sample, using the IBM SPSS 'bootstrap' method for determining the Likelihood Ratio and Cramer's V statistics in the same manner as question 10B. Again, the Likelihood Ratio and Cramer's V were selected for analysis because the small sample size (n =19) was comprised of categorical and nominal variables (Akoglu, 2018; Field, 2018; IBM, 2024; Perneger, 2021). For all 12 learning content samples, the risk score was analyzed against the three possible interaction-delivery combinations, resulting in a total of 36 crosstab comparisons being completed (see Appendix P).

For statistically significant crosstab findings (i.e., nurse call system), the Bayes Factor was calculated. A further crosstab analysis step was necessary to identify significant interaction correlations. Data were transformed to 'preferred' or 'not preferred' for the delivery mode, thereby enabling crosstab analysis to determine which of the six possible delivery modes were responsible for the significant interaction findings (see Appendix Q). There were three notable findings.

1. There was a significant relationship between risk score and preference for learner-content interaction for nurse call (skill-based building system) training (LR (10, n = 19)

= 26.515, *p* = .003). Based on the Cramer's V value, the effect size was significant (Cramer's V = 0.798, *p* = .007) and indicated a very strong association (Akoglu, 2018; IBM, 2024). The Bayes Factor (.005) confirms that the alternative hypothesis (there is an association between risk and preference for LC interaction) is 200 times more likely than the null hypothesis (Jarosz & Wiley, 2014; Rosenfeld & Olson, 2021). Because this correlation involved three comparisons (LI, LL, and LC), a Bonferroni correction (*p* =.05 ÷ 3 = .016) was used to determine statistical significance.

2. The significant LC interaction crosstab for nurse call was further analyzed to uncover which delivery method was responsible for the significant result. There was a significant relationship between risk score and preference for learner-content interaction delivered by in-person face-to-face modality (LR (2, n = 19) = 19.785, *p* = .000). The effect size based on the Cramer's V values was significant (Cramer's V = 0.900, *p* = .000) and it indicated a near perfect association (Akoglu, 2018; IBM, 2024). The Bayes Factor (.001) confirms that the alternative hypothesis (there is an association between risk and preference for LC interaction via in-person face-to-face delivery) is 1000 times more likely than the null hypothesis (Jarosz & Wiley, 2014; Rosenfeld & Olson, 2021). Because this correlation involved six comparisons (asynchronous online, any, none, blended, in-person face-to-face and synchronous online), a Bonferroni correction (*p* =.05 ÷ 6 = .0083) was used to determine statistical significance.
3. The risk-interaction crosstabs for two learning content samples (medium-risk pneumatic tube and high-risk ceiling lift) had a statistically significant Likelihood Ratio; however, Cramer's V was not; thus, no further analysis was completed (see Appendix P).

The frequencies of delivery mode and interaction preference for each risk level (see Appendix O) were plotted relative to one another to identify the combined preference order for interaction and delivery mode with respect to risk rating (see Table 7). Participants identified learner-content interaction via asynchronous online delivery as most important for low-risk content. Learner-content interaction via asynchronous online or blended delivery was ranked most preferred for medium-risk learning content. Learner-instructor interaction via in-person face-to-face delivery was preferred for high-risk learning content.

Table 7

Summary of Delivery-Interaction Preference Frequencies for Risk-Rated Learning Content

	Interaction Type		
Learning Content Risk Level	Learner-Content	Learner-Learner	Learner-Instructor
High Risk	Blended	Asyn	IPF2F
Medium Risk	Asyn – BL	IPF2F	IPF2F
Low Risk	Asyn	IPF2F	Blended

Note. Asyn = Asynchronous Online, IPF2F = In-person Face-to-face. White cells = lowest relative frequency for the risk level, Grey cells = medium relative frequency for the risk level, Black cells = highest relative frequency for the risk level.

Chapter V. Discussion

Workplace instructional designers' experience challenges with balancing the cost, time, and resources needed to deliver efficient and effective training and orientation. These challenges, coupled with the healthcare environment's need for patient and staff safety, adds pressure to identify and justify the instructional design. Little is known about delivery mode and interaction choices for evidence-based healthcare workplace instructional design (Birca & Matveiciuc, 2021; Peltokoski et al., 2016). The idea that a risk-based approach may provide support for workplace training and orientation planning is rooted in, and aligns with, healthcare's historical risk-based approach to decision-making (Palm, 2020; Pascarella et al., 2021). The purpose of this mixed methods study is to explore instructional preferences and practices through engagement with frontline healthcare workplace training and orientation designers to determine if there is a relationship between the risk score of learning content and online or face-to-face training delivery that can be incorporated into a consensus derived instructional design decision tool. Since health care is attuned to risk mitigation, developing an instructional design decision tool based on learning content risk assessment and a pre-determined 'best practice' priority for instructional delivery and interaction choices may contribute to enhanced workplace and patient care safety.

Participant Discussion

The study sample provides a reasonable variation of healthcare instructional designer roles, workplace environments, and experience levels. The combined participants' demographics indicate there is a suitable sample from which the survey questions are thoughtfully and adequately answered to provide useful study data about Canadian instructional designers representing the instructional design role in various healthcare workplaces. The study participants are the workplace training designers, not the end users of workplace training.

The vast majority (80.8%) of participants (healthcare workplace instructional designers) indicate they use only their judgment and experience to make blended learning design decisions (see Figure 14), perhaps posing a problem for novice instructional designers, considering there is no statistically significant correlation found between years' experience and the use of blended learning design tools, and more than half of the participants (61.5%) have less than five years of experience (see Figure 4). It seems more appropriate that less experienced instructional designers would choose to use some form of design framework since they may not yet have acquired experiential knowledge to guide their instructional design choices.

Non-Risk Rated Interaction Discussion

The skill versus knowledge focus results provide insight into whether the type of learning content could potentially impact risk ratings as a confounding variable in this study. The results indicate that participants did not discriminate between skill and knowledge-focused learning (see Figures 7 and 8) concerning their preferred learning interaction order. The learner-instructor (LI) interaction was preferred over learner-learner (LL) and learner-content (LC) interaction types, with learner-content interaction being least preferred [LI > LL > LC] (see Figures 5 and 6). The observed frequencies for skill-focused and knowledge-focused interaction preference orders are almost identical and are confirmed as not having a statistically significant difference using the chi-square (goodness of fit - likelihood ratio) test. No difference between skill and knowledge-focused interaction preference orders is an important finding because it indicates that the learning content focus is not thought to be a confounding variable, leaving open the possibility that the risk level of learning content may be a viable method for determining appropriate interaction types and delivery modes for healthcare workplace training. In addition, findings indicate that the non-risk ranked interaction preference [LI > LL > LC] is different than the risk ranked interaction preference [LC > LI > LL], suggesting that risk assessment of learning content influences instructional design choices related to interaction preference.

Non-Risk Rated Delivery Mode Discussion

The instructional designer participants' ranking of general (non-risk ranked) preference for the four delivery modes (in-person face-to-face, asynchronous online, synchronous online, and blended) results in the selection of only seven of 36 possible combinations. Within the seven combinations, all four delivery modes are selected as the first choice for delivery mode preference (see Figure 9), but with widely different frequencies. In-person face-to-face (IPF2F) delivery is most preferred, followed by asynchronous online (Asyn) and synchronous online (Syn), then blended learning (BL) was least preferred [IPF2F > Asyn > Syn > BL]. This general (non-risk rated) preference order for delivery mode [IPF2F > Asyn > Syn > BL] does not match the risk-ranked preferred delivery order [IPF2F > Asyn or BL > Asyn], again suggesting that risk assessment influences instructional design choices.

There is a clear and equal split between instructional delivery preference orders that includes in-person face-to-face as a first choice and least preferred. It is also evident that asynchronous and synchronous online delivery are almost equally preferred for non-risk-rated learning content (see Figure 9). In contrast, for risk-rated learning content, it is interesting to note that synchronous online learning is not preferred for any risk level. Generally, without considering the nature of the learning content (i.e., risk level), there is a near equal divide among the study participants, regarding preference for online and in-person face-to-face delivery modes, not blended learning.

The participant's non-risk-rated delivery preference findings suggest that healthcare workplace training has not yet recognized, accepted, or adopted the advantages of blended learning. There does not seem to be consensus about the use of online or blended learning over in-person face-to-face delivery methods, leading one to consider the possibility that healthcare workplace training is in a state of transition or that there are barriers present in the healthcare workplace, such as a lack of technology infrastructure, technology support, or computer skills; instructional designer or leadership stuck doing things the old way (i.e., via in-person face-to-face delivery); a lack of advocacy for blended learning; or blended learning design complexity (Cleveland-Innes & Wilton, 2018). Since most participants self-identified as junior instructional designers with one to five years of experience, there may also be a lack of blended learning know-how in this participant study sample, which accounts for this finding.

It is somewhat surprising in a post-COVID-19 world, that blended learning is selected as most preferred by only a small fraction (7.6%) of participants, considering the growing popularity of blended learning and significant attention in the literature about its benefits and utility (Bernard et al., 2014; Bozkurt 2022; Peltokoski et al., 2016). This finding is also surprising in relation to the operational issues that healthcare continues to face, specifically around staffing, efficiency, and cost challenges (Benson, 2004). One would think that healthcare workplace instructional designers would be proactive or even forced to find flexible, consistent, and accessible alternatives for in-person, face-to-face training methods that require learners to be relieved from duty to attend training.

When considering the (non-risk rated) interaction type for in-person face-to-face delivery (see Figure 13B), we see a learner-instructor interaction preference, echoing the skill and knowledge-focused learning findings. In contrast, learner-learner interaction is preferred for asynchronous online delivery, while learner-instructor interaction is preferred for synchronous online delivery. The learner-instructor findings are intuitively consistent; where asynchronous online delivery may be completely learner-driven without the aid of an instructor, in comparison to instructor facilitation requirements for in-person face-to-face delivery and synchronous online learning. However, evaluation of the interaction and delivery mode relationships via chi-square analysis revealed statistically significant results for very strong relationships for in-person face-to-face via synchronous online delivery only, not asynchronous online delivery.

Risk Ranked Preferences for Delivery and Interaction Discussion

Expected versus Observed Risk Ratings

The risk rating survey question (question 10) is designed to enable grouping of the learning content by risk. A participant's rank of the learning content is neither correct nor incorrect, because it is influenced by an instructional designer's or organization's unique risk tolerance. The risk rankings in this study, serve to partition the learning content and allow participants to more readily consider their preference for learning design based on their chosen risk level. The actual risk rating for the study purposes is arbitrary; however, it is needed to allow for the correlation between a specific risk level and the associated instructional design delivery and interaction preferences.

The expected risk rank (what I thought) is considered the most likely risk level based on experience in the healthcare sector, while the observed risk is the risk level chosen by the participant. As the learning content's perceived risk increases, the following trends are identified: 1) there is a higher level of risk agreement between participants, and 2) a higher percentage of agreement between the researcher's expected and the participant's selected risk ratings. The participant's preference for interaction type and delivery mode is also found to be more uniform for high-risk learning content. This study highlights that it may be easier for instructional designers to discern high-risk learning content than medium or low-risk content and may account for the difference in interaction and delivery preference orders observed between risk-rated and non-risk-rated learning content.

The difference in expected versus observed risk scores and very low intercoder reliability results, as measured using Krippendorf alpha (K-alpha) to estimate the agreement the participants' risk ratings, do not have an impact on this study's ability to propose an instructional design decision matrix, other than to demonstrate that there are likely to be various opinions about the risk of any specific learning content and suggests that an organization or instructional designer must define their risk tolerance and rating parameters before using any risk-based decision tool. Because the learning content is risk-rated across all risk levels from low to high, and is not focused on only one risk level, we are able to utilize risk rating as a method of partitioning the learning content for further analysis in association with interaction and delivery mode.

Learning Content Risk, Interaction Type, and Delivery Mode Discussion

A risk-based decision matrix (see Table 8) was created, by combining the participants' risk-rated interaction preferences and risk-rated delivery mode preferences. A two step process was used to summarize, collate, and layer the data to establish a risk-based decision matrix for instructional design in the healthcare workplace.

First, the highest risk-rated interaction preference frequencies (see Table M1) were transformed, according to the participants' perceived risk level of the learning content, into the risk-based interaction preference summaries (see Tables M2, M3 and M4). The order of preferred interaction type was determined from Tables M2, M3 and M4 and then compiled into a risk-based interaction decision matrix (see Table 6). The overall order of interaction preference in relation to risk level is established from the collated findings in Table 6, as the following: learner-content, learner-instructor, then learner-learner [LC > LI > LL]. Of note, this interaction preference order differs from the learner-instructor, learner-learner, and learner-content order [LI > LL > LC] previously identified when interaction is considered without respect to risk.

Though the statistical analyses data cannot completely verify the interaction preference findings for risk-rated learning content, the three statistically significant correlation tests (see Appendix N) do provide support for the interaction preference findings. The nurse call bedside communication system, ranked as high-risk, strongly correlates with a preference for learner-instructor interaction. The operating room boom equipment, rated high-risk, also shows an extremely strong correlation with learner-instructor interaction preference. Lastly, incident report training, rated medium risk, shows a moderately strong correlation with preference for learner-content interaction.

The second step in creating a complete risk-based decision matrix (see Table 8) from the participants' interaction and delivery mode preferences, followed a parallel process as described above. The highest risk-rated delivery mode frequencies for each interaction type (see Table O1) were transformed into the risk-based summaries of the combined interaction and delivery preferences (see Tables O2, O3, and O4). The preferred order for interaction and delivery mode in combination, were identified from Tables O2, O3, and O4, and then layered together based on the participants' perceived risk rating (see Table 7). The overall risk-based preference for interaction in combination with delivery mode is established from the collated findings in Table 7, as the following:

- High-risk learning content via in-person, face-to-face delivery using learner-instructor interaction.
- Medium-risk learning content via asynchronous or blended learning using learner-content interaction
- Low-risk learning content via asynchronous delivery using learner-content interaction.

Again, the statistical analyses data cannot completely verify the findings in Table 7. The high-risk rated nurse call bedside communication system is the one statistically significant delivery-interaction-risk preference finding (see Appendix P), showing a very strong association between preference for LC interaction via in-person face-to-face. This statistical result verifies the risk-rated interaction preference findings in Table 6, where learner-content interaction-rates as the highest preference for low-risk learning content. However, this statistical result does not verify the risk-rated preference frequency findings for interaction in combination with delivery mode in Table 7, where LC interaction via in-person face delivery is not preferred for any risk level. These contrary findings may be due to the statistical errors common to small sample size studies (i.e., more false negatives - type II errors where the null hypothesis [H0 - no relationship] is accepted when it is false and the alternative hypothesis [H1- positive relation] is true). Further study is needed involving a larger sample to determine which, if any, of these statistical results are accurate.

This final part of the survey, question 10, bridges interaction technique and delivery mode preference with perceived learning content risk, to create the proposed risk-based training and orientation planning support (RB-TOPS) matrix (see Table 8) as a novel instructional design decision tool for healthcare workplace training.

Table 8

Risk-Based Training and Orientation Planning Support (RB-TOPS)Matrix

Risk Level	Preferred Delivery Mode Order	Corresponding Preferred Interaction Type
High	**1. In-Person Face-to-Face**	**Learner-Instructor**
	2. Blended	**Learner-Content**
	3. Asynchronous	Learner-Learner
Medium	1. Asynchronous or Blended	**Learner-Content**
	2. In-Person Face-to-Face	Learner-Instructor
	3. In-Person Face-to-Face	Learner-Learner
Low	1. Asynchronous	Learner-Content
	2. In-Person Face-to-Face	Learner-Learner
	3. Blended	Learner-Instructor

Note: This matrix is based on the relative frequencies of the instructional designers' preferences. Bolded font indicates statistically significant findings. Learner-content interaction correlates significantly with in-person face-to-face delivery for high-risk content, not learner-instructor content.

The proposed RB-TOPS matrix is intended for use in the following manner.

- For high-risk learning content, the instructional designer will first consider in-person face-to-face training facilitated by an instructor or subject matter expert. If a solely in-person face-to-face delivery mode is not practicable, then the instructional designer will attempt to provide blended learning that prioritizes learner-content interaction. If the blended mode is not possible, the last choice for high-risk content is asynchronous online learning, including learner-learner interaction such as learner-driven or facilitated online discussion boards.
- For medium-risk learning content, the ideal design will be based on asynchronous or blended delivery with primarily learner-content interaction.
- For low-risk learning content, the ideal design will emphasize learner-content interaction via asynchronous delivery modes.

For learning content with components that include a combination of high, medium, and low-risk items, the instructional designer will strive to provide a design that consists of the various preferred interaction and related delivery mode combinations according to the assessed risk of the learning content. In this way, the RB-TOPS matrix may act as a blended learning design tool in this workplace learning context.

Limitations

Two fundamental limitations are apparent in this study. First, low statistical power (the chance of discovering genuinely true effects) due to small sample size and/or small effects is known to negatively impact the probability of finding true results that are not spurious or biased (Button et al., 2013). Small sample size studies contribute to low predictive power (lower probability of finding a true effect or positive correlation result), more false negatives (type II errors where the null hypothesis [H_0 - no relationship] is accepted when it is false and the alternative hypothesis [H_1- positive relation] is true), and overestimated effect size for true effects (Button et al., 2013).

The sample size (N = 26) is insufficient to interpret questions five to nine based on the a priori power analysis (see Appendix H). Since power is the probability of rejecting the null hypothesis (no relationship), the absence of a statistically significant result indicates that there is not enough evidence to support either the null or alternative hypothesis – that there is a relationship (Kyonka, 2019). A test whose goal is to compare two variables from a small sample may not produce a statistically significant result; however, "the absence of evidence is not evidence of absence" (Kyonka, 2019, p. 137). Even though the a priori sample size of N = 29 for an 80% power is not met for questions five to nine, evaluating *p* values and confidence intervals using Cramer's V and the Bayes Factor allows more accurate detection of correlations within this small sample.

Similarly, the post hoc power level calculated by G*Power (see Appendix I) for the sample in question 10 (n = 19) at the large effect size (0.5) is less than the 80% ideal power level, increasing the chances that effects are not accurately detected (Field, 2018). The likelihood that a statistically significant research finding reflects a true effect is reduced due to the study's decreased power (Bottom et al., 2013). The small sample size negatively impacts the external validity, which is the extent to which the findings can be generalized to other contexts (Bui, 2020). For example, the small sample size may have contributed to a skewed participant demographic, composed mainly of instructional designers with one to five years of experience. Because 50% of participants were junior instructional designers, the findings may not be generalizable across all experience levels.

The post hoc power analysis (see Appendix I) indicates that between 24% and 61% of the study's claimed results may be correct. In addition, the magnitude of the effect provided by the statistically significant results is likely inflated by 10-25% (Bottom et al., 2013). By selecting an a priori large effect size (0.5) for this low-powered study, which can only detect large effect sizes with large power (80%), it was hoped that the "winners curve" of inflated effect size estimates is mitigated such that any statistically significant results with very large effect size would remain at worst, valid at the medium effect size level (Bottom et al., 2013, p. 373).

The second limitation is related to the study questionnaire. The survey design does not allow evaluation of more than one finding or principle, as Graham and Massyn (2019) reported regarding the use of interaction techniques in combination, because the questionnaire only allowed for single preference selections. Another barrier posed by the questionnaire is its length and complexity, which may have contributed to the loss of seven (27.9%) of the N = 26 participants who did not complete question 10. An overly complicated and lengthy questionnaire may negatively impact the study's internal validity.

A third possible limitation is worth mentioning. This study was completed by a researcher who presently works in the healthcare workplace training environment as a new employee orientation and training consultant. Care was taken to design the study to reduce potential bias in the interpretation of findings; however, personal bias should always be considered a limitation in these circumstances.

Recommendations for Future Research

Based on the study results and lessons learned, there are several recommendations for future research. First, some of the limitations already identified should be rectified. An increase in the sample size may be achieved by expanding the target population, perhaps by including other workplaces, such as oil and gas, forestry, or mining, where there too, is a high likelihood of workplace learning content spanning the entire risk strata. Second, revise the questionnaire to reduce the complexity and number of questions, streamline or eliminate the need to rank pseudo-learning content, and reconsider the order of the questions may enhance the return rate of completed questionnaires. Third, modify the research survey design to meet the unmet goal of better understanding the instructional designers' preference for the interaction combinations that align with each delivery mode instead of single interactions. Lastly, where the RB-TOPS matrix does distinguish between interaction types (i.e. face-to-face learner-instructor interaction is preferred), undertake further study to identify if a specific kind of learner-instructor facilitator (such as subject matter expert instructor or peer mentor) is a potential refinement of the matrix.

Conclusion

The preceding discussion outlines evidence for reflection on the study's research goals and questions. This study does add to a better understanding of the ideal blend of learning interaction and delivery that enables effective utilization of available training resources through the exploration of instructional designers' preferences for the use of interaction (learner-content, learner-instructor, or learner-learner) and delivery mode (online or in-person) in association with the perception of content risk (high, medium, or low) in the corporate training context. Anderson's (2003) interaction equivalence theorem is put into practice by determining what interaction types the instructional designers prefer as most important for quality learning. This study successfully examines the relationship between: 1) interaction techniques and delivery modes, 2) interaction technique and learning content risk, 3) delivery mode and learning content risk, 4) content type (skill or knowledge-based) and delivery, and 5) content type and interaction techniques.

For the main research question (Is there a relationship between the risk score of learning content and online or face-to-face delivery of health care workplace training?), a positive and significant relationship between instructional designer's preference for interaction type and delivery mode has been minimally established through assessment of instructional designer's preferences, resulting in rejection of the null hypothesis that there is no relationship. The alternative hypothesis 1A (i.e., High-risk competencies correlate positively with synchronous instructor-mediated in-person training) is accepted, based on evidence of a positive correlation between high-risk learning content and learner-instructor mediated in-person face-to-face delivery (see Table 8). Alternative hypothesis 1B (i.e., Low-risk competencies correlate positively with asynchronous learner-driven online training) is also verified by the finding that asynchronous learner-driven online training via learner-content interaction is preferred for low-risk learning competencies. (see Table 8).

The sub-question conclusions are as follows.

1. What interaction and delivery mode combinations are valued/used most often by instructional designers for blended learning knowledge-based content? Skill-based content?

- There is no statistically significant difference between the participant's preference of interaction type for skill-based or knowledge-based learning content.
- Graham and Massyn's (2019) findings that a learner-learner interaction is best suited for skills-based or socially-oriented types of learning content are not confirmed.

2. What is the relationship between the perceived quality of interaction (high or low-level risk), the quantity of interaction (multiple modes), and the preferred delivery mode (online or in-person) of blended learning?
    - Blended learning is preferred for high-risk and medium-risk content via learner-content interaction.
    - Blended learning is preferred for low-risk content via learner-instructor interaction.
3. When do instructional designers perceive that online and in-person delivery modes are required?
    - In-person face-to-face delivery is preferred for high and medium-risk content using learner-instructor interaction.
    - Learner-instructor interaction is preferred for face-to-face learning and for complex content to be learned (high-risk content) and/or more than one interaction technique, as reported by Graham and Massyn (2019).
    - In-person face-to-face delivery via learner-learner interaction is preferred for medium and low-risk content.
    - Asynchronous online delivery via learner-learner interaction is preferred for high-risk content.
    - Asynchronous online or blended delivery is preferred for medium risk using learner-content interaction.
    - Asynchronous online delivery via learner-content interaction is preferred for low-risk content.
    - Synchronous online delivery is entirely not preferred.

- Graham and Massyn's (2019) findings that learner-content (not LI) interaction is preferred for online delivery is confirmed.
- Learner-learner interaction is the least preferred, as reported by Graham and Massyn (2019).
- As described by Graham and Massyn (2019), learner-learner interaction can substitute for learner-instructor interaction when non-subject matter expertise is needed. This study found that learner-learner is the preferred interaction mode when learner-instructor interaction and/or in-person face-to-face delivery is not practicable.

As recommended by Berge (2002), this study explores interactions for learning, not in isolation, but in relation to the learning context (healthcare workplace) and delivery modes (in-person face-to-face, asynchronous online, synchronous online and blended). Identification of preferred delivery modes and interaction types is accomplished based on the learning content risk level as a marker for learning needs (Berge, 2002). The major conclusion of this study is a decision support model (RB-TOPS: Risk-based Training and Orientation Planning Support); however, the results must be tempered with the knowledge that the conclusions are based on a small sample size, which has likely resulted in type II (false negative) errors, where the hypothesis (no relationship) is false but not rejected in error (Button et al., 2013).

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Appendices

Appendix A. Definitions, Synonyms, and Acronyms

ADDIE - Analysis, Design, Development, Implementation, and Evaluation instructional design model.

Asymmetrical Interaction - “One-way communication” (Bernard et al., 2009, p 1247).

Asynchronous Learning - Time-independent activities. Independent-oriented learning strategies (Miyazoe & Anderson, 2010, p. 94). Participants learn together separately at different times. (Cleveland-Innes & Wilton, 2018, pp. 52-53).

Behavioural-Based Safety- “Reducing at-risk behaviours via performance goals, observation, feedback and worker responsibility, accountability and commitment via instruction, support, and motivation” (Mullins-Jaime et al., 2021, pp. 21-22).

Blended Learning - The combination of on-site face-to-face and online virtual settings (Ashraf, 2021, Bozkurt 2022).

Building Equipment - Machinery, apparatus, systems, and fixtures attached to the building structure. Building equipment is manufactured elsewhere and then installed in the building (Johnston, 2014; Law Insider, n.d.).

Building Systems - The collection of components that combine to make an element or perform a function (Uniclass, 2022 August 05). The constituent parts of a building, including, but not limited to, structural, mechanical, plumbing, transport, technology/communications, and electrical systems, that are built onsite as an integrated component of the building.

Clinical commissioning - *“*The activities undertaken to determine the readiness of staff, procedures, and other non-infrastructure elements of the clinical program prior to commencement of patient care” (CSA, 2023, p. 16).

Commissioning process - “A systematic verification, documentation, and training process applied to all activities during the design, construction, static verification, start-up, and functional performance testing of equipment and systems in a facility to ensure that the facility operates in conformity with the owner's project requirements and the basis of design in accordance with the contract documents” (CSA, 2023, p. 16).

Consequence - “The result of an effect” and “impact and consequence are used as synonyms” (Pascarella et al., 2021, p. 2900).

Criticality of Failure - The degree of risk that poor performance places on the patient based on task/skill competency, frequency of use, complexity, and severity of impact (Parsons & Capka, 1997). High criticality of failure indicates a significant negative or deadly impact on the patient.

Distance Education - Originated from an industrialized self-instruction correspondence package packet with a rigid commitment to autonomy and self-pacing. Its core assumption is learner independence. Interaction is between learner-content only (Garrison, 2009).

Equipment - Freestanding, not fixed equipment that can work outside the building without being linked to the building structure. Equipment is manufactured elsewhere and delivered to the facility for use (Johnston, 2014).

Impact or Severity - Effect of the realized threat (Pascarella et al., 2021, p. 2900).

Interaction - "Communication between the two major types of actors (human and non-human) in modern distance education" and blended learning (Anderson, 2003, p. 130). "Reciprocal events that require at least two objects and two actions" (Wagner (1994) in Anderson, 2003. p. 1). "Interaction occurs when these objects and events mutually influence each other" (Wagner (1994) in Miyazoe & Anderson, 2010, p. 94).

Interaction Equivalence Theorem - "A theorem developed by Anderson (2003) to initially clarify the interaction mechanism in distance education. The theorem proposes three forms of interaction (learner-content, learner-learner, and learner-instructor) and that the learner experience will be high quality, provided that at least one form of interaction is provided at a high level. It argues that different economies exit between independent-oriented and interactive-oriented learning strategies and activities and that these need to be considered when designing and delivering distance education" (Miyazoe & Anderson, 2010, p. 94).

Interaction Techniques (aka Interaction Treatments)- "Conditions or environments that are designed and arranged by teachers [instructional designers] to encourage such interactions," namely learner-content, learner-learner, and learner-instructor interactions (Bernard et al., 2009, p. 1248), that provide "two-way communication among two or more persons" or "one-way communications from the author of the learning material to the student" (Berge, 2002, p. 183).

Learner-Content Interaction (LC) - "The process of intellectually interacting with the content that results in changes in the learner's understanding the learner's perspective, or the cognitive structures of the learner's mind" (Moore, 1989, p. 2). "Student interaction with content is asymmetrical" (Xiao, 2017, p. 124), "one-way communication" and "largely self-directed" (Moore, 1989, p. 1), as "a kind of internal dialogue" (Berge, 2002, p. 185).

Learner-Learner Interaction (LL) - "Interaction among students or among students working in small groups" (Bernard et al., 2009, p. 1247). This type of interaction may be synchronous online, synchronous face-to-face, or asynchronous in the online environment. "Peer group interaction" or "inter-learner interaction, between one learner and other learners, alone or in group settings" (Moore, 1989, p. 2). Involves "interpersonal relationship building" that "replicates authentic working conditions" (Berge, 2002, p. 185).

Learner-Instructor Interaction (LI) - "Classroom-based dialogue between students and instructor," which may be synchronous in-person or asynchronous/synchronous in online

environments (Bernard et al., 2009, p. 1248). “Interaction between learner and the expert” “professional instructor” that includes “reality testing and feedback” to ensure “learner’s application of new knowledge” (Moore, 1989, pp. 1-2). Includes “mentoring relationships” (Berge, 2002, p. 186).
Loss - “Results in a compromise to function, life, or assets” (Alum, 2016, p. 1).

Near Miss - “An event or process variation that could have resulted in injury but did not, either by chance or timely intervention” (Alum, 2016, p. 1).

Nominal Scale - “A measurement scale where items are placed in mutually exclusive categories. Differentiation is by name only (e.g., race, sex). Appropriate categories include ‘same’ or ‘different.’ Appropriate transformations include counting” (Cronk, 2018, p. 148).

Off-line Training - Traditional classroom instruction or in-person training (Bernard et al., 2009, p 1244).

Online Learning - Descended from computer-based instructional technology and constructivist theory in higher education. Its core assumption is collaboration and community and is associated with the collaborative-constructivist view of learning (Garrison, 2009). A teaching “method that integrates information technology and human learning process to facilitate learning at any time and in any place” (Shih et al., 2013, p. 343). Online learning may include asynchronous independent-oriented, synchronous interactive-oriented, and synchronous face-to-face activities (Miyazoe & Anderson, 2010, p. 94). Online learning is considered a synonym for eLearning

Online Training - “Learning activities within a K-12, higher education, or professional continuing education environment where interaction is an integral component.” (Bernard et al., 2009, p 1246). Synonyms: distance education, eLearning (Bernard et al., 2009, p. 1244).

Operational Readiness (OR) - “The installation and commissioning of the owner's supplied systems and equipment. Note: Operational commissioning brings the facility to a fully operational condition and includes staff orientation and training. It is carried out after the building commissioning” (CSA, 2023, p. 19). Also known as activation, operational commissioning, operational readiness, or transition planning.

Ordinal Scale - “A measurement scale where items are placed in mutually exclusive categories, in order. Appropriate categories include “same,” “less,” and “more.” Appropriate transformations include counting and sorting” (Cronk, 2018, p. 148).

Practitioner - This is a general term that includes persons who are learning course/program designers, such as instructors/teachers, instructional designers, learning and development departments, project managers, and consultants.

Probability - “The measure of the likelihood that an event will occur” (Alum, 2016, p. 1).

Quality of Interaction - The level or “amount of interaction planned/realized in a course design.” A high level of interaction “may be enough to sustain meaningful learning (referring to effectiveness” (Miyazoe & Anderson, 2012, p. 3).

Quantity of Interaction - “One or more kinds of interaction may be more satisfactory but also most costly (referring to efficiency” (Miyazoe & Anderson, 2012, p. 3).
Risk - The “probability/threat of damage, injury, liability, or loss that is caused by vulnerability and that may be avoided through pre-emptive actions” (Alum, 2016, p. 1). “The vulnerability to a threat” (Pascarella et al., 2021, p. 2900). “The chance of something happening that will have an impact on the achievement of the stated organizational objectives” (Pascarella et al., 2021, p. 2897).

Risk Assessment - Includes “risk identification, risk analysis, and risk evaluation” (Pascarella et al., 2021, p. 2897)

Risk Management for Healthcare - “An organized effort to identify, assess, and reduce, where appropriate, risk to patients, visitors, staff, and organizational assets” (Alum, 2016, p. 1).

Risk Matrix - Includes “two variables; severity of harm and occurrence probability of this harm or likelihood” (Pascarella et al., 2021, p. 2897)

Sentinel event - “An unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof, not related to the natural course of a patient’s illness or underlying condition” (Alum, 2016, p. 1).

Symmetrical Interaction - “Interaction equally balanced between the parties involved” (Bernard et al., 2009, p. 1247).

Synchronous Learning - Time-coordinated activities where participants are doing the same thing at the same time. These activities can be in-person or online. (Cleveland-Innes & Wilton, 2018, pp. 52-53).

Threat - “Any activity that represents a possible danger” (Alum, 2016, p 1). “The potential for harm” (Pascarella et al., 2021, p. 2900)

Vulnerability - “A weakness” (Alum, 2016, p. 1).

Appendix B. Systems Approach to Risk-Based Blended Learning Design

Table B1

Learning Interactions for Blended Learning

Relationship to Interaction Equivalence Theory	Link to Community of Inquiry Subsystem	Content Risk Level* & Hazard Score**	Online or In-Person	Asynchronous or Synchronous	Asymmetrical or Symmetrical	Independent or Interactive Orientation	Quantity of Interaction Equivalence Theorem***	Minimum Blended Learning Interaction Mode for Curriculum Design	Applicable Principles that Guide the Risk-Based BL Design
Learner-Content Interaction	Cognitive Presence	Low (1 -5)	Online	Asynchronous	Asymmetrical	Independent	LC	▪ Online asynchronous (learner-driven) content with no Learner-Instructor or Learner-Learner Interaction	#1. A blended learning format requires 'push' online learning bridged to in-person learning, and in-person learning bridged to 'pull performance support' online resources (Cleveland-Innes & Wilton, 2018). #2. LC should be used for all risk levels (Bernard et al., 2009, p. 1260). #3. LC strength is a predictor of asynchronous achievement (Bernard et al., 2009, p. 1262). #4. LC or LL is more effective than LI. (Bernard et al., 2009, p. 1259).
Learner-Learner Interaction	Social Presence	Medium (8-12)	Online Online In-person (Individuals)	Asynchronous Asynchronous Synchronous	Asymmetrical Symmetrical Symmetrical	Independent Interactive Interactive	LC + LL	▪ Online asynchronous content with no Learner-Instructor Interaction, plus ▪ Online or in-person synchronous or asynchronous peer mentor/coach-mediated Learner-learner Interaction	#5. If online LC interaction does not have teaching presence for higher-order learning, then LL or LI interaction is needed (Garrison et al., 1999). #6. For higher-order thinking and collaborative work, LL interaction is needed in addition to LC interaction (Garrison et al., 1999). #7. Higher level strength (stronger treatments) of any interaction positively impacts learning achievement (Bernard et al., 2009, p. 1259). #8. There is no advantage between asynchronous, synchronous, or mixed synchronous + asynchronous online interaction. (Bernard et al., 2009, p. 1261).
Learner-Instructor Interaction	Teacher Presence	High (15 - 25)	Online Online In-person (Team)	Asynchronous Synchronous Synchronous	Asymmetrical Symmetrical Symmetrical	Independent Interactive Interactive	LC + LL + LI	▪ Online synchronous or asynchronous content with Learner-Instructor Interaction, plus ▪ In-person/team synchronous with subject matter expert (clinical educator or vendor)	#9. LL and LC interaction can be used alone, but LL cannot be used alone for increased achievement and must be combined with LL or LC (Bernard et al., 2009, p. 1259). #10. LL plus LC and LI plus LC increase achievement, but LL plus LI do not independently increase achievement (Bernard et al., 2009, p. 1260). #11. LL and LI should be utilized in combination with LC (Bernard et al., 2009, p. 1260). #12. LI is less effective than LC or LL in the online environment. #13. Increased LI or LL interaction positively affects online learning (Bernard et al., 2009, p. 1264). #14. Design should consider all three interaction techniques: LC for facts, LL for cooperative learning and LI for higher-order learning (Bernard et al., 2009, p. 1265). #16. Course effectiveness is not enhanced by non-asynchronous online interaction; thus, higher-order learning should include in-person interaction (Bernard et al., 2009, p. 1264).

Note. Produced from Anderson, 2003; Bernard et al., 2009; Cleveland-Innes & Wilton, 2018, pp. 23, 32; Garrison et al., 1999, pp. 98, 100; Miyazoe (2009) reported in Miyazoe & Anderson, 2010.
* Risk level correlates to the criticality of failure or degree of higher-order learning required, based on a 5 x 5 risk matrix.
** Hazard score is identified by SME instructional designers familiar with the learning context and content to be learned.
*** LC = learner-content interaction, LL= learner-learner interaction, LI = learner-instructor interaction.

Appendix C. Quantitative Data Collection and Analysis

Table C1

Quantitative Analysis Codebook - Table of Variables and Measures

Variable / Variable Description	ID number	Organizational role	Role experience	Workplace environment	Workplace location	Content type	Interaction level preference (rank)	Learning content delivery mode preference	Risk score rating (rank)
Variable type	Control	Independent[1]	Independent	Independent	Independent	Independent	Independent	Dependent[2]	Independent
Data characteristics	Qualitative[3]	Qualitative Categorical (no mean)	Quantitative[4] Numerical	Qualitative Categorical (no mean)	Qualitative Categorical (no mean)	Qualitative Categorical (no mean)	Qualitative Categorical (no mean)	Qualitative Categorical (no mean)	Qualitative Categorical (no mean)
Measurement scale	Nominal	Nominal	Continuous Interval Raw Score	Nominal	Nominal	Nominal	Ordinal Ranked (Huck, 2011, p. 53)	Nominal (Huck, 2011, p. 54)	Ordinal Rated (Huck, 2011, p. 435)
Statistical tests that apply							Correlation: Crosstab followed by Chi-square test of independence.	Correlation: Crosstab followed by Chi-square test of independence.	Correlation: Crosstab followed by Chi-square test of independence.
Survey Response Options	LimeSurvey Random Participant Number	1. Capital Planning 2. Clinical Instructor 3. Consultant 4. Instructional Designer 5. Instructor 6. Human Resource Dept. 7. Learning Dev Dept. 8. Peer Mentor Coach 9. Project Manager 5. Vendor SME 6. Other	Number of Years	1 = Acute, 2 = Consulting Firm 3 = Corporate / Business 4 = Health Authourity 5 = Health Care Organization 6 = Independent Consultant 7 = Long-Term Care 8 = Vendor / Supplier 9 = Other	1. Canada 2. USA 3. Europe 4. South America 5. Central America/Caribbean 6. Asia 7. Pacific Islands 8. Australia/NZ 9. Africa 10. International 11. Other	1. Building equipment 2. Building system 3. Equipment 4. Workflow	Each content item is ranked on the preferred interaction level based on the following categories: 1. High - Highest quantity/quality of interaction provided 2. Medium - Moderate quantity/quality of interaction provided 3. Low - Lowest quantity/quality of interaction provided	Each learning technique is assigned the preference for delivery mode: 1. Online 2. In-person 3. Both 4. None	Each content item is rated as one of the following: 1. High 2. Medium 3. Low
Hypothesis to be tested							H_0: No association between interaction level, risk score, and delivery mode.		
	None.	Null Ho: No difference in the frequency of participant roles.	Null Ho: No difference in the experience of the participants.		Null Ho: There is an equal distribution of responses.	Null Ho: No difference in the likelihood of interaction technique, risk score and delivery mode ranks assigned to the content types.	Null Ho: No difference in the likelihood of interaction order. The frequency of each interaction rank order will be 16%. (6 combinations of rank: LI-LL-LC, LI-LC-LL, LL-LI-LC, LL-LC-LI, LC-LL-LI, LC-LI-LL)	Null Ho: No difference in the likelihood of each interaction mode. The frequency of each mode will be 25%.	Null Ho: No difference in the likelihood of risk score. The frequency of each risk score will be 33%.

Variable / Variable Description	ID number	Organizational role	Role experience	Workplace environment	Workplace location	Content type	Interaction level preference (rank)	Learning content delivery mode preference	Risk score rating (rank)
Descriptive Statistics Methods	Frequency distribution - not applicable.	Frequency distribution - histogram.	Frequency distribution – histogram.		Frequency distribution – histogram.	Frequency distribution - not applicable	Frequency distribution - histogram, stem and leaf plot.	Frequency distribution – histogram.	Frequency distribution - histogram.
	Central tendency – not applicable.	Central tendency – mode[5], median[6]	Central tendency - mode, mean[7], median.		Central tendency - mode, median.	Central tendency - mode, median	Central tendency - mode, median.	Central tendency - mode, median.	Central tendency - mode, median.
			Variability[8]: range box plot, standard deviation, and variance.				Scatter plot to review for outliers and linearity before correlation (Huck, 2011, p. 63-64). (Cannot use scatter plot for interval/ratio numerical data). Effect Size via the coefficient of determination[9] (Cronk, p. 2018, 132).		
Inferential Statistics							Chi-square [χ^2] test of independence to test (SPSS crosstab analysis to identify the likelihood ratio) for a relationship between variables (nominal or ordinal only). Suitable for categorical, not numerical, data. Likelihood Ratio is best for small sample sizes where SPSS crosstab assumptions have been violated. How to interpret https://www.youtube.com/watch?v=-qcIVHECqco		
Reliability Estimation							Bayes Factor – Evaluates the Likelihood Ratio, by quantitatively assessing the probability that the null hypothesis is or is not more likely than the alternative hypothesis (Rosenfeld & Olson, 2021).		
							Krippendorf Alpha (Q10A) – SPSS test of interrater reliability[10] for any number of raters, with greater than two variable categories, and with/without missing data (Hayes & Krippnedorf, 2007; Zapf et al., 2016).		
							Cramer V – SPSS test to identify the strength of the Likelihood Ratio for nominal x nominal variables with greater than two variable categories. Better for small samples (Field, 2018).		
							Bootstrap Confident Interval – SPSS test that is not based on the underlying distribution assumption and used for situations where there is a small sample and the standard error derivation is complex (Zapf et al., 2016).		
							Bonferroni Correction – Adjusts the *p* value when multiple tests are applied (Field, 2018).		

Note. Produced from: Cronk, 2018; Hazra & Nayak, 2011; Huck, 2011; Miyazoe & Anderson, 2011.

Definitions Legend:

1. independent variable - A variable that the researcher manipulates.
2. dependent variable - A variable that is affected by manipulating the independent variable.
3. qualitative variable - "when the things being measured vary from one another in terms of the categorical group to which they belong relative to the characteristic of interest" (Huck, 2011, p. 53).
4. quantitative variable - "the targets of the measuring process vary as to how much of the characteristic is possessed" (Huck, 2011, p. 53).
5. mode - "the most frequently occurring score" (Huck, 2011, p. 28)
6. median - "the number that lies at the midpoint of the distribution of earned scores; it divides the distribution into two equally large parts" (Huck, 2011, p. 28).
7. mean - "the point that minimizes the collective distances of scores from that point" (Huck, 2011, p. 28).
8. variability - "the degree of this dispersion among the scores" (Huck, 2011, p. 28).
9. coefficient of determination - "indicates the proportion of variability in one variable that is associated with (or explained by) variability in the other variable. The value of r^2 lies between 0 and +1.00, and researchers usually multiply by 100, so they can talk about the percentage of explained" (Huck, 2011, p. 62). "The implication of this is that the raw correlation coefficient (i.e., the value of r when not squared) exaggerates how strong the relationship really is between two variables. Note that r must be stronger than .70 for there to be at least 50 percent explained variability" (Huck, 2011, p. 63)
10. interrater reliability - "to quantify the degree of consistency among the raters" (Huck, 2011, p. 74).

Table C2

Data Analysis Table for Representative (Sample) Learning Content

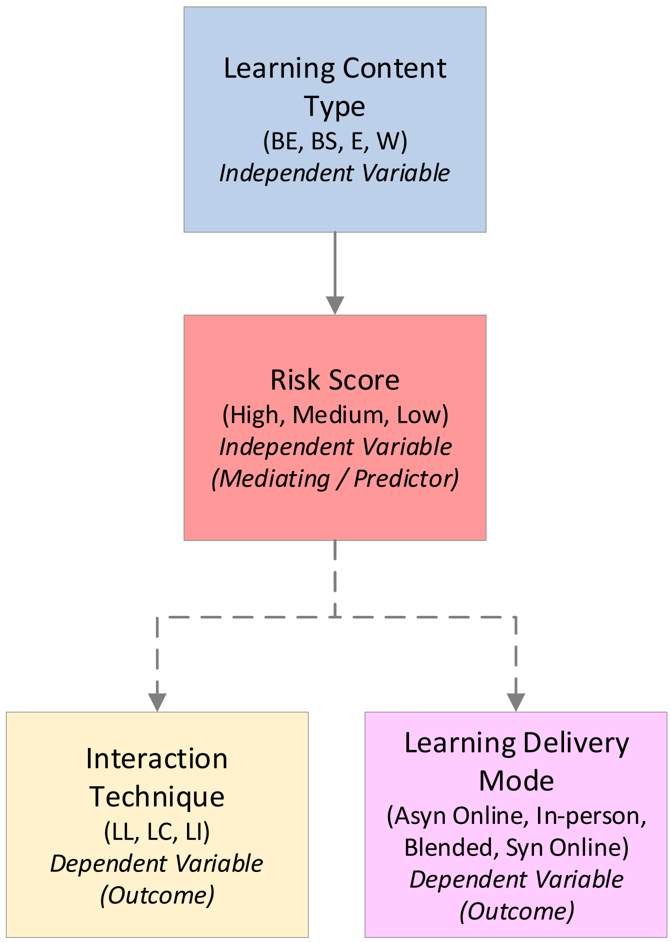
Delivery Mode Dependent Variable (Outcome)	**Interaction Technique** Independent Variable		**Risk Score** Independent Variable [Counts from all sample content]			**Total**
		Rank # (1-3)	**High**	**Med**	**Low**	
Online	**LC**		# (%)			# (100%)
	LL					
	LI					
	None					
In-person	**LC**					
	LL					
	LI					
	None					
Both (Blended)	**LC**					
	LL					
	LI					
	None					
None	**LC**					
	LL					
	LI					
	None					
Total			# (100%)			

Note. Produced from RMU, n.d.

Figure C1

Quantitative Variables

This figure outlines the expected relationship between variables. It is suspected that the delivery mode and interaction technique depend on the nature of the learning content type, as assessed by the risk score.



Note. BE = Building Equipment, BS = Building Systems, E = Equipment, W = Workflow, LL = Learner=Learner Interaction, LI = Learner-Learner Interaction, LC = Learner-Content Interaction.

Appendix D. Ethics Approval

Appendix D1. Original Approval

Athabasca University
RESEARCH CENTRE

CERTIFICATION OF ETHICAL APPROVAL

The Athabasca University Research Ethics Board (REB) has reviewed and approved the research project noted below. The REB is constituted and operates in accordance with the current version of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2) and Athabasca University Policy and Procedures.

Ethics File No.: **25242**

Principal Investigator:
Ms. Deborah Exelby, Graduate Student
Faculty of Humanities & Social Sciences\Master of Education in Open, Digital, and Distance Education (MDDE)

Supervisor/Project Team:
Dr. Cynthia Blodgett-Griffin (Supervisor)

Project Title:
Online or face-to-face: A risk-based approach to healthcare workplace training design

Effective Date: April 20, 2023 **Expiry Date**: April 19, 2024

Restrictions:

Any modification/amendment to the approved research must be submitted to the AUREB for approval prior to proceeding.

Any adverse event or incidental findings must be reported to the AUREB as soon as possible, for review.

Ethical approval is valid *for a period of one year*. An annual request for renewal must be submitted and approved by the above expiry date if a project is ongoing beyond one year.

An Ethics Final Report must be submitted when the research is complete *(i.e. all participant contact and data collection is concluded, no follow-up with participants is anticipated and findings have been made available/provided to participants (if applicable))* or the research is terminated.

Approved by: **Date: April 20, 2023**

Tobias Wiggins, Chair
Faculty of Humanities & Social Sciences, Departmental Ethics Review Committee

Athabasca University Research Ethics Board
University Research Services Office
1 University Drive, Athabasca AB Canada T9S 3A3
E-mail rebsec@athabascau.ca
Telephone: 780.213.2033

Appendix D2. Ethics Modification Approval

Deborah Exelby

From:	do-not-reply-athabascau@researchservicesoffice.com
Sent:	August 14, 2023 8:38 AM
To:	Deborah Exelby
Cc:	Blodgett-Griffin Cynthia(Supervisor); gleicht@athabascau.ca
Subject:	Modification Review Outcome

CAUTION: External email. Do not click links or open attachments unless you know the content is safe. If you suspect this is a phishing or fraudulent email, report it using the "Phish Alert" button.

August 14, 2023

Ms. Deborah Exelby
Faculty of Humanities & Social Sciences\Master of Education in Open, Digital, and Distance Education (MDDE)
Athabasca University

File No: 25242

Certification of Ethical Approval Date: April 20, 2023

Dear Deborah Exelby,

The Athabasca University Research Ethics Board (REB) has reviewed the modifications to your research entitled 'Online or face-to-face: A risk-based approach to healthcare workplace training design' as outlined in the Modification Request form submitted and confirms that the amendments you have outlined are approved.

You may proceed with your project as amended. To arrange for your recruitment notice to be sent out to AU Staff/Faculty, please contact Jillian Calliou in the Research Services Office to discuss including your recruitment document in the Research Newsletter-- jillc@athabascau.ca I believe the **deadline is today** for submissions to the newsletter!

At any time you can login to the Research Portal to monitor the workflow status of your application.

If you have any questions about the REB review and approval process, please contact me at 780.213.2033 or by email to rebsec@athabascau.ca.

Sincerely,

Gail Leicht
Research Ethics Officer

Appendix E. Invitation to Participate

LETTER OF INFORMATION

A Risk-based Approach to Blended Learning Design for New Employee Orientation in the Healthcare Workplace: Survey Study

December 2, 2022

Principal Investigator (Researcher)
Deborah Exelby,
dexelby1@learn.athabascau.ca

Supervisor
Dr. Cynthia Blodgett-Griffin
cynthiab@learn.athabascau.ca

You are invited to take part in a research project entitled *A Risk-based Approach to Blended Learning Design for New Employee Orientation in the Healthcare Workplace*

Introduction

My name is Deborah Exelby, and I am a *Master of Distance Education* student at Athabasca University. As a requirement to complete my degree, I am conducting a research project about practitioners' preferences for blended learning interaction and delivery mode in relation to the perceived risk of the learning content. This research project is conducted under the supervision of Dr. Cynthia Blodgett-Griffin.

Why are you being asked to take part in this research project?

I am seeking your participation because you are currently a practitioner engaged in workplace training design and/or delivery as an instructional designer, clinical instructor, vendor subject matter expert, peer mentor-coach, consultant, or project manager involved in operational commissioning (new facility orientation training) or general healthcare new employee orientation.

Your experiences are important because you have experience with the study subject that seeks to find consensus and relationships that lead to a standard and best practice for blended learning design. As no previous studies have evaluated this topic, your participation is especially important.

What is the purpose of the project?

The study will explore if a risk score for content to be learned can be used as a decision tool to determine the optimal blended learning curriculum in the healthcare new employee orientation and operational commissioning context.

What will you be asked to do?

Your participation would require the completion of one ten-question survey containing four sections: 1) participant demographics, 2) general preference for interaction techniques for skill and knowledge content to be learned, 3) general preference for delivery modality (online or in-person), and 4) rating 24 representative samples of new employee orientation content based on your perceived risk score, preferred interaction technique, and preferred delivery mode.

The time commitment for completing the survey will be 15 minutes or less.

What are the risks and benefits?
There are no known or anticipated risks to participation. The Athabasca University Research Ethics Board has reviewed and approved this research project.

Do you have to participate in this project?
Please be assured that your involvement in this study is entirely voluntary. You have the right to refuse to participate and to withdraw at any time during the survey.

How will privacy and confidentiality be protected?
All information collected from you will be anonymous and stored in a secure location that can be accessed only by the researcher. All information will be held confidential. The confidentiality and anonymity of participants will be protected at all times.

Who will receive the results of the research project?
On completion of the data analysis, a summary of the results of this research will be made available to all interested participants upon request.

Need for information?
If you have any questions about this study or would like additional information to assist you in reaching a decision about participation, please feel free to contact the researcher, Deborah Exelby, by email at dexelby1@learn.athabascau.ca.

Should you have any comments or concerns about your treatment as a participant, the research, or ethical review processes, please contact the Research Ethics Officer by e-mail at rebsec@athabascau.ca or by telephone at 1-800-788-9041 ext. 6718 or 780.675-6718.

If you are interested in volunteering to participate for this study, please click on the start questionnaire hyperlink in this email. Thank you in advance for your interest in this project.

Yours Sincerely,

Deborah Exelby
M.Ed. (Open, Digital and Distance Education) Student
Athabasca University

If you would like to participate in this study, please proceed by clicking on the link below.
Risk-based Instructional Design for Healthcare Workplace Training Questionnaire

Appendix F. Participant Consent Statement

Consent to Participate (Preamble to Online Questionnaire)

Risk-based Instructional Design for Healthcare Workplace Training Questionnaire

This questionnaire captures information about participants' opinions and practices in a Master's thesis research study about risk-based instructional design for the healthcare workplace.

Thank you for taking the time to participate in this research project.

This ten-question survey captures participants' preferences about their use of learning interaction techniques (learner-content, learner-learner, and learner-instructor); delivery mode (online and in-person); and perceived risk of representative sample content to be learned in a blended learning format.

This Master's thesis research study seeks to determine whether the risk score of the content to be learned can be used to determine a decision tool for developing the optimal blend of interaction and delivery mode for blended learning.

You have the right to refuse to participate in this questionnaire. If you continue, you are free to discontinue your participation in this study at any time, for any reason.

Please note: This study has been reviewed and approved by the Athabasca University Research Ethics Board. Should you have any comments or concerns regarding your treatment as a participant in this study, please contact the Office of Research Ethics by e-mail at rebsec@athabascau.ca or by telephone at 1-800-788-9041 ext. 6718 or 780.675-6718

Note: The completion of this survey questionnaire and its submission is viewed as your consent to participate.

Please click "Next" to continue to the anonymous questionnaire.

Appendix G. Survey Instrument

Consent to Participate Video Introduction

This questionnaire captures information about participants' opinions and practices in a Master's thesis research study about a risk-based approach to blended learning design for healthcare workplace training.

Thank you for taking the time to participate in this research project.

This ten-question anonymous survey collects participants' preferences about their use of learning interaction techniques (learner-content, learner-learner, and learner-instructor); delivery methods (online and in-person); and perceived risk of the content to be learned in a blended learning format.

The goal of this research study is to determine whether the risk score of the content to be learned can be used to determine a decision tool for developing the optimal combination of interaction and delivery method for blended learning.

You have the right to refuse to participate in this questionnaire. If you continue, you are free to discontinue your participation in this study at any time, for any reason.

This study has been reviewed and approved by the Athabasca University Research Ethics Board. Should you have any comments or concerns regarding your treatment as a participant in this study, please contact the Office of Research Ethics by e-mail at rebsec@athabascau.ca or by telephone at 1-800-788-9041 ext. 6718 or 780.675-6718

Note: The completion of this survey questionnaire and its submission is viewed as your consent to participate.

PLEASE CONSIDER PASSING THIS QUESTIONNAIRE TO YOUR COLLEAGUES.

After submitting a completed survey, you will be given an opportunity to enter the prize draw!

Instructions

Complete this questionnaire from the perspective of a person who is designing workplace training, NOT the viewpoint of a learner or student.

When selecting your responses to the questions, assume there are no constraints imposed by your workplace situation or organization.

Glossary of Terms

Term	Definition
Asynchronous Online	Instructional delivery method that is learner driven, with NO online face-to-face component.
Blended Learning	Instructional delivery method that combines online and in-person face-to-face components.
In-person Face-to-face	Instructional delivery method where learners are physically together, such as in a brick & mortor classroom or workplace apprenticeship/practicum.
Instructional Delivery Methods	Four types: Asynchronous Online, Synchronous Online, In-person Face-to-face, and Blended.
Risk	The danger to patients and staff when learning has not occurred or learning is applied incorrectly.
Synchronous Online	Instructional delivery method that includes learner-driven online learning, WITH an online real-time face-to face component

Section 1 – Demographics

1. What is your current workplace training role in your organization?
   Please choose **only one** of the following:
   ☐ Instructional Designer
   ☐ Clinical Educator/Instructor
   ☐ Teacher/Instructor
   ☐ Learning Consultant (aka Learning Development Department staff) department
   ☐ Curricula/Learning Content Developer
   ☐ Operational Commissioner (aka Activation Planner)
   ☐ Capital Planner
   ☐ Peer Mentor/Coach
   ☐ Project Manager
   ☐ Vendor Subject Matter Expert Trainer
   ☐ Other: Please explain in the comments
   Make a comment on your choice here:

2. Years of experience in a workplace training role?
   Please choose **only one** of the following:
   ☐ < 1 year
   ☐ 1 -5 years
   ☐ 6-10 years
   ☐ 11-15 years
   ☐ 16-20 years
   ☐ > 20 years

3. Your current workplace is best described as which of the following?
   Please choose **only one** of the following:
   - ☐ Acute Care Facility
   - ☐ Long Term Care Facility
   - ☐ Health Authourity (Regional health service provider)
   - ☐ Health care organization – Please describe in the comments
   - ☐ Corporate/business organization - Please describe in comments
   - ☐ Consulting firm
   - ☐ Independent Consultant
   - ☐ Vendor / Supplier
   - ☐ Other – Please explain in comments

   Make a comment on your choice here:

4. Location of your workplace?
   Please choose **only one** of the following:
   - ☐ Canada
   - ☐ United States of America
   - ☐ Europe
   - ☐ South America
   - ☐ Central America/Caribbean
   - ☐ Other – Please explain in comments
   - ☐ Asia
   - ☐ South Pacific Islands
   - ☐ Australia/New Zealand
   - ☐ Africa
   - ☐ International

   Make a comment on your choice here:

Section 2 – Your Learning Interaction Preferences and Practice

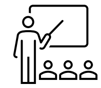
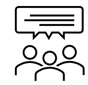
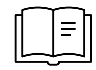
5. For you, what is the order of importance of interaction type for **knowledge focused learning*** that realizes learning of high quality?

   * knowledge focused learning: the theoretical understanding of something, acquired through lectures, textbooks, and media (e.g., video recording, info-graphics), via reading, listening, and watching to obtain the learning information.

   Please number each box in order of preference from 1 to 3.

☐ Learner - Instructor Interaction
☐ Learner - Learner Interaction
☐ Learner - Content Interaction

Interaction Definitions

Interaction Type	Definition	
Learner-Instructor Interaction	Includes interaction with trainers, subject matter experts, clinical instructors, or vendors.	
Learner-Learner Interaction	Includes learner-learner dialogue and/or with a peer mentor/coach.	
Learner-Content Interaction	Includes learners reading text, watching a video, examining an infographic, or writing a paper.	

6. For you, what is the order of importance of interaction types for **skill-focused learning*** that realizes learning of high quality?

   * skill focused learning acquired by doing, through practice or trial and error, which builds learning by developing practical expertise.

   Please number each box in order of preference from 1 to 3.
   ☐ Learner - Instructor Interaction
   ☐ Learner - Learner Interaction
   ☐ Learner - Content Interaction

Section 3 – Your Learning Modality Preferences and Practice

7. For you, **generally speaking**, rank your preference* for instructional design delivery methods used for workplace training in your organization.

   * Assume there are no constraints imposed by your workplace.

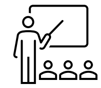
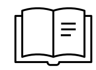
   Please number each box in order of preference from 1 to 4.
   ☐ In-Person/Face-to-face
   ☐ Online Asynchronous (learner driven, no online face-to-face)
   ☐ Online Synchronous (online face-to-face interaction included)
   ☐ Blended (in-person/face-to-face and online)

8.1 For you, when considering the **In-person/Face-to-face Instruction Delivery Method**, rank order your preference* of importance for the interaction elements.

   * Assume there are no constraints imposed by your workplace.

   Please number each box in order of preference from 1 to 3.
   ☐ Learner - Instructor Interaction
   ☐ Learner - Learner Interaction
   ☐ Learner - Content Interaction

Interaction Definitions

Interaction Type	Definition	
Learner-Instructor Interaction	Includes interaction with trainers, subject matter experts, clinical instructors, or vendors.	
Learner-Learner Interaction	Includes learner-learner dialogue and/or with a peer mentor/coach.	
Learner-Content Interaction	Includes learners reading text, watching a video, examining an infographic, or writing a paper.	

8.2 For you, when considering the **Online Asynchronous Instruction Delivery Method**, rank order your preference* of importance for the interaction types.

* Assume there are no constraints imposed by your workplace.

Please number each box in order of preference from 1 to 3.
☐ Learner - Instructor Interaction
☐ Learner - Learner Interaction
☐ Learner - Content Interaction

8.3 For you, when considering the **Online Synchronous Instruction Delivery Method**, rank order your preference* of importance for the interaction types.

* Assume there are no constraints imposed by your workplace.

Please number each box in order of preference from 1 to 3.
☐ Learner - Instructor Interaction
☐ Learner - Learner Interaction
☐ Learner - Content Interaction

Section 4 – Blended Learning Preference and Practices

9. To determine learning interaction and delivery methods when designing blended learning, I primarily use experience and judgement, not a framework, guideline, model or standard?

Please choose only one of the following:
☐ Yes
☐ No

If you use a framework, guideline, model or standard, please explain the nature of your process: what process you use, why, and how you use it.

Section 5 – Learning Content Assessment

10. This final section of the survey presents sample learning content, for you to evaluate based on A) risk, B) instruction interaction type, and C) instructional delivery method.

Learning Content Assessment Example

A. What is the risk category?

Consider the sample learning content, then indicate your perception of learning content risk based on the risk criteria provided. Consider the risk of an incident occurring by not gaining workplace training knowledge or learning the skill adequately. This example demonstrates medium level risk.

○ Low
⦿ Medium
○ High

Please enter your comment here:

Risk Category Criteria = The risk to patient of staff when learning has not occurred or learning is applied incorrectly.

Risk category	Task/skill complexity	Task/skill frequency	Task/skill impact
None	Not Used	Not Used	No impact
Low	Simple – one step	Frequent - task occurs every day	Negligible – minor injury not requiring first aid
Medium	Moderate – a few ordered steps	Possible – occurs every 1-2 days	Moderate – injury with no long-term effects
High	Complex – many sequential steps	Rare - occurs more than every 5 days	Catastrophic – major permanent injury or death

B. What is your interaction preference?

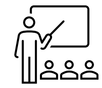
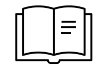
Consider the sample learning content, then indicate your preference* for the interaction type(s) that are important to support learning quality. This example demonstrates preference for learner-content interaction (1st), learner-instructor interaction (2nd), and learner-learner interaction (3rd).

*Assume there are no constraints imposed by your workplace.

	Highest Importance	Medium Importance	Lowest Importance
Learner-Instructor	○	⦿	○
Learner-Learner	○	○	⦿

Learner-Content	⦿	○	○

Interaction Types Definitions

Interaction Type	Definition	
Learner-Instructor Interaction	Includes interaction with trainers, subject matter experts, clinical instructors, or vendors.	
Learner-Learner Interaction	Includes learner-learner dialogue and/or with a peer mentor/coach.	
Learner-Content Interaction	Includes learners reading text, watching a video, examining an infographic, or writing a paper.	

C. How would you like to deliver this learning content?

Consider the sample learning content, then indicate your preference* of delivery method(s) for each interaction type. This example demonstrates preference for learner-content interaction via asynchronous online delivery, learner-instructor interaction via in-person face-to-face delivery, and no learner-learner interaction.

*Assume there are no constraints imposed by your workplace.

	Asynch Online	**Synchronous Online**	**In-person Face-to-face**	**Blended**	**None**	**Any (No Preference)**
Learner-Instructor	○	○	○	○	⦿	○
Learner-Learner	⦿	○	○	○	○	○
Learner-Content	○	○	⦿	○	○	○

Delivery Methods Definitions

Learning Modality	Definition
Asynchronous Online	Instructional delivery method that is learner-driven, with NO online face-to-face component.
Blended Learning	Instructional delivery method that combines online and in-person face-to-face components.
In-person Face-to-face	Instructional delivery method where learners are physically together, such as in a brick & mortar classroom or workplace apprenticeship/practicum.
Synchronous Online	Instructional delivery method that includes online learning, WITH an online face-to-face component
Any	No preference. All instructional delivery methods could be used with equal effectiveness for this interaction type.
None	Preference not to use this interaction type.

Question 10 - Building Systems Learning Content

	A. Risk Score	B. Interaction Preference			C. Delivery Method Preference		
Learning Content		**Learner-Instructor Interaction**	**Learner-Learner Interaction**	**Learner-Content Interaction**	**Learner-Instructor Interaction**	**Learner-Learner Interaction**	**Learner-Content Interaction**
1. Nurse Call	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)
2. Patient Entertain ment System	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)
3. Pneumatic Tube System	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)

Note. Drop-down menus were utilized in the survey instrument. The survey allowed 1) one response for risk score, 2) one response for interaction priorities 1, 2, and 3, and 3) one response for delivery mode for each of the three interaction types. L-I = Learner-Instruction Interaction, L-C = Learner-Content Interaction, LL = Learner-Learner Interaction

Question 10 - Building Equipment Learning Content

	A. Risk Score	B. Interaction Preference			C. Delivery Method Preference		
Learning Content		**Learner-Instructor Interaction**	**Learner-Learner Interaction**	**Learner-Content Interaction**	**Learner-Instructor Interaction**	**Learner-Learner Interaction**	**Learner-Content Interaction**
4. Biological Safety Cabinet	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)
5. Stryker Operating/ ICU Boom	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)
6. Vernacare Waste Disposal	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)

Note. Drop-down menus were utilized in the survey instrument. The survey allowed 1) one response for risk score, 2) one response for interaction priorities 1, 2, and 3, and 3) one response for delivery mode for each of the three interaction types. L-I = Learner-Instruction Interaction, L-C = Learner-Content Interaction, LL = Learner-Learner Interaction

Question 10 - Equipment Learning Content

	A. Risk Score	B. Interaction Preference			C. Delivery Method Preference		
Learning Content		**Learner-Instructor Interaction**	**Learner-Learner Interaction**	**Learner-Content Interaction**	**Learner-Instructor Interaction**	**Learner-Learner Interaction**	**Learner-Content Interaction**
7. Stretcher	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)
8. Ceiling Lift	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)
9. Telehealth/ conference equipment	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)

Note. Drop-down menus were utilized in the survey instrument. The survey allowed 1) one response for risk score, 2) one response for interaction priorities 1, 2, and 3, and 3) one response for delivery mode for each of the three interaction types. L-I = Learner-Instruction Interaction, L-C = Learner-Content Interaction, LL = Learner-Learner Interaction.

Question 10B - Workflow Learning Content

	A. Risk Score	B. Interaction Preference			C. Delivery Method Preference		
Learning Content		**Learner-Instructor Interaction**	**Learner-Learner Interaction**	**Learner-Content Interaction**	**Learner-Instructor Interaction**	**Learner-Learner Interaction**	**Learner-Content Interaction**
10. Supply Restock Process	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)
11. Incident Reporting	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)
12. AED/Code Blue Cart Location	☐ High ☐ Medium ☐ Low	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Priority 1 ☐ Priority 2 ☐ Priority 3	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)	☐ Asyn Online ☐ Synch Online ☐ In-Person ☐ Blended ☐ None ☐ Any (no preference)

Note. Drop-down menus were utilized in the survey instrument. The survey allowed 1) one response for risk score, 2) one response for interaction priorities 1, 2, and 3, and 3) one response for delivery mode for each of the three interaction types. L-I = Learner-Instruction Interaction, L-C = Learner-Content Interaction, LL = Learner-Learner Interaction.

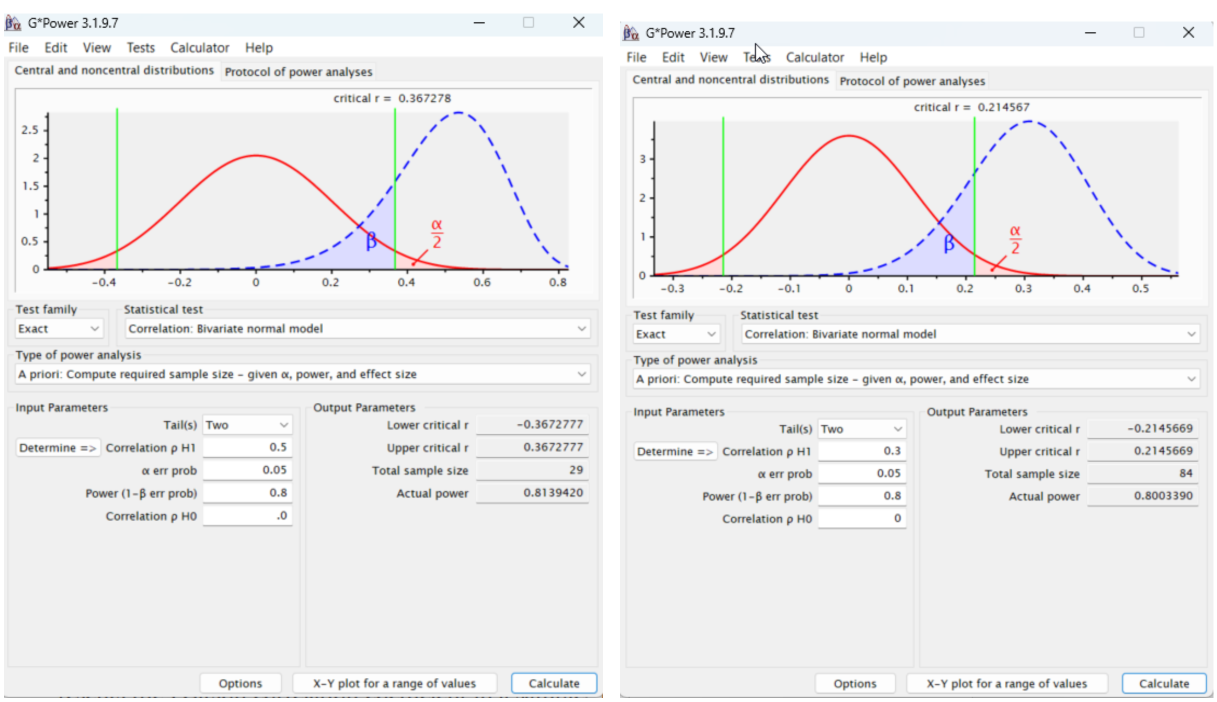
Appendix H. G*Power A-priori Sample Size Calculation

G*Power Procedure (Kang, 2021, pp. 2-3, 9)

1. Determine hypotheses: H_0 (null hypothesis): correlation = 0 and H_1 (alternative hypothesis): correlation ≠ 0
2. Select statistical test using the design-based approach: correlation and regression
3. Choose power analysis method: a priori
4. Input variable parameters:
   - Select a two-tailed test.
   - G*Power does not use effect size to calculate sample size for correlation; therefore, the correlation coefficient or coefficient of determination is used. Set ρ H_1 to 0.5 or 0.3 based on Cohen's correlation levels 0.1 = small, 0.3 = medium, 0.5 = large effect sizes (Kyonka, 2019, p. 137; Huck, 2011, p. 166).
   - Level of significance is set at $\alpha = 0.05$ (Type I error rate – false positive).
   - Beta value is commonly set at $\beta = 0.20$ (Type II error rate – false negative) (Cresswell & Cresswell, 2017, p. 151). Set power level $(1 - \beta = 0.80)$ for rejecting the null hypothesis (Cresswell & Cresswell, 2017, p. 151; Huck, 2011, p. 169; Kang, 2021).
   - H_0 is set to 0.

Figure F1

*G*Power A-Priori Output*



Note. Produced from G*Power 3.1.9.7. The left graph represents G*Power output at the 0.5 effect size level. The right graph represents the G*Power output at the 0.3 effect size level. The 0.5 effect size (*p* H_1) was selected to reduce the impact of small sample size effect exaggeration.

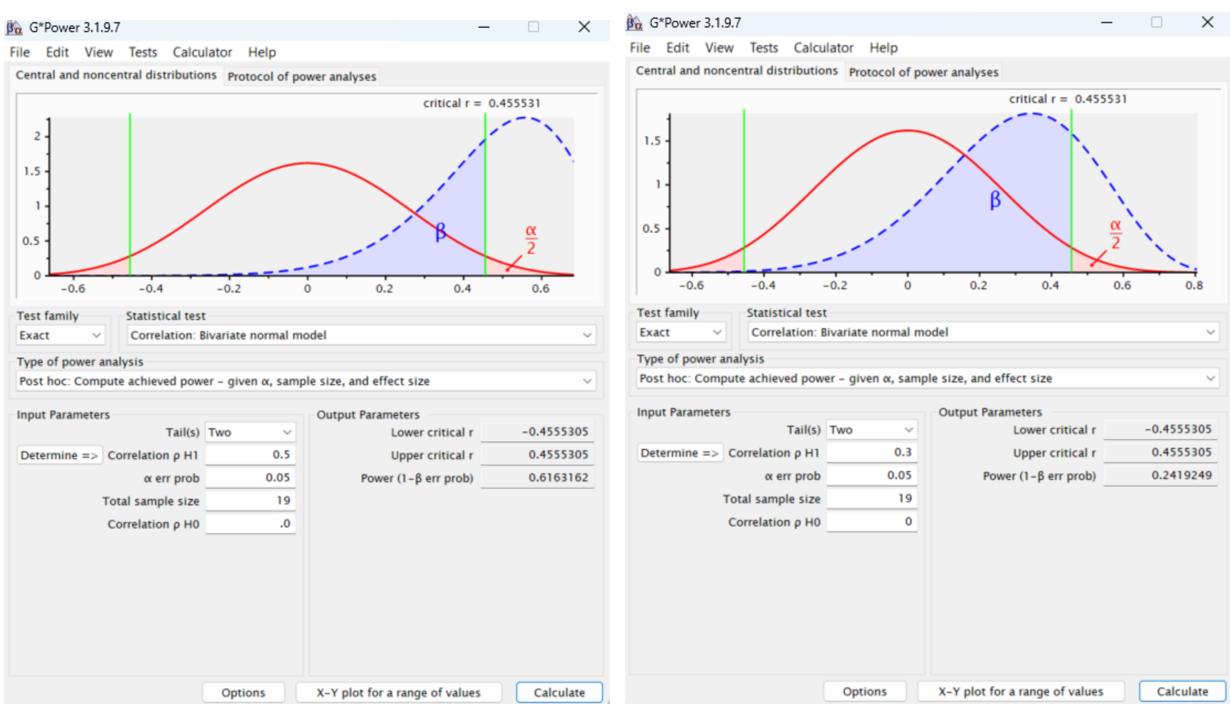
Appendix I. G-Power Post Hoc Power Calculation

G*Power Procedure (Kang, 2021, pp. 2-3, 9)

1. Determine hypotheses:
   H_0 (null hypothesis): correlation = 0 and H_1 (alternative hypothesis): correlation ≠ 0
2. Select statistical test using the design-based approach: correlation and regression
3. Choose power analysis method: post-hoc
4. Input variable parameters:
   - Select a two-tailed test.
   - G*Power does not use effect size to calculate sample size for correlation; therefore, the correlation coefficient or coefficient of determination is used. Set ρ H_1 to 0.5 or 0.3 based on correlation levels 0.1 = small, 0.3 = medium, 0.5 = large (Huck, 2011, p. 166).
   - Level of significance is set at α = 0.05 (Type I error rate – false positive).
   - Enter sample size n = 19.
   - H_0 is set to 0.

Figure G1

*G*Power Post Hoc Output*



Note. Produced from G*Power. The left graph represents G*Power output at the 0.5 effect size level. The right graph represents the G*Power output at the 0.3 effect size level. The 0.5 effect size (*p* H_1) was selected to reduce the impact of small sample size effect exaggeration.

Appendix J. Survey Criteria Key

Table J1

Interaction Type Criteria

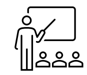
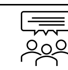
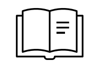
Interaction Type	Definition	
Learner-Instructor Interaction	Includes interaction with trainers, subject matter experts, clinical instructors, or vendors.	
Learner-Learner Interaction	Includes learner-learner dialogue and/or with a peer mentor/coach.	
Learner-Content Interaction	Includes learners reading text, watching a video, examining an infographic, or writing a paper.	

Table J2

Delivery Modality Criteria

Learning Modality	Definition
Asynchronous Online	Instructional delivery method that is learner-driven, with NO online face-to-face component.
Blended Learning	Instructional delivery method that combines online and in-person face-to-face components.
In-person Face-to-face	Instructional delivery method where learners are physically together, such as in a brick & mortar classroom or workplace apprenticeship/practicum.
Synchronous Online	Instructional delivery method that includes online learning, WITH an online face-to-face component
Any	No preference. All instructional delivery methods could be used with equal effectiveness for this interaction type.
None	Preference not to use this interaction type.

Table J3

Risk Rating Criteria

Risk category	Task/skill complexity	Task/skill frequency	Task/skill impact
None	Not Used	Not Used	No impact
Low	Simple – one step	Frequent - task occurs every day	Negligible – minor injury not requiring first aid
Medium	Moderate – a few ordered steps	Possible – occurs every 1-2 days	Moderate – injury with no long-term effects
High	Complex – many sequential steps	Rare - occurs more than every 5 days	Catastrophic – major permanent injury or death

Appendix K. Krippendorf Alpha Results

Table K1

K-alpha by Participant Role

	Clinical Instructor	Operational Readiness Commissioner	Teacher-Instructor	Peer Mentor/Coach
Participants Included	P1, P2, P3, P4, P5, P6, P7, P8, P9, P13, P14	P11, P12	P15, P16, P18, P19	P10, P17
K-alpha	0.2971	**0.6270**	0.2156	0.2698
CI upper	0.2403	0.2541	0.0413	-0.0952
CI lower	0.3540	1.0000	1.0000	0.6349

Note. K-alpha = Krippendorff alpha statistic, CI = Confidence Interval. Bold text = indicates weak agreement.

Table K2

K-alpha by Participant Workplace

	Acute	Long Term Care	Heath Authourity	Other
Participants Included	P4, P5, P7, P8, P9	P2, P3, P6, P10, P19	P1, P11, P12, P13, P14, P18	P15, P16, P17
K-alpha	0.3853	0.4683	**0.6585**	0.4568
CI upper	0.2211	0.3532	0.5759	0.177
CI lower	0.5425	0.5799	0.7346	0.6858

Note. K-alpha = Krippendorff alpha statistic, CI = Confidence Interval. Bold text = indicates weak agreement.

Table K3

K-alpha by Participant Experience Groups

	Junior (<1 - 5 yrs)	Mid-Career (6 - 15 yrs)	Senior (16 - >20yrs)
Participants Included	P1, P2, P3, P4, P6, P8, P10, P11, P13, P14, P15, P17	P7, P9, P12, P19	P5, P16, P18
K-alpha	0.5691	-0.2988	0.3096
CI upper	0.5210	0.0743	-0.0411
CI lower	0.6152	0.5040	0.6160

Note. K-alpha = Krippendorff alpha statistic, CI = Confidence Interval.

Table K4

K-alpha by Participant Years Experience

	<1 yr	1-5 yrs	6-10 yrs	11-15 yrs	16-20 yrs	> 20 yrs
Participants Included	P1, P6	P2, P3, P4, P8, P10, P11, P13, P14, P15, P17	P9, P12, P19	P7	None	P5, P16, P18
K-alpha	-0.1761	0.4684	0.3750	-	-	0.2689
CI upper	-0.5682	0.0472	0.1250	-	-	-0.0052
CI lower	0.0216	0.5297	0.6250	-	-	0.5531

Note. K-alpha = Krippendorff alpha statistic, CI = Confidence Interval. Dash (-) represents data not calculated or available.

Appendix L. Summary of SPSS Analysis Methods

Analysis Option	When Used	Output	Drawing Conclusions	Related Research Question(s) Analyzed

Frequency	• Single variable
	• Describing samples where the mean is not useful (e.g., nominal or ordinal scales),
	• Useful in determining skew and identifying outliers
	• To determine percentile ranks (p. 21)
	• Central tendency and dispersion values such as the median or mode (p. 24)
		• Number of occurrences
		• Percentages
		• Valid percentages
		• Cumulative percentages
			• Describing the numbers or percentages of cases in the sample.
			• If the data are at least ordinal, conclusions can be drawn regarding the cumulative percentage and/or percentiles.
				• Participant demographics
				  ○ role
				  ○ year in role
				  ○ workplace geographic location
				  ○ workplace environment – the type of organization
				• Frequency analysis was applied to questions 1 through 10.

Cross-tabulation (Crosstabs)	• Frequency distributions for multiple variables (p. 25) • Useful for describing samples where the mean is not useful (e.g., nominal or ordinal scales) • Describes the relationship between two categorical variables (KSU) • The categories of one variable determine the rows of the table, and the categories of the other variable determine the columns (KSU) • Row percentages add up to 100% horizontally • Column percentages add up to 100% vertically	• Number of occurrences of each combination of levels of each variable • Percentages for any or all variable • Output consists of a contingency table (p. 26).	• Each cell contains the number of times the designated criteria are met – the number of times the particular combination of categories occurred. • Percentages for each cell are also shown.	• Relationship of variables: interaction, delivery mode, and risk score. • Crosstab analysis was applied to questions 1 through 10, where possible.
Chi-square test of independence (2 variables, 1 sample) (SPSS Likelihood Ratio)	• Nonparametric • Whether or not two variables are independent of each other. • The chi-square test of independence is essentially a nonparametric version of the interaction term in ANOVA. • **Suitable for categorical data, not numerical (ratio/interval) data.** • Tests for a relationship between variables (nominal or ordinal only). Suitable for categorical, not numerical, data. • Likelihood Ratio test is best for small sample sizes where SPSS crosstab assumptions have been violated. • When to use chi-square or Spearman https://www.youtube.com/watch?v=IM2Xrd2ufM0	• A significant chi-square test result (*p* value) indicates that the two variables are not independent. • A value that is not significant indicates that the variables do not vary significantly from independence. • *p* value < .05 is significant to reject H0.	• How to interpret chi-square and assumptions https://libguides.library.kent.edu/SPSS/ChiSquare. • If the results agree with the null hypothesis, we "Retain the null hypothesis" (which most standard statistics texts would call "fail to reject the null hypothesis ") (p. 101). • The chi-square test tests whether the variables are independent only. • The chi-square has no measure for the strength of association since chi-square values are not bounded. For that, in the case of categorical data, Cramer's V can be calculated, similar to other correlation coefficients.	• Use to analyze interaction rank (LL, LC, LI) associated with risk score (high, med, low) and delivery modality (in-person, online, both, none) • Sample wording of significant results: A chi-square test of independence was calculated in SPSS. A Likelihood Ratio of *p* < 0.05 is a significant finding, indicating that the null hypothesis (there is no relationship or association between the variables) can be rejected. The alternative hypothesis is accepted - there is an association between the variables.

Cramer's V	• A measure of effect size used in association with the Chi-squre test of independence (Likelihood Ratio) to determine the strength of association (correlation coefficient) for nominal x nominal variables with greater than two variable categories. Better for small samples (Field, 2018).	• Output value between 0 and 1 with an associated *p* value output.
		0 = no association
		1 = perfect association
			• Interpretation:
			  ○ Cramer'V ≤ 0.2 = weak
			  ○ 0.2 < Cramers V ≤ 0.6 = moderate
			  ○ Cramer's V > 0.6 = strong (Akoglu, 2018).
				• A Cramer's V of .798 and *p* value less than .05 indicates a strong likelihood of association.
				• Cramer's V was used in question 10B and 10C analysis.

Krippendorf Alpha	• Test of interrater reliability for any number of raters, with greater than two variable categories, and with/without missing data (Hayes & Krippnedorf, 2007; Zapf et al., 2016).
	• Intended for use with nominal data, multi-raters, 2 categories.
		• Output value from 1 to -1
		0 = not reliable
		1 = perfect reliability
			• Inter-rater interpretation:
			  ○ < 0.67 = very low reliability
			  ○ 0.67 to 0.8 = low reliability
			  ○ > .8 = excellent reliability
			(Hazra & Nayak, 2011)
				• A high inter-rater reliability rating indicates agreement among the different participants.
				• Krippendorf alpha was used in question 10A analysis.

Bayes Factor	• Evaluates the likelihood ratio, by quantitatively assessing the probability that the null hypothesis is or is not more likely than the alternative hypothesis (Rosenfeld & Olson, 2021).	• Value output
		• Bayes Values:
		  ○ 1 to .3 = weak
		  ○ .3 to .05 = moderate
			• Based on the output value, the likelihood of H1 over H0 is determined quantitively.	• Example 1 sample wording: There is a strong probability of HI. H1 (there is a significant relationship between variables) is 1000 times more likely than H0 (no relationship).

Analysis Option	When Used	Output	Drawing Conclusions	Related Research Question(s) Analyzed
	• The Bayes Factor assesses the strength of the evidence in a comparative manner, as a ratio of the likelihood of H0 versus H1. It has a similar purpose as the *p* value, but makes inferences about H1 and an estimate of the amount (effect size) of evidence present in the data (Jarosz & Wiley, 2014).	○ .05 to .0067 = strong ○ < 0.0067 = very strong (Jarosz & Wiley, 2014)	• Example 1: Bayes factor of .001 indicates a 1000 times higher probability of the alternative hypothesis (H1) over the null hypothesis (H0). • Example 2: Bayes factor of .203 indicates a 4.9 times likelihood of H1 than H0.	• Bayes Factor was used in question 10B and 10C analysis.
Bonferroni Correction	• Adjusts the significance level (*p* value) to control for increased type 1 errors (false positives) when multiple hypothesis tests are used (Field, 2018).	• The accepted level of significance (*p* value = .05) is divided by the number of tests to determine the adjusted significant level.	• If three tests are used, the adjusted *p* value becomes .05/3 = 0.016. Therefore, the SPSS output must be less than 0.016, instead of .05 to be considered a significant finding.	• The Bonferroni correction was used in question 10B and 10C analysis.
Bootstrap Confidence Interval	• The confidence interval is provided to report the precision of the estimation of the effect size. • This test is not based on the underlying distribution assumption and used for situations where there is a small sample and the standard error derivation is complex (Zapf et al., 2016). • CI is used to justify the conclusions reached concerning effect size (i.e., Cramer's V).	• An upper and lower value is provided at the 95% confidence level.	• The confidence interval verifies the significance when the upper and lower CI limits are on the same side of zero. • If the CI includes zero, there is no evidence that the finding is statistically significant (Flaherty & Currall, 2012).	• The SPSS bootstrap confidence interval was used in question 10 for every CI calculation.

Note. Produced from Cronk, 2018, pp. 21, 24-29; RMU, n.d.; KSU Library, 2022.

Appendix M. Question 10B – Interaction Importance Preference

Table M1

Interaction Importance Frequency Table

Learning Content	Interaction Type	Highest Importance	Medium Importance	Lowest Importance
Nurse Call System	LL	5.3	52.6	42.1
	LC	42.1	31.6	26.3
	LI	52.6	21.1	26.3
Patient Entertainment System	LL	10.5	42.1	47.4
	LC	63.2	36.8	0
	LI	21.1	31.6	47.4
Pneumatic Tube System	LL	10.5	31.6	57.9
	LC	57.9	36.8	5.3
	LI	47.4	31.6	21.1
Biological Safety Cabinet	LL	5.3	42.1	52.6
	LC	52.6	36.8	10.5
	LI	57.9	26.3	15.8
Body Waste System	LL	15.8	42.1	42.1
	LC	47.4	52.6	0
	LI	42.1	36.8	21.1
Boom	LL	15.8	47.4	36.8
	LC	57.9	36.8	5.3
	LI	26.3	53.6	21.1
Stretcher	LL	26.3	52.6	21.1
	LC	31.6	42.1	26.3
	LI	52.6	26.3	21.1
Ceiling Lift	LL	5.3	73.7	21.1
	LC	47.4	26.3	26.3
	LI	78.9	5.3	15.8
Teleconference Equipment	LL	10.5	52.8	36.8
	LC	68.4	31.6	0
	LI	10.5	42.1	47.4
Restock process	LL	15.8	63.2	21.1
	LC	52.6	42.1	5.3
	LI	21.1	36.8	42.1
Defib/Code Blue Process	LL	36.8	31.6	31.6
	LC	52.6	31.6	15.8
	LI	89.5	10.5	0
Incident Reporting Process	LL	10.5	42.1	47.4
	LC	68.4	31.6	0
	LI	26.3	47.4	26.3

Note. LI = Learner-Learner Interaction, LC = Learner-Content Interaction, LI = Learner-Instructor Interaction. Cell counts are provided as percent frequency.

Table M2

Interaction Importance Preference Frequency Summary for High-Risk Content

Inter-action Type	Nurse Call System	Biological Safety Cabinet	Body Waste System	Operating Room Boom	Ceiling Lift	Defib/Code Blue Process	Inter-pretation	Prefer-ence Order
LL	M (52.6 %)	L (52.6%)	L (42.1%)	L (36.8%)	M (73.7%)	H (36.8%)	**Low**-Med	3
LC	H (42.1%)	H (52.6%)	M (52.6%)	H (57.9%)	H (47.4%)	H (52.6%)	**Med** - High	2
LI	H (52.6%)	H (57.9%)	H (42.1%)	M (53.6%)	H (78.9%)	H (89.5%)	**High** - Med	1

Note. H = High importance, M = Medium importance, L = Low Importance, LI = Learner-Learner Interaction, LC = Learner-Content Interaction, LI = Learner-Instructor Interaction.

Table M3

Interaction Importance Preference Frequency Summary for Medium-Risk Content

Interaction Type	Pneumatic Tube System	Stretcher	Incident Report Process	Interpretation	Preference Order
LL	L (57.9%)	M (52.6 %)	L (47.4 %)	**Low -** Med	3
LC	H (57.9%)	M (42.1%)	H (68.4%)	**High**-Med	1
LI	H (47.4%)	H (52.6%)	M (47.4%)	High **- Med**	2

Note. H = High importance, M = Medium importance, L = Low Importance, LI = Learner-Learner Interaction, LC = Learner-Content Interaction, LI = Learner-Instructor Interaction.

Table M4

Interaction Importance Preference Frequency Summary for Low-Risk Content

Interaction Type	Entertainment System	Teleconference System	Restock Process	Interpretation	Preference Order
LL	L (47.4%)	M (52.8%)	M (63.2%)	**Med -** Low	2
LC	H (63.2 %)	H (68.4%)	H (52.6%)	**High**	1
LI	L (47.4%)	L (47.4%)	L (42.1%)	**Low**	3

Note. H = High importance, M = Medium importance, L = Low Importance, LI = Learner-Learner Interaction, LC = Learner-Content Interaction, LI = Learner-Instructor Interaction.

Appendix N. Question 10B – Interaction Importance Preference Analysis Results Summary

Content	Crosstab Row	Crosstab Column	Likelihood Ratio	df	*p* value	Cramer's V	*p* value	95% CI LL	95% CI UL	Bayes Factor	Bayes Interpretation
Nurse Call System	RiskCat1	LIPref#1	9.540*	2	0.008[a]	0.639*	0.021	0.382	0.912	0.049	very strong for H_1
	RiskCat1	LCPref#1	4.627	2	0.099	-	-	-	-	-	-
	RiskCat1	LLPref#1	3.337	2	0.189	-	-	-	-	-	-
Patient Entertainment System	RiskCat2	LIPref#2	3.958	2	0.138	-	-	-	-	-	-
	RiskCat2	LCPref#2	2.094	2	0.315	-	-	-	-	-	-
	RiskCat2	LLPref#2	1.007	2	0.605	-	-	-	-	-	-
Pneumatic Tube System	RiskCat3	LIPref#3	4.451	2	0.108	-	-	-	-	-	-
	RiskCat3	LCPref#3	2.440	2	0.298	-	-	-	-	-	-
	RiskCat3	LLPref#3	0.504	2	0.762	-	-	-	-	-	-
Biological Safety Cabinet	RiskCat4	LIPref#4	2.070	2	0.355	-	-	-	-	-	-
	RiskCat4	LCPref#4	1.334	2	0.513	-	-	-	-	-	-
	RiskCat4	LLPref#4	0.630	2	0.730	-	-	-	-	-	-
Body Waste System	RiskCat5	LIPref#5	0.648	2	0.723	-	-	-	-	-	-
	RiskCat5	LCPref#5	0.024	2	0.988	-	-	-	-	-	-
	RiskCat5	LLPref#5	0.913	2	0.633	-	-	-	-	-	-
Boom	RiskCat6	LIPref#6	19.585*	1	0.000[a]	0.899*	0.000	0.651	1.000	0.000458	extreme for H_1
	RiskCat6	LCPref#6	0.544	1	0.788	-	-	-	-	-	-
	RiskCat6	LLPref#6	0.287	1	0.592	-	-	-	-	-	-
Stretcher	RiskCat7	LIPref#7	1.584	2	0.453	-	-	-	-	-	-
	RiskCat7	LCPref#7	1.052	2	0.591	-	-	-	-	-	-
	RiskCat7	LLPref#7	4.114	2	0.128	-	-	-	-	-	-
Ceiling Lift	RiskCat8	LIPref#8	3.509	1	0.061	-	-	-	-	-	-
	RiskCat8	LCPref#8	3.557	1	0.059	-	-	-	-	-	-
	RiskCat8	LLPref#8	0.784	1	0.376	-	-	-	-	-	-
Teleconference Equipment	RiskCat9	LIPref#9	0.730	1	0.393	-	-	-	-	-	-
	RiskCat9	LCPref#9	2.529	1	0.112	-	-	-	-	-	-

Content	Crosstab Row	Crosstab Column	Likelihood Ratio	df	*p* value	Cramer's V	*p* value	95% CI LL	95% CI UL	Bayes Factor	Bayes Interpretation
	RiskCat9	LLPref#9	0.730	1	0.393	-	-	-	-	-	-
Restock Process	RiskCat10	LIPref#10	0.551	2	0.759	-	-	-	-	-	-
	RiskCat10	LCPref#10	2.242	2	0.326	-	-	-	-	-	-
	RiskCat10	LLPref#10	0.538	2	0.764	-	-	-	-	-	-
Defib/Code Blue Process	RiskCat11	LIPref#11	0.229	1	0.632	-	-	-	-	-	-
	RiskCat11	LCPref#11	1.556	1	0.212	-	-	-	-	-	-
	RiskCat11	LLPref#11	0.951	1	0.329	-	-	-	-	-	-
Incident Reporting Process	RiskCat12	LIPref#12	5.768	2	0.056	-	-	-	-	-	-
	RiskCat12	LCPref#12	8.541*	2	0.014[a]	0.579*	0.041	0.331	0.809	0.172	moderate for H_1
	RiskCat12	LLPref#12	0.678	2	0.712	-	-	-	-	-	-

Note. **p* < 0.05. [a] Bonferroni adjusted $p = 0.016$ was used to determine significance.
Dash (-) represents data that has not been calculated. Df = degrees of freedom. CI = confidence interval. H_1 = alternative hypothesis. LL = lower limit. UL = upper limit.

Appendix O. Question 10C – Interaction-Delivery Preference

Table O1

Delivery-Interaction Response Frequency Table

Learning Content	Interaction Type	Asynchronous Online	In-person Face-to-face	Blended	Synchronous Online	None	Any - No Preference
Nurse Call System	LL	**42.1**	5.3	31.6	10.5	0	10.5
	LC	5.3	**47.4**	31.6	5.3	5.3	5.3
	LI	5.3	**68.4**	21.1	0	0	5.3
Patient Entertainment System	LL	21.1	**47.4**	5.3	5.3	5.3	15.8
	LC	**57.9**	5.3	15.8	5.3	0	15.8
	LI	21.1	**36.8**	15.8	15.8	5.3	5.3
Pneumatic Tube System	LL	15.8	**36.8**	26.3	5.3	5.3	10.5
	LC	**31.6**	15.8	**31.6**	10.5	0	10.5
	LI	10.5	**52.6**	21.1	10.5	5.3	5.3
Biological Safety Cabinet	LL	**52.6**	0	31.6	10.5	0	5.3
	LC	**42.1**	10.5	21.1	15.8	0	10.5
	LI	0	**57.9**	31.6	10.5	0	0
Body Waste System	LL	5.3	**36.8**	21.1	10.5	5.3	21.1
	LC	**31.6**	21.1	21.1	10.5	0	15.8
	LI	5.3	26.3	**42.1**	5.3	10.5	10.5
Boom	LL	**47.4**	0	26.3	10.5	0	15.8
	LC	21.1	31.6	**36.8**	5.3	0	5.3
	LI	**47.4**	0	36.8	5.3	5.3	5.3
Stretcher	LL	5.3	**63.2**	15.8	0	0	15.8
	LC	**31.6**	21.1	**31.6**	10.5	0	5.3
	LI	5.3	**63.2**	15.8	5.3	10.5	0
Ceiling Lift	LL	**63.2**	0	26.3	5.3	0	5.3
	LC	21.1	31.6	**36.8**	5.3	0	5.3
	LI	**73.7**	0	21.1	5.3	0	0
Teleconference Equipment	LL	15.8	**26.3**	15.8	21.1	5.3	15.8
	LC	**52.6**	15.8	10.5	10.5	0	10.5
	LI	21.1	5.3	**31.6**	21.1	5.3	15.8
Restock process	LL	10.5	**36.8**	26.3	10.5	5.3	10.5
	LC	**31.6**	10.5	26.2	21.1	0	10.5
	LI	21.1	21.1	31.6	10.5	5.3	10.5
Defib/Code Blue Process	LL	**57.9**	0	31.6	5.3	0	5.3
	LC	15.8	26.3	**42.1**	10.5	0	5.3
	LI	0	**63.2**	31.6	5.3	0	0
Incident Reporting Process	LL	10.5	15.8	15.8	21.1	5.3	**31.6**
	LC	**36.8**	5.3	10.5	26.3	0	21.1
	LI	15.8	**21.1**	**21.1**	**21.1**	0	**21.1**

Note. LI = Learner-Learner Interaction, LC = Learner-Content Interaction, LI = Learner-Instructor Interaction. Cell counts are provided as the percent frequency. Bold text indicates the highest frequency for the interaction type.

Table O2

Delivery-Interaction Preference Frequency Summary for High-Risk Content

Inter-action Type	Nurse Call System	Biological Safety Cabinet	Body Waste System	Operating Room Boom	Ceiling Lift	Defib/Code Blue Process	Interpretation	Prefer-ence Order
LL	Asyn	Asyn	IPF2F	Asyn	Asyn	Asyn	83.0% **Asyn**, 16.0% IPF2F	3
LC	IPF2F	Asyn	Asyn	BL	BL	BL	50.0% **BL**, 33.0% Asyn, 16.0% IPF2F	2
LI	IPF2F	IPF2F	BL	Asyn	Asyn	IP	50.0% **IPF2F**, 33.0% Asyn, 16.0% BL	1

Note. Asyn = Asynchronous Online Delivery, IPF2F = In-person Face-to-Face Delivery, BL = Blended Delivery, Any = No Delivery Preference. LI = Learner-Learner Interaction, LC = Learner-Content Interaction, LI = Learner-Instructor Interaction. Bold text indicates the highest frequency delivery mode for the interaction.

Table O3

Delivery-Interaction Preference Frequency Summary for Medium-Risk Content

Inter-Action Type	Pneumatic Tube System	Stretcher	Incident Report Process	Interpretation	Prefer-ence Order
LL	IPF2F	IPF2F	Any	66.0% **IPF2F**, 33.0% Any	3
LC	Asyn or BL	Asyn or BL	Asyn	66.0% **Asyn or BL**, 33.0% Asyn	1
LI	IPF2F	IPF2F	IPF2F, BL, Any or Syn	66.0% **IPF2F**, 33.0% IPF2F, BL, Any or Syn	2

Note. Asyn = Asynchronous Online Delivery, IPF2F = In-person Face-to-Face Delivery, BL = Blended Delivery, Any = No Delivery Preference, Syn = Synchronous Online. LI = Learner-Learner Interaction, LC = Learner-Content Interaction, LI = Learner-Instructor Interaction. Bold text indicates the highest frequency delivery mode for the interaction.

Table O4

Delivery-Interaction Preference Frequency Summary for Low-Risk Content

Interaction Type	Entertainment System	Teleconference System	Restock Process	Interpretation	Preference Order
LL	IPF2F	IPF2F	IPF2F	100% **IPF2F**	2
LC	Asyn	Asyn	Asyn	100% **Asyn**	1
LI	IPF2F	BL	BL	66.0% **BL**, 33.0% IPF2F	3

Note. Asyn = Asynchronous Online Delivery, IPF2F = In-person Face-to-Face Delivery, BL = Blended Delivery Online. LI = Learner-Learner Interaction, LC = Learner-Content Interaction, LI = Learner-Instructor Interaction. Bold text indicates the highest frequency delivery mode for the interaction.

Appendix P. Question 10C – Interaction-Delivery Preference Analysis Results Summary

Content	Crosstab Row	Crosstab Column	Likelihood Ratio	df	*p* value	Cramer's V	*p* value	95% CI LL	95% CI UL	Bayes Factor	Bayes Interpretation
Nurse Call System	RiskCat1	LLDel1	11.065	8	0.198	-	-	-	-	-	-
	RiskCat1	LCDel1	26.515*	10	0.003 [a]	0.798*	0.007	0.632	1.000	0.005	Extreme for H_1
	RiskCat1	LIDel1	6.648	6	0.355	-	-	-	-	-	-
Patient Entertainment System	RiskCat2	LLDel2	8.779	10	0.553	-	-	-	-	-	-
	RiskCat2	LCDel2	7.033	8	0.533	-	-	-	-	-	-
	RiskCat2	LIDel2	9.088	10	0.524	-	-	-	-	-	-
Pneumatic Tube System	RiskCat3	LLDel3	11.893	10	0.292	-	-	-	-	-	-
	RiskCat3	LCDel3	16.047*	8	0.042 [a]	0.598 [†]	0.095	0.441	0.889	-	-
	RiskCat3	LIDel3	8.498	8	0.386	-	-	-	-	-	-
Biological Safety Cabinet	RiskCat4	LLDel4	6.486	6	0.371	-	-	-	-	-	-
	RiskCat4	LCDel4	6.817	8	0.556	-	-	-	-	-	-
	RiskCat4	LIDel4	4.337	4	0.362	-	-	-	-	-	-
Body Waste System	RiskCat5	LLDel5	11.790	10	0.299	-	-	-	-	-	-
	RiskCat5	LCDel5	9.295	8	0.318	-	-	-	-	-	-
	RiskCat5	LIDel5	11.790	10	0.299	-	-	-	-	-	-
Boom	RiskCat6	LLDel6	0.600	3	0.896	-	-	-	-	-	-
	RiskCat6	LCDel6	5.095	4	0.278	-	-	-	-	-	-
	RiskCat6	LIDel6	7.192	4	0.126	-	-	-	-	-	-
Stretcher	RiskCat7	LLDel7	3.078	6	0.799	-	-	-	-	-	-
	RiskCat7	LCDel7	5.484	8	0.705	-	-	-	-	-	-
	RiskCat7	LIDel7	5.761	8	0.674	-	-	-	-	-	-
Ceiling Lift	RiskCat8	LLDe81	3.473	3	0.324	-	-	-	-	-	-
	RiskCat8	LCDel8	10.824*	4	0.029 [a]	0.685 [†]	0.063	0.420	1.000	-	-
	RiskCat8	LIDel8	0.951	2	0.622	-	-	-	-	-	-
Teleconference Equipment	RiskCat9	LLDe9	7.210	5	0.205	-	-	-	-	-	-
	RiskCat9	LCDel9	6.253	4	0.181	-	-	-	-	-	-

Content	Crosstab Row	Crosstab Column	Likelihood Ratio	df	*p* value	Cramer's V	*p* value	95% CI LL	95% CI UL	Bayes Factor	Bayes Interpretation
	RiskCat9	LIDel9	2.170	5	0.825	-	-	-	-	-	-
Restock process	RiskCat10	LLDel10	6.370	10	0.783	-	-	-	-	-	-
	RiskCat10	LCDel10	4.964	8	0.761	-	-	-	-	-	-
	RiskCat10	LIDel10	9.339	10	0.500	-	-	-	-	-	-
Defib/Code Blue Process	RiskCat11	LLDel11	7.835	3	0.050	-	-	-	-	-	-
	RiskCat11	LCDel11	5.630	4	0.404	-	-	-	-	-	-
	RiskCat11	LIDel11	0.951	2	0.622	-	-	-	-	-	-
Incident Reporting Process	RiskCat12	LLDel12	9.541	10	0.482	-	-	-	-	-	-
	RiskCat12	LCDel12	3.661	8	0.886	-	-	-	-	-	-
	RiskCat12	LIDel12	5.409	8	0.713	-	-	-	-	-	-

Note. * $p < 0.05$. † $p \geq 0.05$ (non-significant Cramer's V).
[a] Bonferroni adjusted $p = 0.016$ was used to determine significance.
Dash (-) represents data that has not been calculated. df = degrees of freedom. CI = confidence interval. LL = lower limit. UL = upper limit.

Appendix Q. Question 10C - Detailed Analysis Results

Content	Crosstab Row	Crosstab Column	Likelihood Ratio	df	*p* value	Cramer's V	*p* value	95% CI LL	95% CI UL	Bayes Factor	Bayes Meaning
Nurse Call System	RiskCat1	LCAsynPref1	3.337	2	0.189	-	-	-	-	-	-
	RiskCat1	LCSynPref1	2.831	2	0.243	-	-	-	-	-	-
	RiskCat1	LCBLPref1	5.968	2	0.051	-	-	-	-	-	-
	RiskCat1	LCIPF2FPref1	19.785*	2	0.000	0.900*	0.000	0.676	1.000	0.001	extreme for H_1
	RiskCat1	LCAnyPref1	2.831	2	0.243	-	-	-	-	-	-
	RiskCat1	LCNonePref1	2.831	2	0.243	-	-	-	-	-	-

Note. * $p < 0.05$. Dash (-) indicates no output due to no participant responses in this category, data not calculated or not available. H_1 denotes the alternative hypothesis. LL = lower limit. UL = upper limit.