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An Instructional Designer Competency Framework for Complex Learning Designs

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by

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We hereby certify that this dissertation, submitted by Dave Schubert, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirements for the degree of Doctor of Philosophy.

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An Abstract of a Dissertation Report Submitted to Nova Southeastern University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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Learning design competency frameworks published by professional organizations, exist for typical instructional design efforts. However, a review of literature revealed a lack of frameworks available for the creation of complex learning designs (CLDs). The goal of this research was to develop a competency framework for the creation of CLDs. Quantitative and qualitative methods were employed in the four phases of the design and development research approach.

In phase one, a survey based on the Educational Technology Multimedia Competency Survey (ETMCS) was sent to instructional designers who self-reported as having experience creating CLDs. The purpose of phase one was to identify competencies that instructional designers felt were most important to the creation of complex, technology-mediated learning designs.

The preliminary CLD framework was constructed during phase two, based on analysis of the ETMCS survey results. Measures of central tendency were used to identify competencies considered essential and desirable. Additionally, competencies were categorized into seven domains.

In phase three, semi-structured interviews were conducted with a subset of survey participants. The purpose was to gain deeper insight into the participant's perception of the design complexities involved with each of the competencies included in the preliminary framework.

In phase four, the preliminary framework was internally validated using an expert panel employing the Delphi method to build consensus. Three rounds were required to achieve consensus on all competencies within the framework. This consensus resulted in 79 competencies including 30 essential and 49 desirable competencies from the set identified as the preliminary framework during phase two.

Several conclusions emerged from the creation of this framework. Though technology is often a trigger for many types of CLDs, specific technologies are certainly desirable, but not essential. The research also revealed that communication and collaboration competencies are almost universally essential due to the complexity of the designs which

typically necessitates the formation of multi-discipline teams. Without these competencies, the team's cross-profession effectiveness is often hindered due to differences in terminology, processes, and team member geographic location.

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Chapter 1
Introduction

Background

The roots of instructional design can be traced to World War II. (WWII). This massive effort required a systematic approach of training new soldiers in the operation and maintenance of tanks, airplanes, firearms, and other war materiel. The systematic linear assembly line processes employed by Ford Motor Company and other manufacturers was adopted for the design of the instructional material for the linear nature of an assembly line enabled a consistent and rapid design and development of training materiel.

ADDIE, today's ubiquitous acronym representing the Analysis, Design, Development, Implementation, and Evaluation phases of instructional design, describes the generic process adopted from the assembly-line manufacturing model. Though its exact origin is obscure (Bichelmeyer, 2005; Molenda, 2003), ADDIE has become the de facto standard for describing instructional design. Schwier, Campbell and Kenny (2004) pointed out that though learning theories abound, models of instructional design are called into question as "…not been drawn from the practice of the instructional designer and, consequently, instructional design theory is not grounded in practice" (p. 69). Brown, Frontier, and Viegut (2016) compared the legacy approaches to learning as anachronisms, stating that:

> As evidence mounts about the skills and dispositions students will need to be successful learners through the 21st century, many of the policies and practices that guide the efforts of educators and learners through the process of schooling are like ashtrays in armrests: omnipresent but anachronistic (p. 2).

Learning models, theories, and strategies that might be acceptable for well-defined, linear learning environments are less appropriate for more technologically complex and ill-defined learning environments (Jonassen, 1997). These more complex, ill-defined learning environments require more active experiential participation by learners while often providing realistic problems to solve, both of which are key tenets of andragogy (Knowles, 2012). At the same time, while there is a difference between the types of instructional design theories and models used to guide well-defined, linear instruction and ill-defined problems, there is also a difference between the competencies required of instructional designers to design these various types of learning designs. The research focuses on the topic of instructional design competencies.

The following chapter includes an introduction of the study's problem statement, and associated research questions, their significance and relevance, and potential barriers and issues that may inhibit the completion of the research. The chapter concludes with assumptions, limitations, and delimitations, and definition of terms and acronyms.

Stance of the Researcher

Results of this research likely were affected by the researcher's previous experience with the design and development of the type of complex instructional designs described in this document. As part of his professional experience, the researcher has experience participating as part of multi-disciplinary teams that were tasked with the design and development of multi-touch maintenance simulations for the healthcare industry as well as a desktop military flight simulation controlled by voice-recognition software. The researcher has also designed and developed military desktop simulations and branching goal-based scenarios (GBS) for the healthcare industry. The knowledge, skills, and abilities (KSAs) as well as the expectations, culture, and language of each discipline revealed competencies that were seldom required in more basic instructional design activities. Experiences within multi-disciplinary teams also revealed regular instances where tasks performed by programmers or 2D/3D graphic artists impacted the instructional validity of the training product. Instead of performing usability tests conducted by instructional designers, the interfaces and interactivity were designed according to individual programmer preferences.

This set of experiences revealed a lack of established sets of expectations and roles for instructional designers within multi-disciplinary teams. The researcher believes that identification and validation of the competency framework for instructional designers working in complex design projects is significant in several ways: It provides current and future instructional designers a roadmap for enhancement of their skillset to remain relevant in today's technologically-centric 21st learning environments; it assists professional service organizations in assessing their current competency frameworks (van Rooij, 2012); it provides research-based incentives for higher education to offer instructional design courses that include higher order knowledge, skills, and abilities; and, an established framework helps define the roles instructional designers are suited for in multidisciplinary teams.

Problem Statement

Existing research about instructional designer competencies lacks context-specificity such that ambiguity exists for competencies specifically related to the creation of CLD (Ritzhaupt & Kumar, 2015). This ambiguity represents a gap within the instructional design domain of knowledge that is worthy of further study.

Various professional organizations such the International Board of Standards for Training, Performance, and Instruction (2013), the Association for Educational Communications and Technology (n.d.), and the eLearning Guild (Munzenmaier, 2015) have published competency guides and research reports about instructional designer competencies. Numerous researchers have reported competencies for educational technologists (Kang & Ritzhaupt, 2015; Ritzhaupt & Martin, 2014; Ritzhaupt, Martin, & Daniels, 2010), and instructional designers (Ritzhaupt & Kumar, 2015; Sugar et al., 2012; Wakefield, 2012; Yanchar, 2014). Other researchers have examined multimedia competencies of educational technologists (Ritzhaupt &Martin, 2014; Ritzhaupt, Martin, & Daniels, 2010).

Larson and Lockee (2007) pointed out that the "…competency requirements, content, culture, and value systems of business and industry career environments can differ significantly from that of the higher education context where instructional design and technology (IDT) students receive their formal training" (p. 1). Most of the research has concentrated on instructional designers and educational technologists working in the higher education domain. Therefore, data from participant populations is biased toward this domain. Fewer studies of "professional service firms," defined as firms that provide services such as engineering, legal advice, and accounting (Williams van Rooij, 2012, p. 34) are found in the literature. This research will consider instructional design firms as providing a similar service to that defined by Williams van Rooij and therefore employ the “professional service firm” term to represent the broad domain of firms who employ instructional designers.

Despite this bias, Ritzhaupt and Kumar (2015) pointed out the lack of instructional designer competency granularity from the studies concentrating on the higher education context, saying:

> The above literature provides a wealth of information on the knowledge, skills, and prior experience needed by instructional designers in various contexts to be able to succeed in their job roles. However, these papers do not delineate between contexts, do not provide enough information on the competencies or knowledge and skills of instructional designers in higher education as a specific context, and all call for more research on the activities of instructional designers and the knowledge and skills needed for them to perform their increasingly important role in higher education (p. 53).

Ritzhaupt and Kumar’s (2015) statement declaring that context ambiguity exists and extends beyond the competencies of instructional designers in a higher education work environment. This ambiguity represents a hole within the instructional design research body of knowledge. Specifically, it remains unclear whether competencies identified by the cited professional organizations and validated by Ritzhaupt and Kumar extend to the creation of CLDs more commonly performed by professional services firms for business, government, and military clients.

Dissertation Goal

The goal was to develop a competency framework that extends the 2012 Instructional Design IBSTPI framework specifically to address the instructional design of CLDs. CLDs are considered those that involve the integration of qualitatively different constituent knowledge, skills, and abilities so that what is learned in the training environment may effectively be transferred to daily life and work settings (van Merriënboer & Kirschner, 2013). Technology is often, though not always, associated with mediation of complex designs. Technology-mediated designs (Burkhardt, et al., 2009; Kaptelinin and Nardi, 2009) refer to CLDs delivered by computers, mobile devices, or networks and developed using software or hardware technology.

The 2012 IBSTPI Instructional Design Competency Framework was selected as the base framework to augment with competencies specific to the creation of CLDs. This decision was based on the eLearning Guild's report (Munzenmaier, 2014) that found the IBSTPI competency framework as the one most closely matching what hiring managers were requesting when filling new ISD job postings. Munzenmaier also indicated that the IBSTPI standards were "…the most comprehensive and specific of the models considered. The first standards published for the industry; they are also the most widely accepted of the existing competency models" (p. 16).

Life and work settings commonly present complex and ill-defined problems that are difficult to adequately address with simple, linear learning designs. As Reigeluth (1999) and Jonassen (1997) both point out, ill-defined learning domains are common in complex, constructivist learning environments. This type of learning design calls for higher levels of cognitive learning identified in Bloom's (Bloom, 1956; Driscoll, 2000) and Anderson and Krathwohl's (2001) taxonomies, including application, synthesis, and evaluation. CLDs such as those used in educational games, goal-based scenarios, and educational simulations employ these higher cognitive levels and was considered CLDs for this study.

Research Questions

Answers to the following five research questions were sought:

RQ1: What competency models or frameworks relevant to the creation of CLDs have been reported in the literature?

RQ2: What do instructional designers perceive as the necessary competencies for the creation of CLDs?

RQ3: What competencies identified by instructional designers experienced in CLDs are also included in the 2012 IBSTPI Instructional Design Competency Framework?

RQ4: What competencies identified by instructional designers experienced in CLDs are not accounted for in the IBSTPI organizations' 2012 Instructional Design Competency Framework?

RQ5: What characteristics are perceived to define a CLD by professionals working in the instructional design field?

Relevance and Significance

Advancements in computer and Internet technologies have afforded the design and development of CLDs. Simulations have advanced from grease board overlays to high fidelity computer simulations, games have progressed from board games to video games, and scenarios have morphed from in-person role-playing to online goal-based scenarios. Given that both media and complexity have changed, it follows that instructional design methodology and competencies must follow suit. Hirumi, et al. (2010b) pointed out:

> If there is no change, then many design decisions within new media environments, such as games, simulations, and augmented realities, will not be made by instructional designers, but by those most embedded within the development process. That is what is happening currently in game and simulation design where an instructional designer is nowhere to be found in the development pipeline. (p. 19)

The research aimed at lifting the veil on competencies required for instructional designers to stay "in the loop" of the design process for new, and more complex, contextual and potentially immersive learning environments. The objective was that professional services firms and their client institutions (e.g., educational, military, and corporate) would begin to understand the need to encourage development of these competencies so that the instructional design profession remains relevant in today's learning design environment.

Barriers and Issues

Potential barriers and issues may include the following:

1. Sufficient access to the Internet is a prerequisite for participating in the online survey. Though this must be considered as unlikely since the sample population shall be found online, this may still be a barrier for participation.
2. Due to factors beyond researcher's control, interview participants may not complete both interviews, which may affect queries of the qualitative data.

Assumptions

This study employed the ETMCS survey, which was developed for educational technologists. As described by Ritzhaupt and Martin (2014, p. 13), "The educational technology multimedia competency survey (ETMCS) developed through this research is based on a conceptual framework that emphasizes the current definition of the field." Though the researchers defined this term broadly and included other professions such as instructional designers, certain assumptions are implied in its use for this study.

This study was based on the following assumptions:

1. The ETMCS survey instrument is generalizable to instructional designers performing advanced instructional design to create CLDs.
2. The ETMCS survey instrument sample consisted primarily of educational technologists from higher education and those that held a master's degree or higher. This research assumes the ETMCS is generalizable to instructional designers working in other work domains and do not hold a master's degree or higher.
3. The survey sample is representative of the entire population of instructional designers and educational technologists who have worked on complex design designs.
4. The review of literature was sufficient to offer a reasonably complete grounding.
5. Given the targeted nature of the respondent pool it was assumed that a representative sample would be obtained in response to this study's call for participation.
6. Survey and interview respondents were honest in their answers. This assumption was based on the confidentiality and anonymity afforded each participant during both the survey and interview phases. To ensure this, both software and self-assignment of ID codes were employed for the survey phase, while the survey platform's assigned codes were used to identify interview respondents. In addition, since participants were volunteers, they had the right to withdraw from the study at any point.

7. Survey and interview data analysis would reveal a valid framework of instructional designer competencies.

Limitations and Delimitations

Limitations of this study included the following:

1. Given the sample was obtained strictly from Internet sources the reliability of a sufficient response rate was initially viewed as a limitation.
2. Participants in both phases of the research were volunteers, which might have yielded somewhat biased results.
3. Participants included instructional designers, educational technologists, and other managers and professionals with similar job descriptions who are likely to have varied levels of experience.
4. Virtual online interviews were employed to develop deeper understanding of the data received in online survey responses.
5. Participants employed in higher education, military, business, health care, and government were recruited.

Delimitations of this study include the following:

1. Participants were recruited from LinkedIn, which delimited the solicitation to those people whom have existing connections with the researcher.
2. This study focused on instructional designers currently working in the field and those who have created CLDs.

Definitions of Terms

Activity Theory: A commonly used term that is interchangeable with Vygotsky's CHAT (see acronyms). A key objective of activity theory is to resolve philosophical dualism of objectivity-subjectivity, agent-object, person-environment, employing mediating objects (e.g., “tools”). This theory has evolved from Vygotsky’s mediated action model (Holzman, 2006).

Adaptive Learning: Landsberg, et al. (2012, p. 17) point out that many definitions of adaptive training are found in the literature. This research takes the perspective detailed by Lavieri (2016), defining the term as follows: “A type of learning instantiated by computer software that adapts, in real-time to learner actions in order to maximize learning outcomes.”

Advanced Instructional Design: This term refers to instructional design activities related to CLDs. Advanced instructional design activities and decisions are consistent with Elen and Clark’s (2006) dual perspective (learner and environment) on complexity with learner-environment interactions, feedback, and alternative paths often presented for learners to explore and construct their own understanding. The nature of advanced learning objectives tends toward higher order learning such as application, synthesis, and evaluation objectives described in learning taxonomies (Bloom, et al., 1956). Examples of this level of instructional design include game-based learning, software simulations, virtual and augmented reality, scenario-based, problem-based, and story-based learning.

Affordance: Refers to qualities or features of a learning object within an environment that allows a learner to perform an action. Woodill (2014) provides a teacup as an example: the handle allows the active learner to lift the teacup without burning his/her hand. Therefore, the teacup’s handle is considered a key affordance of the teacup object.

Augmented Reality: Augmented reality is a visual system produced by overlaying computer-generated images, sounds, objects, or other data onto a real-world environment enabling the creation of an enhanced interactive experience.

Competency: Competency is often defined in three ways - "behaviors an individual needs to demonstrate," "minimum standards of performance" (Strebler et al., 1997), and underlying attributes of a person" (Boyatzis, 1982). For this research, competencies shall be defined as the knowledge, skills, and abilities (KSA) required when completing a task (Koszalka, Russ-Eft, and Reiser, 2013).

Complexity: Elen and Clark (2006) describe two different perspectives for defining complexity: the learning environment and the learner. One view of complexity arises from the number and varying relationships of elements designed within the learning environment. Complexity also varies according to the interrelationship between elements and characteristics of individual learners, including relative aptitude, experience, and prior task knowledge.

CLDs: Agnes and Guralnik (1999) define complex in multiple ways: "consisting of two or more related parts; not simple; involved or complicated; a group of interrelated ideas, activities, etc. that form, or are viewed as forming, a single whole" (p. 298), while van Merriënboer, Kirschner, and Lester (2003) correlate complex learning to degree of intrinsic cognitive load imposed on the learner. Consistent with both definitions, CLDs include instructional design activities consisting of multiple assets, actors, feedback types, and activities that impact complexity according to the relative intrinsic cognitive load imposed on the learner. Examples include the design of game-based learning, software simulations, virtual and augmented reality, scenario-based, problem-based, and story-based learning. The learning objectives and content will typically be of a higher level of learning, as distinguished by Bloom's taxonomy.

Cognitive Load Theory: Cognitive load explains memory in a fashion like that commonly understood about personal computer memory: random access memory (RAM) correlates with our brain's working memory, while hard drives correlate to our long-term memory. Excess load (i.e.-through complexity) inhibits learning because of the limited capacity available in working memory. The goal, therefore, should be to process information out of working memory into long-term memory as fast and efficiently as possible. Four types of cognitive load are generally accepted: germane, intrinsic, extraneous, and extrinsic (Hollender, et al., 2010; van Merriënboer & Ayres, 2005). Of interest is intrinsic load, which is influenced by the complexity of the information and the level of expertise of the learner, the learner.

Delphi Technique: A research technique that employs a panel of experts who participate anonymously to build consensus. Initial inquiries are sent to each expert, responses are compiled, and results are sent back to the experts for review. This process occurs iteratively until a consensus is observed by the researcher (Mulcahy, 2009).

Empirical Rule: Statistical rule that states that "in a normal distribution approximately 68% of values are within +/- 1 SD from the mean, 95% of values are within +/- 2 SD of the mean, and 99.7% of values are within +/- 3 SD of the mean" (Terrell, 2012, p. 109).

Framework: Webster's New World College dictionary (1999) defines framework primarily as a rigid structure that holds parts together or supports something over the framework, the term may also be considered a synonym for models or facets.

Game-based Learning: A type of game play that is based upon defined learning outcomes.

Gamification: The application of game elements such as badges, leaderboards, and competition to non-game learning experiences.

Goal-based Scenarios: A constructivist learning theory introduced by Roger Schank that combines case-based learning with learning by doing.

Kanban Board: A Kanban board is one of the tools that can be used to manage work at a personal or organizational level. Simple boards have columns for "waiting," "in progress," and "completed" (or "to-do," "doing," and "done"). It is often used by agile development teams to manage the work in complex projects.

KSA: Refers to the knowledge, skill, or ability associated with a competency statement. In some situations, the “A” refers to “attitudes,” however this study defers to the use of “abilities” which was used in the ETMCS survey instrument. The competencies involved in this study’s framework may well be used to create curriculum for certification of instructional designers. As such, the use of ability is supported by Wang, et al. (2005) in cases of accreditation or certification.

LM-GM Model: Learning mechanics - Game mechanics framework based on mechanics that is mapped to the (2001) learning taxonomy.

Professional Service Firms: Williams van Rooij (2012) defines professional service firms as firms that create knowledge-intensive, high performance designs with human capital as the firms' largest asset. Examples include as law, engineering, management firms as well as firms that create training typically requiring instructional designers.

Simulations: Representation of the behavior or characteristics of a system using a computer program designed for that purpose.

Social Presence: Gunawardena and Zittle (1997) define social presence as "…the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships…" (p. 9).

Technology-mediated: Refers to CLDs delivered by computers, mobile devices, or networks and developed using software or hardware technology.

Virtual Reality: Virtual reality is a computer-simulated, three-dimensional environment in which a user can experience telepresence—the simulated sense of being in the real world (Steuer, 1992).

Web 2.0: Web 2.0 describes World Wide Web sites that emphasize user-generated content, usability, and interoperability. Although Web 2.0 suggests a new version of the World Wide Web, it does not refer to an update to any technical specification, but rather to cumulative changes in the way Web pages are made and used. Examples of Web 2.0 include social networking sites, blogs, wikis, folksonomies, video sharing sites, hosted services, Web applications, and mashups (Wikipedia, 2016).

List of Acronyms

ADDIE: Commonly used acronym to describe typical instructional design phases of design and development. Refers to the following five phases: Analysis, Design, Development, Implementation, and Evaluation.

AECT: Association for Educational Communications & Technology

AR: Augmented Reality

ASTD: American Society for Training and Development, the precursor name for ATD.

ATD: Association for Talent Development

CAQDAS: Computer Assisted Qualitative Data Analysis Software

CHAT: Cultural-Historical Activity Theory

CMID: Civic-Minded Instructional Designer

EP: Educational Psychologists

IBSTPI: International Board of Standards for Training, Performance, and Instruction

IT: Information Technology

ISD: Instructional Systems Design

KSA: Knowledge, Skills, and Abilities ("Attitudes" is often used interchangeably with abilities). Abilities is employed in this research based on its use in the validated ETMCS survey instrument.

PDF: Adobe Acrobat software's Portable Document File format

ROL: Review of Literature

VR: Virtual Reality

VRGLE: Virtual Reality-based, Gamelike Learning Environment

Summary

Chapter 1 introduced the research. Instructional design experiences were traditionally based on the assembly-line approach adopted by the U.S. military during WWII. As such, instructional design models reflected the linear nature of assembly line processes. However, with the advent of advanced technologies and a new generation of learners, more complex and nonlinear designer experiences have emerged. Though instructional design knowledge, skills, and abilities (competencies) have been periodically updated by professional organizations, specific competencies appropriate for the more complex, contextual, and advanced instructional design experiences have not been explicitly identified. This situation is reflected in the five research questions included in Chapter 1.

In addition to the research problem, questions, and overall goal, chapter 1 discusses the stance of the researcher. This is appropriate since a significant component of the research discussed in chapter 3 involves qualitative methods and the researcher is a "key instrument" serving as the person who is gathering the information from participants (Creswell, 2007, p. 38). Chapter 1 concluded with sections discussing the relevance of the research, potential barriers that may be encountered, and assumptions and limitations inherent to this work. These sections are followed with a list of relevant definition of terms and acronyms the reader may find useful when reading this document.

Chapter 2
Review of the Literature

Overview of Topics

The following review of the literature is divided into five sections. First, the terms framework, competency, and learning design are discussed as they pertain to professionals working in educational technology and related professional fields. Second, relevant research studies addressing both instructional design competencies and educational technology competencies are presented. Third, the concept of complex learning is explored, and a definition is offered. Fourth, learning theories that are applicable to the design of complex learning are provided. These theories include constructivism, complexity theory, activity theory, and cognitive load theory. Finally, CLDs representative of advanced learning designs including adaptive learning environments, goal-based scenarios, game-based learning, augmented and virtual reality, mobile learning, and educational simulations are discussed.

Frameworks

Frameworks Defined

Although Webster's New World College dictionary (1999) defines framework primarily as a rigid structure hold parts together or supports something over the framework, the term may also be considered a synonym for models or facets. For example, instructional designers may consider the ubiquitous ADDIE acronym a framework or a model. Likewise, the collection and categorization competencies published by instructional design-related professional organizations such as Association for Educational Communications & Technology (AECT) and International Board of Standards for Training, Performance, and Instruction (IBSTPI) may also be considered as frameworks. For the purposes of this research a competency framework is a categorization of like competencies, which are refined in an iterative process.

Instructional Design Frameworks

MacLean and Scott (2011) described competencies for learning design, compared competency frameworks (including IBSTPI and AECT), and presented a framework for learning design as an alternative to the IBSTPI framework for learning designers in the United Kingdom (U.K.). A series of focus groups were employed up front to guide the research design. Subsequent focus group sessions, interviews and a survey were employed to flesh out the framework. MacLean and Scott pointed out the resultant set of competencies is specific to "learning design," as practiced in the U.K., and not "instructional design," as practiced in the U.S. Though the two perspectives may not align completely, the methodological approach as well as the resulting framework should prove useful as a reference point for this research. The IBSTPI and AECT competency sets, considered frameworks by MacLean and Scott, address instructional designer competencies of all levels and work domains and do not specifically address CLDs.

Other Frameworks

Yusop and Correia (2012) presented a framework of roles and qualities of a civic-minded instructional designer (CMID). Their CMID framework represents a synthesis of perspectives gathered from a review of literature (ROL) from the fields of sociology and educational technology. The researchers used the ROL to categorize roles and qualities of "civic professionalism" (p. 80) which Yusop and Correia viewed as an alternative to frameworks based on "training on-the-job approaches" (p. 80).

Atkinson, Dunsmuir, and Wright (2016) developed a competency framework for initial training of educational psychologists. What is interesting about this framework is that the researchers' efforts were sparked by a change in the professional standards expected of educational psychologists (EPs). This change brought about by the U.K. Children and Families Act extended the role (and therefore expected competencies) of EPs to work with young people ages 16-25. This is a similar situation to that instructional designers face today with increasing technological and design demands due to the increased design capability and level of complexity that technology affords. The Delphi technique was employed to establish a framework that encompassed competencies the new requirements have added to the role of the EP profession. Atkinson, Dunsmuir, and Wright sought a pool of participants that included EPs who had experience working with the 16-25-year-old population.

Liu, Huang, Salomaa, and Ma (2008) created an activity –oriented framework for mobile learning experience design. The research team's perspective of activity design borrows from the activity model created by Engeström (1987) which the Liu, et al. (2008) adjusted to fit mLearning by defining learning activity as "the specific interactions between learners and mLearning context mediated by wireless and mobile technology enhanced tools and resources that may constrain or support the learners in their goals of acquiring knowledge and skills" (p. 186). The design framework involves 5 stages including, mLearning activity design, requirement and constraint analysis, mLearning scenario design, mLearning technology environment design and mobile learner support services design.

Marne, Wisdom, Huynh-Kim-Bang, and Labat (2012) examined two disparate sets of competencies involved in serious game design: instructional design and game design competencies. The researchers built a design pattern library (framework) to facilitate communication and collaboration between the two disciplines as well as a conceptual framework for serious game design. The framework consists of six facets: pedagogical objectives, domain simulation, interactions with the simulation, problems and progression, decorum, and conditions of use. Each facet is then associated with the best expert discipline, and design patterns, which can form a pattern language to facilitate communication between disciplines. What is significant in this study is the attempt to enhance collaboration through communication, which this author has personally found to be problematic in numerous instructional design contracts involving multiple disciplines in the design and development team. In a similar vein, Arnab, et al. (2015) constructed a framework that maps learning mechanics to game mechanics called the LM-GM model. Arnab et al. created a simplified framework then by associating the game/learning mechanics mapping to the Anderson and Krathwohl (2001) taxonomy.

While competency frameworks can be called many names and are available in the literature, no single competency framework was found that focused on categorizing the competencies involved in the design of CLDs.

Competency

Competency Defined

Hoffmann (1999) stated that the term competency reflects a multifaceted concept and argued "the rationale for the use of competencies will determine the definition given to the term" (pp. 275-276). Hoffmann cited Strebler et al. (1997) when identifying two types of competency definitions, first expressed as "behaviors that an individual needs to demonstrate" (p. 275) and second as "minimum standards of performance" (p. 275). Since these competencies are learner-centric, they are not appropriate for use in defining instructional designer competencies.

Hoffmann (1999) also cited Boyatzis (1982), and Sternberg and Kolligian (1990) to identify a third definition as the "underlying attributes of a person" which include an individual's "knowledge, skills and abilities" (p. 276). Koszalka, Russ-Eft, and Reiser (2013) defined competency for IBSTPI similarly, stating that a competency is "…a knowledge, skill, or attitude that enables one to effectively perform the activities of a given occupation or function to the standards expert in employment" (p. 145), while Ritzhaupt and Martin (2014) defined competencies, saying "Competencies are generally measurable or observable knowledge, skills, abilities, attitudes, and behaviors critical to successful job performance (p. 15)." Ritzhaupt and Martin further stated that technology has impacted "what instructional designers do" and note this impact was reflected in the 22 updated competencies included in the 2012 IBSTPI standards.

In attempting to define instructional designer leadership competencies, Ashbaugh (2013) summarized myriad perspectives regarding the definition of competencies, and cited Dooley, et al. (2007) and Larson and Lockee (2009) to define competencies as "behavioral demonstrations of knowledge, skill and ability" (p. 4). Ashbaugh pointed out other research that also defines competencies as traits, character, emotions, temperament or values.

Multiple studies (Kang & Ritzhaupt, 2015; Ritzhaupt & Kumar, 2015; Ritzhaupt & Martin, 2014; Ritzhaupt et al., 2010) defined competencies as knowledge, skills, and abilities. Ritzhaupt and Kumar (2015) explained their use of a triangular framework consisting of knowledge statements, "… an organized body of information, usually factual or procedural," skill statements, "… the manual, verbal or mental manipulation of things," and ability statements, "… the capacity to perform an activity") (p. 427).

Other studies have approached instructional designer competencies, while providing examples of knowledge, skills, and attitudes. Examples include knowledge of constructivist and cognitivist theories, skills such as communication and collaboration, and attitudes such as leadership competencies (Ashbaugh, 2013).

Professional Organizations' Published Competencies

Several professional organizations have published competencies related to instructional design. They include IBSTPI, AECT, and the Association for Talent Development (ATD), formerly known as American Society for Training & Development (ASTD). AECT is geared primarily for instructional design in the higher education domain. Though the 2012 AECT competencies include a domain called professional knowledge and skill, that domain also includes other competencies dealing with research, ethics, and diversity. ATD encompasses areas of talent development, only one of which relates to training and instructional design.

IBSTPI, however, is a not-for-profit corporation whose mission is to “develop, validate, and promote implementation of international standards to advance training, instruction, learning, and performance improvement for individuals and organizations” (Koszalka, Russ-Eft, & Reiser, 2013, p. ix. Koszalka, et al.’s (2013) IBSTPI Instructional Designer Competencies is an update to the 2001 IBSTPI competencies. Twenty-two instructional design competencies are organized across five domains. Each domain contains specific skills and knowledge categorized as essential, advanced, and managerial. The five domains consist of professional foundations, planning and analysis, design and development, evaluation and implementation, and managerial.

Koszalka, et al. (2013) raised two important issues: the increase in complexity of learning designs and the need for specialization within the instructional design profession. Updated from 2001, the 2013 IBSTPI instructional designer competencies reflect “… that the field of instructional design has grown in breadth, depth, and complexity such that no one person can be expected to be fully competent in all related skills and knowledge” (Koszalka, Russ-Eft, & Reiser, 2013, p. 23). Given a statement indicating that technology has made learning designs too complex for any individual instructional designer, it is surprising that of the three professional organizations only the ATD competency model identified learning technology at a competency domain level of significance. In contrast, IBSTPI mentioned technology as a “Performance Statement” within of the Professional Foundations competency domain, while AECT viewed technology competency through the perspective of an institution’s technology infrastructure, rather than an instructional designer’s use in design and development of learning designs. In each set of standards, the specificity of technology as a competency is lacking.

The changes incorporated into the 2013 IBSTPI competencies addressed an explosion of technology into instruction and learning environments over the last decade. Digital technologies have influenced the design of instruction and the development of the learning environment. Recognizing that some employers expected specialized instructional design skills rather than the entire set of competencies, IBSTPI initially identified four specializations in the field of instructional design in their 2001 competency standards:

1. The analyst specializes in performance analysis and training needs assessment.
2. The evaluator specializes in various forms of evaluation and assessment, but especially transfer and impact evaluation.
3. The e-learning specialist specializes in development of multimedia and electronic learning products, particularly Web-based learning.
4. The project manager specializes in managing internal or external designers on one or several projects.

In the 2013 version of the IBSTPI competencies, these specializations were updated slightly to include: instructional design specialist, analyst/evaluator, instructional design manager, and e-learning/instructional technology specialist. Specialization implies that a team is required to perform functions an individual instructional designer may not be able to perform.

Recognition of the increasing significance of online education (versus face-to-face), IBSTPI commissioned a separate set of competencies for online learners. Three competency domains were identified: personal, learning, and interaction. Beaudoin, Kurtz, Jung, Suzuki, and Grabowski (2013, pp. 10-30) identified 14 competencies within these domains, which include:

Personal domain

1. Set realistic expectations for online study. (Personal)
2. Maintain determination to achieve learning goals.
3. Manage the challenges of online learning.
4. Manage time effectively.
5. Comply with academic, ethical and legal standards.
6. Use technology proficiently.

Learning domain

7. Be an active learner.
8. Be a resourceful learner.
9. Be a reflective learner.
10. Be a self-monitoring learner.
11. Apply learning.

Interaction domain

12. Engage in effective online communication.
13. Engage in productive online interaction.
14. Engage in collaborative online communication to build knowledge.

These competency domains are not specifically aimed at instructional designers. However, they inform IDs what must be addressed for this type of learner. The seismic shift caused by advances in communication networks and computer-based technology increases the need for enhanced communication and collaboration skills which are included, in various forms, in all the three professional organization competency models.

Fortunately, there is now an abundance of social software tools that can facilitate collaboration and exchange of peer-generated content. Additionally, the increased acceptance of Web 2.0 collaboration tools by instructors and learners and implementation by their associated technical teams will, according to Churcher, Downs, and Tewksbury (2014), connect people in ways akin to communities of practice, whether that community consists of students enrolled in an online class or a geographically dispersed design team consisting of multiple work disciplines.

> While Koszalka, Russ-Eft, and Reiser (2013) described instructional designers as "…persons who demonstrate instructional design competencies on the job regardless of their job title or training," they were quick to point out that instructional designers perform development tasks, but "…those who concentrate totally on development of production tasks are not generally considered designers" (p.15).

Koszalka et al. (2013) noted that many employers often expect even entry-level instructional designers to have advanced levels of technical competence, which is confirmed by Villachica, et al. (2010). Further, Koszalka described the difference between information/educational technologists and experienced instructional designers as a function of visual software competency versus the competency to design instructionally valid learning designs. For this study, the definition of competencies shall be adapted from the 2012 IBSTPI definition of the knowledge, skills, and abilities (KSAs) that instructional designers have or must develop in order to successfully design CLDs.

Competency Studies

Researchers have published numerous studies regarding both instructional designer and educational technology competencies. In many of the educational technology studies, the researchers specifically broadened their definition to include instructional designers, considering them virtually synonymous with educational technologists. Research methodologies for these studies have typically employed job announcement analysis, surveys, interviews, or Delphi studies. This section will examine several studies to understand what research has been conducted regarding instructional designer and educational technologist competencies required for the design of CLDs.

Instructional Designer Competency Studies

Ritzhaupt and Kumar (2015) recruited participants for their study of instructional designer competencies through a listserv. A short survey was developed to screen for participation in the second phase of their study, which consisted of in-depth, semi-structured online interviews. Criteria for inclusion in the second phase included a job title of instructional designer, experience in that role of at least one year, and availability for online interviews.

Ritzhaupt and Kumar (2015) revealed competencies raised during the interviews with instructional designers working in a higher education environment. These competencies included people skills sufficient to interact with personnel ranging from the students, the Information Technology (IT) department, faculty, and administration personnel. Analysis of the interviews also revealed the need for competency with the technology that higher education learners interact with daily, such as learning management systems and the multitude of learning platforms (e.g., cellphone, tablet, and desktop). Contrary to many studies, Ritzhaupt and Kumar (2015) found that soft skills such as communication, collaboration, and just “people skills” were perceived to be more valuable than technical skills.

Ritzhaupt and Kumar’s (2015) goal was to examine the instructional designer competencies specifically related to instructional designers working in a higher education environment. This participant sample differs from the research described in this dissertation proposal. While this dissertation research will serve as an extension to Ritzhaupt and Kumar’s work and process. However, the pool of instructional designers for this research will exhibit a broader range of work experience than just higher education. The survey will identify which instructional designers have participated in the creation of CLDs from a wider cross-section of work domains including professional service firms (Williams van Rooij, 2012), military, government, as well as the higher education work domain examined by Ritzhaupt and Kumar.

Park and Luo (2017) employed a mixed method to investigate instructional designer competencies essential for online higher education at both the organizational and individual level. Data was collected and analyzed that was based on the 2013 IBSTPI Instructional Designer competency standards. Their research produced a refined competency model “…to improve IDs performance in human resources development and management practice” (p. 87). Data was collected from organizational artifacts and a survey of individuals within the organization. A five-point Likert scale was employed to evaluate the responses to 105 questions. A rating of “5” was considered “critical,” while a rating of “1” represented the least level of importance.

Clark (2015) identified creativity-related competencies for instructional designers working in higher education by employing a three-round Delphi methodology with an expert panel consisting of 28 higher education instructional design managers and leaders. The Delphi panel obtained consensus on 35 concepts related to instructional designer creativity in a higher education context. Panelists were asked to respond to topic statements on a five-point Likert scale followed by an explanation of each rating. Competencies were mapped to literature-based creativity themes, which included the following: problem solving, problem finding, boundary awareness, the creative act, ambiguity tolerance continuum, and motivations/intrinsic rewards. As a final component of this research each panelist was asked to provide examples of tasks and duties associated with each topic statement.

Klein and Jun (2014) studied instructional designer competencies through the development of a two-part survey based on IBSTPI (Richey et al., 2001) and ASTD (Bernthal et al., 2004) competencies. Eighty-two working professionals responded to the survey and revealed a diverse cross-section including higher education (N=19), consultant services (N=15), and government (N=15) work domains. This diverse population was purposeful to enhance the generalizability of the findings. Responses were calculated based on a three-point Likert scale of importance. Of note, two open-ended questions were asked at the end of the survey:

1. Based on your work history, what skills that you believe are important are not listed in this survey?

2. What performance interventions should Instructional Designers be aware of?

The second part of Klein and Jun's (2014) survey gathered demographic data including work domain, job description, academic degree, and years of experience. Prior to data collection the survey was tested by three working professional instructional designers who completed the survey and offered suggestions for improvement.

Wakefield, Warren, and Mills (2012) employed a similar instructional designer job announcements analysis methodology to that used by Ritzhaupt, et al. (2010) and Ritzhaupt and Martin (2014). However, the source of job announcements for the Wakefield et al. research was LinkedIn, which produced a broad cross-section of respondents that included instructional designers working for professional services firm with contracts for the military, other businesses, non-profits, K-12, and higher education clients. Wakefield, Warren, and Mills use of LinkedIn as the source for a job announcement analysis aligns with the targeted participant pool of this study. Results from Wakefield et al. identified numerous themes, which were merged into eight competency categories:

1. Technology skills and awareness of standards. Technological tools mentioned included learning management systems (LMS) and authoring software.
2. Educational foundation. Many job announcements required a minimum of a bachelor's degree.
3. Communication and interpersonal. This competency includes both verbal and written skills, along with collaboration within team environments.

4. Design and development. Employers cited creativity, innovation, and interactive designs as key characteristics they were looking for in instructional designer applicant.
5. Environmental scanner and professional. Environmental scanner refers to an instructional designer who is constantly scanning the horizon for new technologies, models, strategies, and any other tools that can benefit the learning environments yet to be designed.
6. Management and leadership. This competency refers to leading teams, managing schedules, people, budget, and mentoring less senior instructional designers.
7. Planner and problem solver. Competencies include analyzing and solving problems, resolving challenges, and making decisions. Wakefield also includes knowledge of the instructional systems design (ISD) process and learning theory in this competency.
8. Personal traits. Two key traits are highlighted: the ability to work independently and collaborating within a team structure.

Sugar, Hoard, and Brown (2012) also analyzed instructional design and educational technology job announcements over a seven-month time span to identify multimedia competencies of instructional design and technology professionals. Like many other research studies, Sugar et al. (2012) reported a potential bias in results due to the composition of instructional designer respondents. More than 90% of the respondents in this study worked in higher education. However, of the respondents, significant differences were noted for instructional design activities and skills such as needs assessment and evaluation were significantly higher (61% corporate versus 43% in higher education) incidences of these requirements were observed for instructional designers working in corporate settings than those working in higher education and those. Since most studies found during this literature search were predominantly conducted with higher education samples, this disparity hints at a gap in research that examines the knowledge, skills, and attitudes/abilities (KSA) of instructional designers who work in the corporate sector.

Almost 75% of the postings examined by Sugar et al. (2012) identified software such as Photoshop, Flash, Dreamweaver, Illustrator, and Fireworks as requirements for the instructional design/educational technologist positions. Sugar et al. also observed a difference in the job requirements of instructional designers working in higher education and those working in business-related environments. Higher education job announcements were more likely to require competency with learning management systems like Blackboard, while requirements found in business-related announcements were more likely to require multimedia authoring software skills. In addition to the heavily weighted call for technology competencies, job postings from all employment domains called for interpersonal skills such as communication and collaboration.

Williams van Rooij (2010) suggested a separate set of instructional design management competencies are required to accommodate the burgeoning role of project management within the instructional design discipline. Williams van Rooij stressed the need is due to increased complexity, involvement of other professions, and budget characteristics of today's learning designs:

> …instructional designer positions require not only instructional design skills / competencies, but also project management skills, including the ability to lead a

> project team, estimate project requirements, and develop processes and standards for completion of educational/training product development projects (p. 249).

Sims and Koszalka (2008) summarized the challenges facing instructional designers as they strive to develop the competencies brought by the increasing demands of the profession:

> These are the challenges of the new instructional designer: to understand what makes a powerful learning experience, what technologies can be integrated to foster learning in these environments, and how to do it effectively. The emerging social technologies (e.g., blogs) allow learners to collaborate and communicate informally, and hardware technologies are creating portable devices that facilitate the anytime, anywhere learning principle (p. 571).

Educational Technology Competency Studies

Ritzhaupt, et al. (2010) developed a framework that connected the 2007 AECT definition of educational technology with associated knowledge, skill, and ability statements. In this study, educational technologists were considered synonymous with instructional designers. Two hundred and five job postings were analyzed using qualitative analysis methods in order to identify core competencies. Multimedia competencies were considered a core competency. A survey was then developed based upon the findings of the job posting analysis.

In a subsequent study, Ritzhaupt and Martin (2014) validated the survey by presenting the survey to a sample population consisting of professionals working in the field of educational technology. After validating the survey, the authors named the instrument the Educational Technology Multimedia Competency Survey (ETMCS). Their research concluded that the following were considered important competencies: knowledge of instructional models and principles, facility with authoring software, written, oral, and interpersonal communication skills, collaboration, working within deadlines, organizational, project, and team management, and software programming.

Ritzhaupt, Martin, Pastore, & Kang (2018) have since updated and expanded their previous research using the Educational Technology Multimedia Competency Survey (ETMCS) beyond multimedia competencies. The new survey instrument is called the Educational Technologist Competencies Survey (ETCS). The survey employs fifteen knowledge, seven skill, and nine ability factors which are equivalent to a domain in this research.

Iqdami and Branch (2016) viewed their research as an extension of Ritzhaupt and Martin's (2014) research. Iqdami and Branch concentrated their research on identifying the knowledge, skills and abilities of educational technologists working solely in the higher education domain, which contrasts from Ritzhaupt and Martin's research inclusion of educational technologists from multiple work domains. Additionally, Iqdami and Branch sought to determine whether various demographic characteristics of the online respondents affected their perception of the importance of different competencies. Using an ordinal logistic regression analysis on competencies across demographics, Iqdami and Branch found significant effect on numerous competencies due to differences in gender, years of experience, academic degree, and job title. Though Iqdami and Branch cautioned generalizing their findings across other work domains, these results do suggest reasons for inquiry into demographics in other work domains.

In contrast to the survey and job announcement methods used in previous studies, research into educational technology multimedia competencies conducted by Daniels, Sugar, Abbie, and Hoard (2012), employed a Delphi study where 89% of the respondents worked in either K-12 or higher education. The researchers sought responses from their expert panel regarding entry-level educational technologists as well as how the experts viewed an overlap between multimedia and instructional design competencies. Seventy-one competencies were categorized according to a five-point scale of essential, important, somewhat important, not important, or unnecessary. Communication and video production competencies were rated highest; however, Daniels, et al. concluded that multimedia competencies cannot be isolated or associated with a single software application.

Kang and Ritzhaupt (2015) conducted a job announcement analysis of 400 job announcements collected from online job databases. Researchers derived over 150 KSA statements based upon analysis of educational technology job announcements from military, education, and business domains. Their findings suggested the need for educational technologists to have competencies in instructional design, project management, technical computer skills, and “soft” skills like communication and collaboration.

Learning Design

This research looked at complex designs that require learner participation and performance; as such the design should be learner-centric in nature. Typical instructional designs employ knowledge-level assessments to identify success. But can this “success” be construed as learning? Instead, CLDs also require learners reach a higher level (Bloom, et al., 1956) of learning to apply knowledge through performance. Did the learner perform as needed to accomplish the performance (learning) objective? To maintain consistency with this perspective the term “learning design” (McLean & Scott, 2011, p. 557) was used through much of the body of this report, instead of the more commonly accepted term ‘instructional design” for the simple reason that instructional design is an instructor-centric term.

Complex Learning

Appropriate instructional design competencies are necessary for designing solutions that facilitate learning. Considering the advancements in computers, software, communication, and collaboration technologies over the last few decades, learners have become more astute, while learning opportunities have multiplied and morphed into many forms. As a result, the complexity of learning and its competent design is continuously increasing in its variety of approaches and potential methodologies for delivery.

Koszalka, Russ-Eft, and Reiser (2013) noted the issue of increasingly complex problems along with increased sophistication in in design software and computer-based instructional delivery technologies, the incorporation of multidisciplinary design teams and distributed communication channels, and an increasingly more sophisticated learner as factors that have impacted instructional design, necessitating an updating of IBSTPI competency standards.

van Merriënboer and Kirschner (2013) described complex learning as follows:

Complex learning involves integrating knowledge, skills, and abilities; coordinating qualitatively different constituent skills, and often transferring what is learned in the school or training setting to daily life and work settings. The current interest in complex learning is manifest in popular educational approaches that call themselves inquiry, guided discovery, project-based, case method, problem-based, design-based, and competency-based (p. 2).

Both the Bloom (Bloom, 1956; Reigeluth, 1999, p. 54) and Anderson and Krathwohl (2001) taxonomies of educational objectives describe three domains of knowledge: cognitive, affective, and psychomotor. Bloom (1956) defined six levels of cognitive learning, with the “Knowledge” and “Comprehension” levels at the lower levels of the taxonomy, while Anderson and Krathwohl (2001) also defined six levels of the cognitive domain, with “Remembering” and “Understanding” at the lower level of that taxonomy. These lower levels of cognition form a foundation for the higher levels of cognition and are more commonly taught in passive learning designs, requiring a more basic set of cognitive domain-specific competencies than that found in complex learning environments. The research sought to examine CLDs that require learners to use higher levels of the cognitive domain such as application, synthesis, creation, and evaluation, as identified in Bloom’s (Bloom, 1956) and Anderson and Krathwohl’s (2001) taxonomies.

The affective domain focuses on the development of attitudes and behavior rather than on the intellectual abilities upon which the cognitive domain is based (Rovai, et al., 2009). Rovai also pointed out that psychomotor learning addresses “… skill development relating to manual tasks and physical movement as well as operation of equipment, such as a computer, and performances in science, art, and music” (p. 8). These three domains of knowledge align with the knowledge (cognitive), skill (psychomotor), and attitude/ability (affective) components found in subsequently cited literature that will define competencies.

Complex learning consists of authentic learning tasks based on realistic experience (Kester, Paas, & van Merrienboer, 2010). Kester, et al. indicated that authentic tasks have many potential solutions, cannot be mastered in single sessions, and impose high cognitive load on the learner. Complexity, then, emanates not from separate skills in isolation but from the process of recognizing, differentiating, coordinating, and integrating multiple constituent knowledge, skills, and abilities toward completion of a complex task.

When considering learning environments, complexity can be viewed from two perspectives: the complexity of the internal workings of the learning environment and the varying perception of complexity by the learner. Elen and Clark (2006) explained the two perspectives, which the first perspective viewed the complexity of the system and its elements, without regarding the learner:

> With respect to learning and learning tasks, two related but different approaches to the definition of complexity can be taken. A first approach defines complexity in reference to the features of a learning task (Dorner, 1996; Spector, 2000). It is argued that a task becomes more complex when it has (1) an increasing number of elements; and/or (2) more relationships between elements; and/or (3) more diverse relationships between elements; and/or (4) more changes over time in elements, relationships and interrelationships between elements (pp. 1-2).

This element-centric perspective is consistent with Complexity Theory. The second perspective reported by Elen and Clark (2006) examined the complexity of a learning design as it is perceived by an individual learner.

While agreeing that all four elements are critical to operationalizing complexity, the different contributions in this book tend to locate complexity not in the environment – not in external tasks but instead in the interaction between the characteristics of tasks and the characteristics of individual learners (p. 2).

This perspective, which considers the interaction between the task elements and the learner, is consistent with that of cognitive load theory. Each of the perspectives discussed in this section are, in varying amounts, incorporated into the CLD categories addressed in the following section.

Learning Theory

When designing CLDs, instructional designers need to understand how the learner can form (construct) an understanding of the material as well as consider how the more complex design affects a learner's ability to process and construct an understanding. CLDs can take several forms and viewed from different epistemological perspectives. Therefore, both constructivist and cognitive information processing may be underlying learning theory in different instructional designs.

Constructivism

As Phillips (1995) pointed out, there are many perspectives and theorists within the constructivist epistemological belief system. Key theorists include Vygotsky (social constructivism and the zone of proximal development, ZPD), Piaget (genetic epistemology and cognitive disequilibrium), and Von Glasersfeld (radical constructivism). Each of these theorists viewed human knowledge as something that is constructed by the individual. Phillips suggested that three dimensions distinguish constructivist theorists. The first-dimension deals with whether individual or general knowledge construction is the focus of the research. Phillips described the second dimension as “humans the creators versus nature the instructor” and the third dimension as the construction of knowledge being an “active process” (pp. 7-9).

Von Glasersfeld’s (1991) summation of the nature and origin of constructivism supported Phillips dimensions, stating “The notion that knowledge is the result of a learner’s activity rather than that of the passive reception of information or instruction goes back to Socrates and is today embraced by all who call themselves ‘constructivists’” (p. 8).

Kester, et al.’s (2010) description of complexity mirrored much of what Jonassen (1997) considered an ill-defined domain common to constructivist learning environments. Ill-defined knowledge domains are often situated in the real world, may not be solved by a single specific decision-making process but rather consist of a divergent problem-solving process, and are likely to have multiple correct solutions with varying advantages and disadvantages.

Kester (2010) and Jonassen’s (1997) perspectives of complexity/ill-defined learning domains stand in contrast with a large percentage of learning designs that are typically well-defined, often linear in nature, and possess a single correct path and solution. These types of learning environments are exemplified by the ubiquitous “click next to continue” used to navigate through a linear design. While simple learning designs may aim at the “knowledge” and “comprehension” level of Bloom’s taxonomy (1956), learning within complex and ill-defined domains typically requires higher levels of cognition from learners, as classified by both Bloom, et al. (1956) and Anderson and Krathwohl (2001).

Regarding constructivism, Driscoll (2005, p. 393), described four goals and five conditions for learning within constructivist learning environments. The goals consist of problem solving, reasoning, critical thinking, and the active and reflective use of knowledge. The five conditions for learning include the following:

1. Embed learning in complex, realistic, and relevant environments.
2. Provide for social negotiation as an integral part of the learning.
3. Support multiple perspectives and the use of multiple modes of representation.
4. Encourage ownership in learning.
5. Nurture self-awareness of the knowledge construction process.

These goals and conditions for learning align well with this paper's discussion of complex learning. Complex learning environments are realistic, relevant, and often allow for multiple paths or solutions toward a path (Kester, Paas, & van Merrienboer, 2010). These characteristics of CLDs are also common attributes of constructivist learning environments.

Activity Theory

Complex instructional designs, such as simulations, augmented reality, and games require active learner involvement in ill-structured domains that often incorporate attributes such as branching pathways, levels of interaction with multiple learning objects, and inclusion of environmental context through using "…tools, socio-cultural rules, and community expectations that performers must accommodate while acting on some object of learning" (Jonassen & Rohrer-Murphy, 1999, p. 61). These factors result in learner participation through performance and construction of knowledge, often through trial and error, rather than passive reception of knowledge. They also reflect similar characteristics to activity theory.

For these reasons, activity theory is an appropriate framework when considering categories of instructional design competencies for designing complex learning systems. Jonassen (1999) suggested that activity theory was an appropriate framework for a myriad of constructivist learning environments (CLEs), such as open-ended learning environments (Land & Hannafin, 1996), microworlds, anchored instruction (Cognition and Technology Group, 1992), problem-based learning (Savery & Duffy, 1995), and goal-based scenarios (Schank & Cleary, 1995). Holzman (2000) noted that other researchers have identified activity theory as an appropriate framework when investigating agent technology (Zhang, & Guohua, B., 2005), analysis and design of serious games (Carvalho, 2015), and mobile collaborative learning system (Zurita & Nussbaum, 2007). Other studies have examined activity theory and proposed its use as a framework for designing work (Engeström, 2000), human-computer interaction (HCI) research (Kuutti, 1995), and computer interface design (Gould & Verenikina, 2003).

Activity theory has evolved through multiple generations (Gedera & Williams, 2016). Engeström, Miettinen, and Punamäki (1999) identified three generations of activity theory, as shown through the evolution of activity system models seen in Figures 1 through 4. The first generation of Activity theory originated from Soviet cultural-historical psychology, pioneered by Vygotsky's Cultural Historical Activity Theory (CHAT). The second generation of activity theory originated from Leont'ev, a colleague of Vygotsky. The third generation came from Scandinavian researchers led by Engeström (1987).

Vygotsky's basic Mediated Action model consists of three components, the Subject, the Tool, and the Object (Vygotsky, 1978). The Subject represents the participant involved in the activity, while the Mediational Means (Tools) represent artifacts or participant prior knowledge that influence (mediates) the activity, while the Object represents the goal (or motive) of the activity which leads to the outcome (Gedera, 2016).

Vygotsky viewed the subject as the primary unit of analysis in his Mediated Action model. Vygotsky's model ignored the collective nature of activity, which was incorporated into the second generation by Leont'ev (Gedera, 2016). Leont'ev considered an activity system as the basic level of analysis and added two perspectives to the second generation: a hierarchal order to a system, action, and operation.

Beyond proposing this hierarchy, Leont'ev added components to the Mediated Action model, consisting of Rules, Community, and Division of Labor (Engeström, 1987). It is at this point that activity theory becomes relevant to instructional design competencies. Kaptelinin (2005, p. 5) indicated that the object of an activity is a "…promising analytical tool providing the possibility of understanding not only what people are doing, but also why they are doing it," and points out that objects are "powerful sense-makers" both for the activity's subjects as well as researchers. CLDs typically employ objects that require subjects to operate according to rules and within specific social contexts. Additionally, a division of labor is required from both the end users that operate within the design's context as well as within the design team itself. The third generation of Activity theory (Engeström, 2001), which deals with the relationships and contradictions between multiple activity systems.

This research examined a single type of system: CLDs. Therefore, the second generation of activity theory, which is based on a single activity system, rather than multiple systems provided a touchstone unit of analysis for this study's inquiry of complex instructional design competencies. Activity theory concentrates on the interactions between an individual (subject), mediating artifacts (tools), and other objects or individuals. The semi-structured questions employed in phase two of this study were consistent with this theory. The interviews began by asking questions related to the components identified in the second generation of activity theory: objects, subjects, mediating artifacts, rules, community, division of labor, and outcome.

Pohio (2016), examined activity system tools which, beginning with Vygotsky (1997), have been categorized as either technical or psychological tools. Physical tools available within complex virtual learning environments are more than just the computer and its peripherals. Consider the tools available in serious games, augmented reality or 3D simulations: the "physical" tools are virtual tools that could include a virtual car, train, or hand tool. In that same context psychological tools might include interface components like road maps or signs for navigation or avatar feedback. The difference between technical and psychological tools, according to Wertsch (1998) is that technical tools are externally directed, while psychological tools are inwardly directed. Kaptelinin and Nardi (2009) pointed out that internal activities cannot be understood if they are considered in isolation from external (observable) actions. Identification and definition of tools (i.e., mediating artifacts) within a design would seem to be an essential competency that is not typically considered for more simplistic instructional design activities.

Complexity Theory

Davis and Sumara (2008) pointed out that complexity theory, much like constructivism, has many faces. It is commonly associated with disciplines such as chemistry, physics, cybernetics, information science and systems theory. More recently, social organizations and education have been studied through the lens of complexity theory. Davis and Sumara presented several terms to describe complexity theory including emergent, which indicates that learning “arises in the interactions of many sub-components or agents, whose actions are in turn enabled and constrained by similarly dynamic contexts” (p. 34), and transdisciplinary which positions the learner as a “participant-in-the-production-of-ideas” (p. 35).

Sanger and Giddings (2012) viewed complexity from a sociological perspective and detailed ideas drawn from complexity theory. Their foundational assertion is that simple and complex systems are different; therefore, instructional design approaches that are successful for simple learning systems may not be appropriate for complex systems. This assertion is analogous to using the same instructional design strategies to design a lesson for both stand-up instruction and game-based learning, rather than employing a different set of KSAs more appropriate for each type of instruction.

Though no generally accepted definition of complexity theory exists, Sanger and Giddings (2012) indicated there is general agreement that “…a complex system consists of numerous subsystems interacting with each other through multiple, nonlinear, recursive feedback loops” (p. 371). Jakubowicz (2006) research of an online discussion forum employed in a higher education setting focused on interactivity as a key element fostering complexity, which is consistent with Sanger and Giddings' definition of complexity theory.

Morrison (2006) raised an additional concern that complexity theory is "essentially an ad hoc explanation, with limited prospective or predictive utility" (p. 7). Morrison further noted that "… this raises a difficulty for complexity theory: it is essentially a descriptive or reflective theory. To move from a descriptive to a prescriptive theory is to commit a category mistake…" (p. 7). While complexity theory provides a definition of complexity consisting of subsystems that interact, it will not (because of its nature) identify factors that instructional designers need to consider when creating CLDs.

Though recognition of the internal complexity of a learning design (system) is important, the role of an instructional designer should be to create a CLD in such a manner that the design reduces learners' perceived complexity of the learning design. According to Clark, et al. (2006) the instructional designer's role in reducing perceived learner complexity is important for two reasons: cognitive learning ability and learner motivation. The implication of Clark's point is that CLDs require a more prescriptive theory than complexity theory so that instructional designers can learn how to adjust their design of CLDs for better learner retention and transfer.

Cognitive Load Theory

The second perspective reported by Elen and Clark (2006) deals with the complexity of the relationship between individual learners and the elements of the learning environment, which is more representative of the perspective provided by cognitive load theory (CLT). Ayres (2015) defined cognitive load "as the total load placed on working memory by instructional information" (p. 631). Working memory is characterized by short duration and limited capacity (about seven elements, hence the chunking of our phone numbers), while long-term memory is theoretically unlimited. The basic premise of cognitive load is that excess load inhibits learning because of the limited capacity available in working memory. The goal, therefore, should be to process information out of working memory into long-term memory as fast and efficiently as possible. Four types of cognitive load are generally accepted: germane, intrinsic, extraneous, and extrinsic (Hollender, et al., 2010; van Merriënboer & Ayres, 2005). Intrinsic load is influenced by the complexity of the information and the level of expertise of the learner, while extrinsic is load not associated with processes necessary for learning. Extraneous load elements are key targets for instructional designers to target and remove from the design, since they are elements that provide no learning value. van Merriënboer et al. (2010) directed instructional designers to consider whether the design has overloaded either the visual or auditory memory capacity of working memory, a warning like Mayer's (2009) assertions found in the cognitive theory of multimedia. Germane cognitive load, however, is directly associated with processes involved in learning and "…results from active schema construction processes and is thus beneficial for learning" (Hollender et al., 2010, p. 1279). Therefore, the overall goal should be for instructional designers to be competent in recognizing germane load elements and maximize their presence in the design while minimizing extraneous load elements.

Plass, Moreno, and Brűnken (2010) described how the objective of CLT is to "…predict learning outcomes, by taking into consideration the capabilities and limitations of the human cognitive architecture" (p. 1). They continued by pointing out the significance for instructional designers when stating "…the design of effective learning scenarios has to be based on our knowledge about how the human mind works" (p. 1). Instructional design competencies that tailor presentation of content according to learner expertise levels will reduce the intrinsic load. Removal of information that is irrelevant to the learning objective will reduce extrinsic load. This notion is reinforced by Hollender, et al. (2010). Hollender et al. examined factors that foster germane cognitive load including the variability effect, which states that an increase in the variability of required tasks increases germane load, but also tends to improve cognitive outcomes, by forcing learners to link abstract to concrete examples and therefore strengthen schema construction. Other factors were found to reduce extraneous load including the worked example effect, the split-attention effect, the modality effect, and the redundancy effect. Instructional designers should understand the need to both foster germane cognitive loads while reducing extraneous cognitive load, especially in more complex learning environment designs.

Hollender et al. (2010) also considered the usability of the interface design, as another factor that influences learner cognitive loads instructional designers should consider. Usability is a significant concept of human computer interaction (HCI) and requires knowledge of the users, their level of expertise, and the specific tasks required to be completed. Increasing the level of usability of a design will reduce the level of extrinsic cognitive load, thus freeing up working memory for germane load and schema construction. It should be incumbent on instructional designers to develop competency in reducing extrinsic load so that instructional designers are able to ensure instructional integrity in more CLDs rather than allowing, as Hirumi (2010) warned, other disciplines "most embedded within the development process" (p. 29) making instructional, cognitive, and memory impactful decisions.

van Merriënboer (2003) introduced a method for solving problems that is aimed at reducing learner extraneous cognitive load. Using terminology like "given state" and "desired goal state" to describe conventional problem-solving processes, which van Merriënboer describes as a "means-end analysis" (p. 7) process. This process was examined because of the high level of extraneous cognitive load associated with it. van Merrienboer explained that conventional processes exhibit little relationship to schema construction processes, which are foundational to CLT.

As an alternative, van Merriënboer (2003) proposed a second process called "worked out" (p. 7) that adds a third and fourth state beyond the means-end conventional process: an example solution that is available for learner review. van Merriënboer suggested this process allows the learner to study an example solution which enables learners to induce generalized solutions or schemas. To further reduce the overall level of cognitive load, the researchers introduced a strategy of "completion tasks" that is added to the given state and desired goal states. The completion task strategy presents partially completed designs as a scaffolding mechanism. Combined, the four components (means, end, example solution, and partially completed solutions) constitute the van Merrienboer model, named the 4C/ID model. Models such as van Merriënboer's 4C/ID model provide instructional designers a methodological process for conceiving CLDs. Key principles involved in van Merriënboer's 4C/ID model include:

- Learning tasks, with scaffolded whole-task practice, performance support and fading and simple to complex equivalent-task sequencing.

- Just-in-time presentation of supportive information.
- Just-in-time presentation of procedural information.
- Part-task practice.

Kester, Paas, and van Merriënboer (2010) asserted that authentic learning tasks have common characteristics that include "…many solutions, are ecologically valid, cannot be mastered in a single session, and pose a very high load on the learner's cognitive system" (p. 109). Contrary to traditional learning designs, which seek to promote learning individual skills in isolation, complex learning, according to Kester, et al. (2010) is based on coordination, integration and differentiation of individual knowledge, skills, and abilities. To learn effectively, Kester, et al. suggested that the learner's cognitive system architecture, the environment where the learning is occurring, and the interactions between the three components must be accommodated and aligned. This is reminiscent of Elen and Clark's (2006) second perspective where learner perception is the determinant of complexity. The complex system design requires interactivity where the system can present appropriate content, based on the type of responses provided by the learner.

Increased complexity originating from in CLDs increases cognitive load beyond any level associated with the more passive reception of instructional content common in simplistic learning designs. CLT assumes that the three types of cognitive load are additive, in they collectively reduce the amount of available working memory. For example, a reduction in extraneous cognitive load frees up working memory that can be used for germane learning processes (Hollender, Hofmann, Deneke, & Schmitz, 2010).

However, an increase in extraneous load will reduce the amount of germane load available to the working memory.

CLT identifies factors that can be adjusted by instructional designers to adjust the learning system's cognitive impact on learners according to pre-established instructional strategies. Khacharem, Zoudji, and Kalyuga (2015) related the complexity of a system to the intrinsic cognitive load associated with that system. Further Khacharem, Zoudji, and Kalyuga (2015) cited Sweller, van Merriënboer, and Pass (1998) when stating that "Based on cognitive load theory, complexity can be manipulated by [instructional designers] varying two main factors: the amount and the connectivity of the presented information" (p. 71). CLT highlights the need for instructional designers to have specific knowledge and skills to design CLDs. CLT accomplishes this by linking the design characteristics of learning materials to principles of human information processing (Plass, et. al, 2010). Further, CLT provides opportunities for subjective measurement of an individual learner's cognitive load. Haji et al. (2015) indicate that the relative cognitive load placed on an individual learner depends on the complexity of the learning material, the manner the material is presented to learners, as well as each learner's prior experience and knowledge of that material. Similarly, van Merriënboer (2005) addressed how "difficult" content may be perceived by learners by the content's level of interactivity and the level of expertise of the learner. The complexity of material, its presentation, and [the ability to design to] the learner's level of experience are all skills that instructional designers should be proficient in manipulating when creating CLDs.

Situated Learning

Two common characteristics of CLDs are the authentic nature of activities and the relative higher level of the learning environment's fidelity. These characteristics are often established by connecting learning to objects in complex learning environments typically found in video/educational games, mobile learning activities, 3D simulations, augmented reality activities, and other complex instructional design learning environments. The ubiquitous term of learning objectives becomes attached to the activities and learning objects found within each complex design. Collins (1991, p. 265) summarized that "situated learning occurs in real situations: learners must acquire comprehensive knowledge and establish the meaningfulness and framework of that knowledge by interacting with others in real situations."

Brown, Collins, and Duguid (1989) stated that "…situations co-produce knowledge through activity" (p.32). The authors cite Miller and Gildea's (1987) work as an example. Miller and Gildea examined vocabulary development for children who learned words strictly from a dictionary and those who informally learned their vocabulary outside of school though ordinary communication between peers and family. The informal (situated) learning that occurred in realistic settings produced a much faster vocabulary learning curve. To summarize situated cognition Brown, Collins (1989) state:

> All knowledge is, we believe, like language. Its constituent parts index the world and so are inextricably a product of the activity and situations in which they are produced. A concept, for example, will continually evolve with each new occasion of use, because new situations, negotiations, and activities inevitably recast it in a new, more densely textured form. So, a concept, like the meaning of a word, is always under construction. (p. 33)

CLDs

According to van Merrienboer and Kirschner (2017) instructional design needs to take a more systematic approach to design due to the increased complexity added to current tasks by new technologies, stating:

> New technologies have allowed routine tasks to be taken over by machines, and the complex cognitive tasks that must be performed by humans are becoming increasingly complex and important (Benedikt-frey & Osborne, 2017; Kester & Kirschner, 2012). Moreover, the nature of currently available jobs is not only changing because other skills are needed but also because the information relevant to carrying out those jobs quickly becomes obsolete. (p. 3)

With the increased technological complexity available to instructional designers, more realistic and relevant designs become possible. To facilitate these types of designs recent instructional design theories have tended to center around authentic, real-life theories (van Merrienboer, Kirschner, & Kester, 2003). Van Merrienboer and Kirschner (2013) pointed out that popular educational approaches for complex learning, such as case method, guided discovery, inquiry, problem-based, design-based, and competency-based learning, all rely on tasks that are based on real-life experience.

Five types of advanced learning designs include complex (and ill-defined) elements that must be accommodated within the design: adaptive learning environments, problem-based learning, goal-based scenarios, games, and simulations.

Adaptive Learning Environments

Kinshuk (2016) defined adaptive learning environments as "…learning environments that provide automatic customization of learning and instruction to individual learners" (p. 3). In a special report considering use of adaptive training for simulation-based systems, Landsberg, et al. (2011) defined adaptive training as follows:

> …training interventions whose content can be tailored to an individual learner's aptitudes, learning preferences, or styles prior to training and that can be adjusted, either in real time or at the end of a training session, to reflect the learner's on-task performance. (Landsberg, et al., 2011, p. 9)

Bloom (1984) noted that one-on-one instruction increased student performance when compared to those taught in regular classroom settings. Bloom named this the "2 Sigma Problem," due to results that indicated two standard deviations (SD) higher performance. Adaptive training environments offer the same type of one-on-one, personalized instruction that Bloom referred to. Reflecting this similarity, Landsberg, et al. (2012) indicated that adaptive training, using advanced technologies, can be an ideal solution to the disparity in performance observed by Bloom.

Landsberg, et al. (2012) identified four categories of adaptive training approaches. They include macro (adaptation is based on an assessment prior to instruction), micro (real-time adaptation of instruction based on student's performance), aptitude-treatment interaction ("ATI," which adapts instructional techniques based on learner aptitudes or abilities), and two-step approaches (adaptation is based on both ATI and micro-adaptive approaches).

Kinshuk (2016, pp. 31-36) looked at system adaptivity from a learning, rather than training, perspective and identified three categories of context as key factors that impact adaptation: interactional, objectival, and environmental. Interactional context refers to the interaction between learner and computer; objectival context refers to the context provided by the learning objective; and, environmental context refers to factors external to the learning environment. Truong (2014) reviewed 51 studies investigating the integration of learning styles and adaptive systems during the period of 2004 to 2014. Truong identified a process for this integration, which consisted of: (1) selection of a learning styles framework out of the myriad of those available; (2) identification of learning style predictor data sources such as computer log files that contain data such as the "number of visits, time spent, performance, characteristics and types of objects chosen, sequences of actions and selected search terms" (Truong, 2014, p. 1187).

Though the sources cited by Truong are general in nature, they do point to the type of data that might be collected to highlight attributes and variables that can be incorporated into the third step: selection of a classification algorithm method. Truong identified several approaches in his review of the research, including rules-based, Bayesian network-based, and hybrid Naïve Bayes and Decision Tree (NBTree) methods. While some of the technical competencies described in this section of adaptive training may be outside the professional scope of instructional designers, it is likely they will need the skills to be a part of any team-based development environment to ensure proper design and assessment of adaptive systems.

Problem-based Learning

Problem-based learning (PBL) traces its origin to Howard S. Barrow's alternative approach to medical education (Savery & Duffy, 1995; Savery, 2015). Savery described problem-based learning (PBL) as a learner-centric approach that "empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem" (p. 7). Key components of PBL include the identification of ill-structured, interdisciplinary problems, student-centered construction of knowledge, and the presence of a tutor to scaffold the learning process toward a solution of the stated problem.

PBL is like Schank's (1993) goal-based scenarios (GBS), as both are considered constructivist implementation approaches toward solving a problem or accomplishing a goal. The theory assumes that learning occurs constantly in our lives as we proceed to solve problems. Driscoll (2005) explained that the goal of PBL is to provide a "…problem-solving process that students may use systematically to identify the nature of the problem, assign tasks to be completed, reason through the problem as data and resources are gathered and consulted, arrive at a solution, and then assess the adequacy of the solution" (p. 404). Driscoll also pointed out the importance of designer reflection as part of the process.

Problem-based learning exhibits characteristics that are expected in more CLDs. Hung, Jonassen and Liu (2008) explained that learning begins though the process of solving ill-structured problems such that a reciprocal relationship between knowledge and the problem to be solved develops. Jonassen and Liu also stated that PBL has the following characteristics:

1. It is student centered.
2. Faculty and trainers no longer autocratically dispense the knowledge and skills.
3. Learning is self-directed such that it may occur individually or collaboratively.
4. PBL learning is a process where learners reflect and iteratively adjust their strategies to solve the problem.

The final characteristic Hung, Jonassen, and Liu (2008) discussed is the nature of the instructor. PBL theory views instructors as facilitators as opposed to knowledge disseminators. This instructional role is consistent with the non-linear, recursive feedback loops Sanger and Giddings (2012) described about complex systems.

Problem-based learning theory reveals potential new competencies related to the design of student-centered learning design. PBL is a departure from the typical approach of strict adherence to pre-specified learning objectives and calls for new knowledge and skills of every instructional designer involved in complex design based on PBL.

Goal-based Scenarios

Schank (1999) is credited with a case-based architecture called Goal-Based Scenarios (GBS), an applied learning theory based on Case-Based Reasoning (CBR), which like PBL has its origin in medical education. GBS is considered a well-recognized architecture for designing "learning by doing" CBR/Constructivist learning environments (Riesbeck, 1996, p. 49). Schank posited that humans learn through prior experience, failures, and successes while in pursuit of goals.

Goal-based scenarios (GBS) are Schank's translation of CBR to simulated learning environments (Hung, 2003, p. 30). GBS are composed of missions, each with defined goals, structure and context. Learners construct their own knowledge through simulated activity provided by the scenarios. Because construction of knowledge by the learner is central to GBS, it resides within the constructivist epistemological camp.

Addressing the importance of motivation, Schank (1993) expressed the fundamental principle behind GBS: "An interest is a terrible thing to waste" (p. 305). Through the example of baking, Schank explained CBR as he pointed out that cooks learn what proportion of ingredients to include in a recipe, how hot the oven should be, and how long the item should be baked. Each of these memories is considered a "case," from which the learner can recall what to do and what to avoid in the future. This case-based reasoning works well with complex learning environments that provide multiple avenues of pursuit, and subsequent failures and successes. Schank (1993) established a structure and set of GBS design criteria because "… skills are the form of knowledge that, when applied, enable students to achieve valued goals, we argue that GBSs should be designed to teach a set of targets kills required to achieve a specified goal" (p. 305).

Many of the CBR/GBS design principles and characteristics are also found in games and simulations. These characteristics include building intrinsic motivation in the learning environment, establishing single or multiple goals for the learner to accomplish, and allowing multiple paths for reaching individual goals, while providing opportunities for both success and failure.

Game-based Learning

Hirumi, et al. (2010a) defined the term instructional games (a.k.a., "serious games"), as "…any interactive, digital game that is designed specifically to facilitate the achievement of a specified set of learning outcomes that meet educational goals" (p. 29). Hirumi et al. further defined instructional games by exclusion of popular "gamification" mechanisms like multiple choice questions, game shows, and card games that are ported to a digital format. Hirumi et al. pointed out that an instructional game is complex and two fundamental misconceptions about games and instruction exist: first, that learning cannot be fun and is incompatible with games; second, that learning is sequential, linear, lockstep, and prescriptive. To the contrary, Hirumi et al. suggested that instructional games require "… a complex analysis of the internal and external conditions of learning; not a prescriptive process, but a set of heuristics that rely on a deep conceptual understanding of learning theory and the instructional process" (p. 29).

Instructional designer competency in the performance of complex analysis is an area where increased levels of competency are required. As Villachica (2010) addressed in his study of employers' assessment of entry-level instructional designers, many were unable to perform what might be considered fundamental skills including:

- Conduct a front-end, context, or task analyses.
- Evaluate appropriate instructional strategies based on data analysis.
- Draft a design document.
- Conduct a pilot /prototype test.

Lacking a basic level of analytic competency, it is unlikely that entry-level instructional designers are called upon to perform game-based learning analysis. This deficiency is highlighted by the emphasis educational games place on analysis, which Arnab, et al. (2015) explained:

> Existing practices, framework, models in serious games design focus on providing guidelines and methods for design, but they do not target the analysis of the relationships between game elements and learning mechanics, which is a key factor in game design for learning. (p. 392)

Hirumi, et al. (2010) associated Piaget's cognitive disequilibrium and Vygotsky's use of scaffolding to game design theory. Cognitive disequilibrium is the state when learners must adjust their pre-existing schema when confronted with new information. Vygotsky's perspective of scaffolding, according to Hirumi, related to designs that assist learners in constructing their understanding of a complex game environment without overtly telling the learner what to do to solve the problem, challenge, or goal.

Like the learner participating in a goal-based scenario, game-based learning requires problem solving by reaching a goal that embodies some level of value to the game or learner. Learners must generate new knowledge through experimentation, which includes trial and error and successes and failures, to learn how to meet the goal. This discovery learning process requires a different approach to instructional design than linear, lock-stop instruction.

Hirumi et al. (2010a) discussed the adjustments that instructional designers must make to successfully work with game design:

> If instructional designers are to develop successful instructional games, we must first understand how learning and instructional design are manifested in commercial games and must secondly modify our instructional design practices (if not our models) to design games that are both instructionally effective and as engaging as commercial games. (p. 29)

While game-related frameworks do exist, few specifically address the competencies required for the instructional design of complex educational games. van Staalduinen and de Freitas (2011) presented a framework that shows the relationships between game elements and learning outcomes and cited three educational game design models. Their framework is based on three educational game design models and includes 25 game elements they consolidate to four higher level element themes. More recently, Arnab, et al. (2015) described the learning mechanics to game mechanics (LM-GM) model that maps serious game mechanics and learning. In researching team performance, Marlow, Salas, Landon, and Presnell (2016) indicated a "…dearth of theory relating independent game attributes to teamwork behaviors. Specifically, it is unknown why or how game-based training may foster desired competencies within teams" (p. 413). Marlow et al. (2016) examined nine game attributes and provided a research framework for the future. While these research studies are valuable in providing guidance, none provide a concise competency framework that instructional designers can follow to remain relevant in the design of educational games.

Educational Simulations

Cook (2013) examined 11 key instructional design features and associated strategies employed in medical simulations. Cognitive interactivity was employed to enhance engagement through use of strategies such as having multiple repetitions; varying the level of task difficulty or sequencing; varying the range of task difficulty; mastery learning; and content presentation that is tailored or adapted based on a learner's performance. These strategies exceed the complexity found in current instructional design competency frameworks and indicate a need for more granular analysis and instructional strategy competencies.

Aldrich (2005) examined the design and development process of numerous categories of simulations including branching stories, interactive spreadsheets, game-based simulations, virtual products, virtual labs, marketing games, and microworlds. Using the design of a generic interactive spreadsheet as an example, Aldrich detailed four "slates" (design levels). The four levels are introduced sequentially, allowing for scaffolding the learner's expanding knowledge and skillset to the next level. The first level is the introductory material where the learner is introduced to the topic, the rules, aids, and constraints. In the next level learners can experiment within a scaled down portion of the simulated instructional environment. The third level opens the full simulation to the learner with little or no guidance. The fourth, and final level ("slate") is where students practice their skills and "push the envelope of their experience." Aldrich calls this "unchaperoned engagement" (pp. 218-219). Attainment of these levels requires experimentation (discovery learning) by the learner and is not a typical strategy employed with non-complex instructional designs.

The levels described by Aldrich (2005) are consistent with Cook's (2013) strategies of iterative practice, adaptive content presentation based on learner performance/level, and variation in task difficulty. However, Cook and Aldrich did not specifically address variations in the level or type of feedback. Based on this researcher's personal experience designing educational simulations, varying the level and type of feedback should accompany Aldrich's levels and Cook's variation of task difficulty strategies and would increase the likelihood of transfer and retention of the simulation's content and goals.

The key point that emanates from examination of Aldrich's (2005) and Cook's (2013) work is that variations in level, presentation, difficulty, feedback, and scope of available learning content must be considered by any instructional designer working to design an educational simulation. Much like designing games and scenarios, these studies imply that instructional designers need an extensive level of competence in the analysis and visual design stages of educational simulation design.

Augmented and Virtual Reality

Augmented Reality (AR) and Virtual Reality (VR) promise a tremendous leap forward in providing context to learning experiences. Instead of low levels of learning (i.e., remembering and understanding) that legacy textbook-based education promote, context opens the potential for higher levels of learning such application, analysis, evaluation and creation (Anderson & Krathwohl, 2001).

An AR system supplements the real-world objects with virtual objects that appear to co-exist with the real-world objects and environment, while a VR system consists only of virtual objects existing within a virtual environment (Bacca, Baldiris, Fabregat, Graf, & Kinshuk, 2014). El Sayed, Zayed, and Sharawy (2011) add that AR enables the addition of information that is absent in the real-life environment through the addition of virtual objects. Chatzopoulos, Bermejo, et al. (2017) offer additional advances that have enhanced the capabilities of AR, including increased capabilities of sensors included with today's mobile devices that enable Mobile Augmented Reality (MAR). Other factors include the advent of mobile cloud computing, and device-to-device communications. Chatzopoulos, et al. (2017), note the differences between various forms of reality that is now available:

> "Real Reality is the environment of the user without the use of any device while Virtual Reality is the reality that users experience, which is unrelated with their environment and is completely generated by a computer Mobile technology improvements in built-in cameras, sensors, computational resources and mobile cloud computing have made AR possible on mobile devices. (p. 6917

Though the instructional design of AR and VR-related learning experiences remain in a nascent stage, recent studies have tried to address the lack of a systematic design of AR/VR-centric learning experiences. Xu and Ke (2016) performed a qualitative case-based study that employed direct observation, interviews, and video qualitative analysis to identify design issues of a virtual reality-based, gamelike learning environment (VRGLE). The target audience and context for this study was 5th graders learning mathematic fractions. Xu and Ke identified design challenges both for virtual reality (VR) and game design elements. VR design challenges included spatial contiguity (as defined by Mayer, 2009), human-computer-interaction interfaces (HCI), and in-environment agents, while game-based challenges included usability (user interface design), playability (interactivity, game rules and storyline, quality of audiovisual effects, and social playability), and integration of learning objectives with game mechanics as the main design challenges.

In reviewing literature for cultural heritage applications, Hincapie and Diaz (2016) discovered that no methodological framework had been developed for using different technologies, such as serious games, virtual reality, and augmented reality. Hincapie and Diaz developed a three-axis methodological framework for the systematic design and development of cultural heritage site on-demand applications that associated the type of content resources (text, images, audio/video, animation or 3D models), available technology (AR, VR, serious games, visualization), and category of application (fixed or mobile, and indoor or outdoor). The mobile (inside and outside) application category element of this framework highlights aspects that are atypical in the instructional design of most types of solutions.

Similarly, Klopfer and Squire (2008) conceived of a mobile learning framework for what they called “Augmented reality educational gaming” which is used as a foundation for development of augmented reality games for mobile application. They attributed five affordances to mobile and augmentation (portability, social interactivity, context sensitivity, connectivity, and individuality) which are consistent with the RASE framework (Churchill, et al., 2016) that was discussed in the mobile learning section of this document. The five affordances offer several new modes of interaction: distributed, collaborative investigation, peer-to-peer networking, and coupling physical space with virtual space for contextual instruction.

It is instructive to note that both VR and AR experiences involve the design of environments and objects that offer multiple paths, myriad potential endpoints, and are commonly designed for multiple form factors (desktop, tablet, and smart phone). These features are common to other complex design experiences like simulations, goal-based scenarios, serious games, and require additional instructional designer competencies.

The urgency of updating instructional design competencies suitable for AR and VR were highlighted by Professors Abbie Brown and Tim Green in episode 48 of their Trends and Issues podcast (2015). This episode documented the accelerating emergence of both virtual and augmented reality, specifically citing the numerous VR products making their way to market as well as the VR media productions that have recently been announced by CNN and Netflix. This episode also addressed the worldwide multicultural exposure to VR through former President Clinton's virtual tour of Africa presentation to the U.N.

Mobile Learning

Considering its potential world-wide impact, Elias (2011) detailed the many advantages as well as unique challenges that m-Learning presents for instructional designers. These challenges include device variability (size, capability, and form factor), download speed, Internet access, screen size and resolution, differences in color and contrast fidelity, awkward text input, and limited memory. The Hincapie and Diaz (2016) framework supports the notion that a "one-size fits all" instructional design approach is insufficient for the types of visual, navigational, and content decisions required for the instructional design of m-Learning.

Churchill, Fox, and King (2016) proposed a mobile learning framework and cited numerous theoretical underpinnings for that framework. These include constructivism (Jonassen, 1999), activity theory (Engeström, 2015; Engeström, 2000), problem-based learning (Savery & Duffy, 1995), and situated learning (Brown, et al., 1989). Each of these theoretical underpinnings assumes an involved learner as a common characteristic, whether that involvement is the construction of understanding, an activity, solving problems, or associating knowledge with specific contexts.

The framework Churchill, Fox, and King (2016) introduce is the Resources-Activity-Support-Evaluation (RASE) framework for integrating the affordances that mobile technologies can bring to the design of learning environments. Declaring the Activity component, the most important in the RASE framework, Churchill, et al. (2016) detail mobile-based learning affordances including resources, connectivity, collaboration, capture, representation, and analytical and administration tools. Kamarainen, Metcalf, Grotzer, and Dede (2016) offer portability, social interactivity, context sensitivity, connectivity, and personalization as the key affordances offered by both mobile and augmented learning, while Klopfer and Squire (2008) suggest five characteristics: portability, social interactivity, context sensitivity, connectivity, and individuality. Sharples, Taylor, and Vavoula (2005) published a theory of mobile learning through the lens of activity theory to analyze learning through mediating tools. Sharples et al. (2005) examined the tools through two mediating layers: semiotic and technological. The semiotic layer represents learning through cultural and sign type tools, while the technological layer represents learning as engagement with technology. Sharples, et al.'s theory contains the following seven characteristics:

1. It is the learner that is mobile, rather than the technology.
2. Learning is interwoven with other activities as part of everyday life.
3. Learning can generate as well as satisfy goals.
4. The control and management of learning can be distributed.
5. Context is constructed by learners through interaction.
6. Mobile learning can both complement and conflict with formal education.
7. Mobile learning raises deep ethical issues of privacy and ownership.

Park (2011) compared m-Learning, with e-Learning and ubiquitous learning u-Learning and described the technical and pedagogical affordances that should be incorporated into instructional design for mobile learning. In contrast to Sharples, Taylor, and Vavoula (2005) and Zurita and Nussbaum (2007), Park employed transactional distance (TD) theory as a framework for mobile learning in distance education.

Fulantelli, Taibi, and Arrigo (2014) summarized the need for a framework to manage the complex sets of data that can be collected in mobile learning systems, stating:

> In fact, mobile learning is characterized by the learners' mobility, the possibility of having localized data and information, the large amount of data that can be collected during a learning session, the affordances provided by the technologies and the social dynamics that characterize the context in which learning takes place. Consequently, learning analytics in mobile learning requires original methodological approaches which enrich techniques already tested in different learning contexts (e.g., in virtual learning environments) with specific strategies to deal with the complexity of mobile learning and manage the corresponding datasets (p. 50).

Fulantelli, et al. (2014) examined the issue of data collection for decision making and created a framework for learning analytics applied to the types of interactions that occur within the mobile learning environment (Table 1).

Table 1
Interaction Types and Mobile Learning Factors

Factor	Issue	Values / scale range	Type of interactions	Examples of indicators
Context	Relevancy of environment and learning issue	Independent, formalized, physical and socializing	Students/ context	Position of a student in relation to other students
Tools	Pedagogic role of tools	<u>From</u>: content delivery <u>To</u>: content construction	Students/ content	Access to content, and creation of new content
Control	Responsibility for learning process and goal	<u>From</u>: full teacher control <u>To</u>: full learner control	Students/ teacher	Messages between students and teachers (Note: the direction is highly relevant)
Communication	Social setting	<u>From</u>: isolated learners <u>To</u>: cooperation	Students/ student	Message between students and between students and Teacher
Subject	Previous knowledge	<u>From</u>: novice <u>To</u>: expert	Students/ Content Students/ Teacher	Access to content, # request for teacher intervention
Objective	Level	<u>From</u>: know <u>To</u>: synthesize and evaluate	Students/ Context Students/ con	Indicators strictly related to the type of learning experience

While mobile learning presents new affordances it also presents numerous challenges to the instructional designer. The most commonly recognized challenge is the need of concurrent design for the multiple form factors learners use to access and interact with mobile learning content. This introduces instructional design challenges in visual presentation and scope of content. A second, and equally important, challenge facing instructional designers is based on contextualizing content.

In their research of activity design on a mobile learning trail, Tan and So (2015) noted a paucity of research regarding the design configuration of mobile learning environments. Like Fulantelli, et al. (2014), Tan and So also considered the contextual-orientation of design important, viewing mobile design considerations as either context-oriented or process-oriented. Context orientation refers to both the embedded physical and social context of the environment, while process-oriented emphasizes the design of activity-types that aligns with learning objectives. Because learners are often accessing learning content from varied locations, content is often only relevant within a specific context (time and location). This time and geo-centric nature of mobile learning content requires instructional designers to expand their design to encompass a range of content, while also presenting opportunities for a variety of performance-based activities appropriate to the situational context. In this respect, a similarity with virtual worlds, simulations, augmented reality, and game-based learning becomes apparent. In each case, content may only be relevant to a learner within the situational context of specific objects or places within any of the complex learning environments. Tan and So also include one additional factor to the consideration of mobile learning, the social interaction context associated with the time, location, and reason for use of a mobile device.

HCI: Affordances and Mediation

Affordances

Gibson (1977) redefined visual perception affordances through an interactionist perspective based on an ecological psychological perspective as opposed to the status quo previously viewed in the psychology of perception. The view held by perceptual psychologists considered affordances separate from, and having no relationship with, the agent. Lacking any relationship decontextualizes affordances (Gaver, 1991), which is a major issue. Gaver explained contextualization of affordances with an example:

> In this account, affordances are the fundamental objects of perception. People perceive the environment directly in terms of its potentials for action, without significant intermediate stages involving memory or inferences. For instance, we perceive stairways in terms of their "climb-ability," a measurable property of the relationship between people and stairs. (Gaver, 1991, p. 79)

Gibson's (1997) interactionist perspective was concerned with interactions between an agent and its environment (Greeno, 1994); affordances based upon agent-environment interaction should be considered significant for complex design experiences that provide contextualized interactions within expressive storylines and virtual environments.

Norman (2002) appropriated the affordance concept McGrenere and Ho (2000) for the design of everyday objects (Norman, 2002), while Kaptelinin and Nardi (2012) looked at the concept of affordances as they pertain to HCI and offered an expanded mediated action perspective as an alternative to Gibson's (1977) approach. This view of technological affordances consists of a three-way interaction between the subject, the mediational means, and its environment that is based on a Vygotskian socio-cultural framework. Kaptelinin and Nardi also categorize affordances by type, including handling, effecter, aggregation, instrumental technology, auxiliary technology, learning, and maintenance affordance.

Mediation

Complex designs include far more interactivity and context than a navigational menu and occasional hyperlinks typically included in legacy eLearning courses. Kaptelinin (2015) suggests that complex designs mediate in a multidimensional and more complex way. Kaptelinin highlighted the close relationship mediation holds with Vygotsky's CHAT framework and phenomenology. This relationship is due to the common view that subjects and objects are inseparable from each other and form a triad relationship between the subject, the object, and the environment. Another key point made by Kaptelinin is that technological mediation is employed by more than individuals, but also by teams. This is significant when considering the discussion held in the Computer Supported Collaborative Learning (CSCL) section of this paper. Kaptelinin asserted that HCI mediation be viewed according to the subjects and objects of mediated activities, the levels and dynamics of mediation, and context within which the activities occur.

Gould and Verenikina (2003) pointed out human-computer interaction research is important because cognitive learning theories fail to recognize the differences between how computers and humans process information. To accept this assertion, research into instructional design competencies for CLDs should include queries into the mediating tools employed (Clemmensen, et al., 2016) and interface design (Fragoso, 2014) included by various CLDs.

Design Teams

Complexity of design often requires a different set of team members and processes that what was common for legacy instructional design processes and team composition. Twenty years ago, during the infancy of eLearning, a team might consist only of an instructional designer and a graphic artist. Design complexity has impacted the nature of design teams, their interactions, methodologies, cultural norms, design and development processes and technologies. This often requires adaptation to new group norms of process, terminology, tools, and work patterns, which is the basis of CSCL (Dillenbourg, Jarvela, & Fischer, 2009) and Computer Supported Collaborative Work – CSCW (de Laat, Lally & Lipponen, 2007) research into multidisciplinary design teams.

Additionally, it has become common for design teams to be geographically dispersed, potentially hindering effective collaboration and communication. Kauppila, Rajala, and Jyrämä (2011) described time differences, lack of face-to-face interaction, inter-functional barriers, and cultural barriers as key challenges in distributed work environments, while Koszalka, et al. (2013) addressed the problematic impact of the increasing level of design complexity.

No individual instructional designer can be expected to master all the knowledge and skill required by today's more complex instructional design experiences, and therefore, by inference, all IBSTPI instructional design competencies. This is manifested in the proliferation of multidiscipline design teams that include diverse sets of professional disciplines. Each of these disciplines brings different terminology, expectations, and cultural norms. Therefore, collaboration and clear communication amongst the various team disciplines becomes an increasingly important consideration and should be investigated as a potential competency of all instructional designers working on complex design projects (Phuwanartnurak, 2009).

Summary

Chapter 2 began with an overview of the topics covered followed by a more extensive exploration of the two most significant categories: frameworks and competencies. The two frameworks published by professional organizations that concentrate on instructional designer competencies are discussed: IBSTPI and AECT. Additional frameworks not connected to professional organizations are then discussed. These frameworks examine competencies for instructional designers, educational psychologies (EP), and serious game designers.

Competencies are then discussed. They have been defined in several ways: as demonstrable behaviors, as minimum standards of performance, and the underlying attributes of an individual – specifically their knowledge, skills, and abilities/abilities (KSAs). The latter perspective of competencies (KSA) guides this research.

This chapter then proceeds in a broad look at various learning theories relevant to the nature of this research topic. Knowles' andragogy is explored because adult learners are the focus of this research. Constructivism is the underlying epistemology informing the theories because the CLDs considered for this research all require participatory inquiry and activity on the part of individual learners. Cognitive load theory and complexity theory are discussed due to the complex nature of these instructional designs.

Examples of CLDs are then discussed. These examples include adaptive learning environments, problem-based learning, goal-based scenarios, game-based learning, educational simulations, augmented and virtual reality, and mobile learning.

The chapter concludes with a brief review of the affordances various technologies provide instructional designers and their teams. The importance of designing appropriate human computer interaction (HCI) is discussed in light of the differences in the way that computers and humans process information. These factors emphasize the importance of HCI design and testing. They also highlight the need to ensure there is sufficient team collaboration and communication between the various disciplines within a team are incorporated within the design and development process.

Chapter 3
Methodology

Overview

Previous competency framework studies were evaluated in Chapter 2 in order to identify the various methods used in creation of competency frameworks. The methods included job announcement analysis (Ritzhaupt, Martin, & Daniels, 2010; Sugar, Hoard, & Brown, 2012; Ritzhaupt & Martin, 2014; Kang & Ritzhaupt, 2015; and Ritzhaupt, Martin, Pastore, & Kang (2018), Delphi method (Daniels, Sugar, Abbie, & Hoard, 2012), semi-structured interviews (Yanchar, 2014), and online surveys followed by interviews (Ritzhaupt & Kumar, 2015).

Jakubowicz (2006) pointed out the limitations of data analysis based solely on quantitative research, where a more in-depth perspective may be obtained through qualitative data obtained during semi-structured interviews. To identify as broad a base of competencies, an online component was beneficial. To meet these goals, a design and development method (Creswell, 2015; Richey & Klein, 2007) approach that employed both qualitative and quantitative methods was selected that included an online survey based on Ritzhaupt and Kumar's (2015) Educational Technology Multimedia Survey (ETMCS). Data from the ETMCS was combined with semi-structured interviews (Yanchar, 2014) to provide the in-depth perspective Jacubowicz suggested for the development of the competency framework.

Four phases were implemented in this approach, with the method of each phase providing "complementarity" (Greene et al., 1989) to the previous phase. The phases include: 1) Survey Administration, 2) Preliminary Framework Development, 3) Semi-structured Interviews, and 4) Framework Internal Validation. Each of these phases is described in more detail in the following paragraphs.

Institutional Review Board (IRB) Sign-off

Prior to initiating the research, a review of the intended research by the Institutional Review Board (IRB) was required. Upon completion of this review, consent was received to proceed with the prescribed research. Appendix A provides a copy of the IRB Memorandum approving the research. The IRB further determined that the study was exempt from further IRB review under 45 CFR 46.101(b) (Exempt Category 2).

Phase 1: Survey Administration

The first phase involved collection of data through an online survey tool using Ritzhaupt and Martin's (2014) ETMCS validated survey instrument. During this phase, the goal was to recruit a sample of approximately 400 self-identified instructional designers from a population of approximately 7,700 LinkedIn connections. The sample size was determined based on the guidance provided by Gay, Mills, and Airasian (2009, p. 133) who suggest that 400 is adequate when dealing with populations above 5,000. Of the 580 respondents who agreed to participate, 420 completed 105 items contained in the survey

The purpose of the survey phase was twofold: to obtain Likert scale rating data of instructional design competencies for the creation of CLDs; and second, to screen participants who have first-hand experience designing CLDs that are suitable and willing to participate in phase two follow-up questions. At the end of the ETMCS survey questions, a follow-up question asked whether they were willing to participate in 30-45-minute follow-up interviews.

Survey Instrument

Ritzhaupt and Martin's (2014) ETMCS survey instrument was selected for this study. The ETMCS instrument was created to identify educational technologist multimedia competencies and was developed in three steps: a literature review used to identify knowledge, skills, and abilities (KSA). The second step was an analysis of 205 educational technology job announcements collected during a three-month period from the AECT database, ASTD database, CareerBuilder, Chronicles of Higher Education, the eLearning Guild, Higher Education Jobs, the ISPI database, and Monster. Job titles included both "Educational Technologist" and "Instructional Designer" terms, while all announcements included the term "multimedia." The third step involved a review of each competency by three professionals within the field of educational technology using a five-point Likert scale to assess the competency statement's importance.

Despite this validation process, as Ritzhaupt and Martin (2014) noted, the ETMCS has limitations, one of which stems from its reliance on analysis of a relatively small sample of job announcements. The effect of this limited sample impacts the completeness of the survey questions. Ritzhaupt and Martin (2014) explained this limitation saying: "Some areas (e.g., evaluation) may not have been as well-represented on the survey if the information was not readily accessible in the job announcements themselves. This limitation is likely to limit the full depth and richness of data sought in this study" (p. 25). Jakubowicz highlighted the impact of insufficient data depth and richness stating that studies analyzed from a "…strictly quantitative [data] perspective, the [quantitative] results of student interactions do not do justice to the rich variety of topics that the students covered" (2006, p. 14).

Jakubowicz' observation highlighted the need to develop a more in-depth understanding of the data than just a statistical analysis of the number and type of response to survey questions. This observation is worth remembering when considering the merits of including qualitative methods in this research. Ritzhaupt and Kumar (2015) mitigated the limitation of sole reliance on quantitative data by following up with in-depth interviews, which was the same approach used in this research. Permission to use the ETMCS instrument was obtained and is documented in Appendix B.

Survey Participant Recruitment

Recruitment of survey participants was based on the approach used by Wakefield, et al. (2012) who recruited from a pool of LinkedIn professionals. LinkedIn was an appropriate source for participants due to its more inclusive set of instructional designers which included those working in higher education, corporate, healthcare, government, military, non-profit, and other work domains.

This pool of instructional designers fit with the desired participant experience profile of this research. LinkedIn "connections" are other members (instructional designers, educational technologists in this case) who mutually agree to connect personally with others. Connections are likely to be dispersed demographically and geographically and perform their design work in various technologically mediated environments (blended, online, networked, desktop, and on-site). When combined with the variety of professional work environments that employ the participants, a more balanced distribution was provided to the sample pool.

This researcher has been active in LinkedIn and currently has in excess of 12,000 connections with other instructional designers, educational technologists and other professionals holding similar job titles from government, military, higher education, and what have been called the “professional services” work domain (Williams van Rooij, 2012). LinkedIn provided a large pool of potential participants, which increased the likelihood of obtaining a statistically significant response to the call for participation. Also, recruiting connections from the variety of professional work domains found in LinkedIn diminished the likelihood of researcher bias toward any specific domain. This was important as researcher bias toward specific work domains has been documented as a limitation of previous studies that recruited primarily from higher education (Ritzhaupt & Martin, 2014). Participants were provided all appropriate consent and confidentiality forms required by the IRB prior to participation in the survey administration, semi-structured interview, and internal framework validation phases of the study.

The survey’s pool of connections was recruited directly using the LinkedIn website’s individual and group “connections” functionalities. A personal invitation was sent, via LinkedIn’s internal chat functionality, to personal connections. All connections were screened to ensure they met appropriate experience and job title criteria. Each personal invitation contained a cover letter explaining the research (Appendix C), along with a link to the online survey, where further information was provided about the research, the expected level of anonymity, and other rights. The initial recruitment employed direct solicitation of a random sample of 2,501 LinkedIn connections already connected with this researcher. The goal was to obtain at least a 15% sample (approximately, N=375) from this population which is consistent with the N=400 suggested by Gay, Mills, and Airasian (2009, p. 133) and the 420 respondents that completed each section of the survey. The subset of connections was screened to ensure they met appropriate experience and job title criteria. If a high enough response rate had not been obtained, then an alternative approach would have been employed. Terrell (Terrell, 2012, p. 22) suggested obtaining responses from at least 30 participants that had design experience with a wide range of CLDs (i.e., simulations, adaptive learning, game-based learning, AR/VR, etc.) would be a sufficient alternative.

Use of Online Survey Technology

The eSurv.org online survey platform was used for development, delivery, and initial analysis of survey data. eSurv.org is a higher education institution-backed survey research platform provided free for students and educational institutional use. Structured and open-ended questions, unlimited questions and responses, and question and answer piping functionality were part of the functionality that was provided as part of the service. Results were exported to spreadsheets in Excel and PDF formats for import into Quirkos qualitative data analysis software.

Consent to Participate in Survey

Initial contact with prospective survey participants consisted of a text message that included a hypertext link to the online survey along with a brief description of the survey (Appendix C). The text was sent via LinkedIn messaging with the complete details included within the online survey's initial section (Figures 3-7 in Appendix D). This section discussed the goals and importance of the research, the methodologies that were employed, the levels of confidentiality/anonymity that were provided of personal data collected from participants, the expected amount of time each survey participant should have set aside for participation, and the lack of any compensation expected for participation in any phase of the research (except access to the full results of the research if requested). At the completion of the introductory section, the participant was asked to check a box indicating their willingness to participate in the survey. The participant was only able to proceed to the survey questions after selecting the check box indicating their understanding and agreement to participate.

Design of Online Survey Instrument

The survey phase consisted of an introduction to the research section and three blocks of questions: those that inquired about each respondent's job, demographic and experiential backgrounds, and those that asked respondents to rate competencies they perceived to be important for design of complex projects (Appendix D). An open-ended question was asked at the end of each set of competency domains. The question asked a variation of the following: "In your opinion are any [knowledge/skill/ability] competencies for the instructional design of CLDs missing from this list? If so, please identify each and discuss your rationale for including this competency."

Employing the functionality of the Quirkos software, text analysis identified commonly used words and phrases in the responses to these questions. Text analysis, along with the answers to the open-ended competency questions, provided insight into which competencies were prominent or missing and deserved follow-up questions in the interview phase of this research.

The second block of questions consisted of questions originating from the ETMCS survey instrument (Appendix D) and were presented in a Likert scale that measured respondents' perceived level of importance for each competency item. A five-point scale of importance (Ritzhaupt & Martin, 2014; Daniels, Sugar, Abbie, & Hoard, 2012) was used. Appendix D provides screenshots indicating the online survey layout, interface, and presentation of these questions and competency items. Competency items were presented in a clickable matrix format to reduce respondent burden and fatigue (Ruel, Wagner, & Gillespie, 2016). Competency statements constituted the matrix rows, while the Likert scale rating levels constituted the matrix columns.

For this importance scale, the five categories are listed below and shown in an example survey results matrix layout (Table 2):

1. Not important (N-IPT)
2. Somewhat important (S-IPT)
3. Important (IMPT)
4. Very important (V-IPT)
5. Essential (ESS)

Table 2
Example of Knowledge Domain Survey Matrix Layout

Knowledge Domain	Importance (low < high)				
Complex Knowledge Competencies	N-IPT	S-IPT	IMPT	V-IPT	ESS
Cognitive theories of learning	4	22	93	135	200
Instructional design models	7	73	161	139	74
Web authoring tools (e.g., Dreamweaver)	51	116	125	108	54

Survey Data Analysis

Survey data was analyzed for both nominal (percentages of age, gender, experience) and ordinal (Likert scale rating each competency statement) data (Jamieson, 2004). Statistical calculation of the median and mode values for each Likert scale item identified the competencies that formed the basis of the preliminary CLD framework.

Phase 2: Preliminary Framework Development

The second research phase consisted of construction of the preliminary CLD competency framework. The framework was based on two of the three structural levels (domains and competencies) included in the IBSTPI Instructional Designer Competency framework (Koszalka, et al., 2012). The third level, performance statements was not included because assessment of performance statements was beyond the scope of this study.

The CLD framework includes the following components: competency domains, competency statements, and the classification of each competency as either essential or desirable. Koszalka, et al. (2012) organized competencies into three categories: essential, advanced, and managerial. For purposes of this study, two categories were used: essential and desirable.

Domain Level

To create the domain level of the framework, the essential and desirable competencies were grouped according to the general topic each competency addressed. To establish a hierarchal structure similar to that found in the IBSTPI framework, the competencies were grouped into (seven) domains. These domains were categorized as follows: Standards and Requirements, Analysis and Assessment, Design Models and

Methods, Learning Theories, Communication and Collaboration, Software and Technology, and Organization and Management.

Competency Criticality

The criticality level of the framework was based on responses to the survey. Park and Luo (2017) used the five-point Likert scale from the ETMCS survey referring to levels of criticality where five was the most critical and a value of one was the least critical. Mode and median values were calculated to determine which were considered essential (Most critical) and desirable (somewhat critical) for the instructional design of CLDs (Appendix E). For inclusion in the framework, essential competencies were defined as having median and mode (central tendency) values of only 4 or 5. Desirable competencies were defined as having at least one median or mode value of 3 with the other measures returning values greater than or equal to 3. Any competencies not meeting either of these criteria were excluded from the framework.

Framework Presentation

At the conclusion of the second phase of research a preliminary framework was developed and presented in a tabular format. The essential knowledge, skill, and ability competencies that formed the initial framework's tabular format was similar to Table 6.5 of the IBSTPI Instructional Designer Standards (Koszalka, et al., 2013, p. 127). Each competency was defined as either essential or desirable (based on each competency's median and mode values) competencies.

Phase 3: Semi-Structured Interviews

The third research phase involved semi-structured interviews conducted over the phone with a subset of survey participants. Interviews were recorded and transcribed. The purpose of this phase was two-fold. First, the questions were aimed at identifying themes and examples of each competency item classified as *essential* from the survey analysis phase. The goal of these questions was to develop a fuller understanding of the types of activities respondents performed for competencies identified as essential. This was deemed important since the competencies identified through the ETMCS survey provide a somewhat generic view.

Participants were also asked to describe in more detail what they felt made a learning design complex. The interviews sought to identify common factors that influenced the level of complexity found in the range of different types of CLDs.

At the end of each competency matrix (K, S, & A) portion of the survey, a final open-ended question asked respondents to identify key competencies they believed were not included in the survey matrix. Responses to this question formed additional follow-up questions during the interviews.

Interview Participant Selection Criteria

Interview participants were selected randomly from the survey pool who indicated experience in the design of one or more CLD. Additionally, all interview participants responded affirmatively to a survey question that asked if they were willing to participate in a follow-up session consisting of semi-structured interviews.

Potential participants were selection from the pool of respondents who completed the survey, indicated agreement to participate in the interviews, and had experience with instructional design of complex learning. This criterion was based on that used by Ritzhaupt and Kumar (2015) along with two additional criteria tailored to this research pool. The combined criteria consisted of the following:

1. Each participant indicated his or her job title as either “instructional designer,” “learning designer,” “eLearning Specialist” or similar job titles that indicate job duties equivalent to that performed by instructional designers, or otherwise involved in the instructional design process.
2. Each participant had at least three years of experience in the role as an instructional designer or equivalent job title.
3. Each participant was available for online or in-person interviews.

There were two additional criteria relevant to this research. The additional criteria include the following:

4. Each participant indicated having performed design work on at least one CLD.
5. Each participant identified competencies for the design of CLDs in their responses to the ETMCS survey instrument.

Survey participants who met these criteria and indicated a willingness to participate in the interviews were identified and a purposive sample of ten respondents were asked to participate in the interviews. Participants were informed of the interview procedure, its likely duration, and the approach taken to ensure confidentiality according to IRB requirements. The explanation was provided to the potential participants along with the initial request for participation.

Informed Consent for Interviews

Survey participants were provided an opportunity to express their willingness to participate in the interview phase of the research by answering a question and indicating their preferred contact method. This consent procedure is documented in Appendix D.

Interview Procedure

The semi-structured interview approach employed by Yanchar (2014) during research of informal learning practices of instructional designers was employed. Interviews were conducted by IP phone calls to reduce the need for travel and accommodate time zone differences.

Consent was obtained prior to initiation of the interview (Appendix F), with all required IRB notices and permission forms were signed and each participant was reminded about the content of the IRB notices and forms and that the interview would be recorded and transcribed for later analysis.

The first part of each interview asked respondents to describe what they perceived as a complex instructional design. Questions focused on each participant's background, daily work practices, and experience with complex instructional designs. Of particular interest was the attributes that made the design complex, which was then followed with questions eliciting examples of CLDs.

The second part of the interview process identified the types of activities instructional designers performed while designing CLDs that differed in some degree from activities typically performed in less complex designs. They were generally open-ended in nature in order to elicit summative and reflective responses. This approach provided opportunities for further exploration though follow-up questions.

An iterative approach to conducting interviews, as suggested by Miles, Huberman, and Saldaña (2014), was employed. Reflection provided an opportunity for the researcher to consider the responses obtained and adjust follow-on questions accordingly. In many cases second interviews were performed. The overall purpose of a second interview was to encourage participant reflection as well as completion of questions left unanswered from a first interview. Examples of interview questions are found in Appendix G as well as the following four examples:

1. “Please describe a project requiring a CLD.”
2. "Why do you consider that particular learning design complex?”
3. “What new instructional design knowledge, skills, or abilities tasks (KSAs) did you gain from the design of CLDs?”
4. “What KSAs do you need to improve to more effectively design CLDs?”

Interview Data Collection

Interviews were conducted using Skype and MP3 Skype Recorder software. This method enabled digital recordings of each conversation. The digital audio files were then sent to a professional transcription service for conversion to Microsoft Word files.

Some of the interview participants expressed a preference for extending the first interview instead of participating in a second interview. This required a shift in approach that proved to be equally effective in obtaining additional interview data to clarify examples and better document activities participants performed for each essential competency. After completion of each interview, the data was transcribed and imported into Quirkos, a computer assisted qualitative data analysis software (CAQDAS). Preliminary coding occurred prior to interviewing the next participant, in accordance with the approach suggested in Miles, Huberman, and Saldaña (2014) when they stated: “In this view, qualitative data analysis is a continuous, iterative enterprise. Issues of data condensation, display, and conclusion drawing/verification come into play successively as analysis episodes follow each other” (p. 14).

Qualitative Coding

Miles, Huberman, and Saldaña (2014) view qualitative data analysis as three categories of concurrent activity: data condensation, data display, and drawing and verifying conclusions. Miles, Huberman, and Saldaña (2014) indicated two approaches to creating codes: deductive and inductive. A bottom-up (deductive) approach began with the central tendency values of competencies calculated from the phase one survey results. This data provided the means to construct the preliminary framework from the set of competency domains. This set of domains and their associated competencies were adjusted iteratively as the analysis proceeded.

Computer Assisted Qualitative Data Analysis Software (CAQDAS)

Numerous CAQDAS software were reviewed and analyzed for their cost, ease of use, and feature set. After completion of this review a demo version of Quirkos was downloaded, tested, and selected for use. Quirkos offered a set of features comparable to those found in other CAQDAS alternatives, A key factor that differentiated Quirkos was the highly visual and intuitive approach to data management and analysis, support for drag-n-drop, color coding, and student-friendly pricing. Analysis of Quirkos software's process and functionality fulfilled the three categories listed by Miles, et al. (2014) and compared well with those found in higher priced CAQDAS offerings prompting the selection of Quirkos as the CAQDAS software for this study. Data was password protected to ensure the anonymity and confidentiality of interview participants. In addition, anonymity was protected through exclusive use of ID codes associated with each participant's transcript(s). Numerous options are included in reports. Coding documentation was exported to Excel format, while narrative reports were exported to PDF format.

Interview Data Refinement Process

Interview data were transcribed and analyzed sequentially, with data from the first interviews analyzed before collecting data from subsequent interviews. The iterative nature of a data collection and analysis process enhanced the likelihood that gaps in understanding were recognized and explored during the second interview.

Merriam (2016) described a three-part process of data refinement: constructing categories, sorting categories and data, and then naming the categories, while Yanchar (2014) proposed a more extensive set of steps for refinement of qualitative data obtained from the semi-structured interviews. The following eight-step analysis process suggested by Yanchar (2014) is consistent with an iterative approach to data gathering and analysis process and used in this research. The eight steps follow:

First, gaining a sense of the whole by reading the interview transcripts and identifying preliminary themes. Interview transcripts were imported into Quirkos. Source properties such as personal demographic data obtained from the survey's demographic questions (e.g., gender, years of experience, job title, etc.) were associated to each imported transcript. Identifying themes from each interview began by highlighting passages of quotes in the source pane that are interesting (Seidman, 2006, p. 117). Using open coding, initial themes categories (Merriam, 2016) were identified by selecting the text and providing a representative theme (Yanchar, 2014) or "category" (Merriam, 2016) label. To identify preliminary themes, each code was given a Title and highlighted with a color code. As each transcript was reviewed, each code was selected and associated with an already existing theme or named as a new theme. This iterative process continued until every transcript's text codes had been reviewed and categorized. This resulted in a visual representation of the data with the more commonly associated themes larger than those less commonly associated. In this way a sense of the whole began to emerge.

Second, refining these preliminary themes into more formal themes, through merging, splitting, deleting, adding, editing, etc. This was a nearly continual, iterative process that was revisited after every transcript was initially coded. Themes were renamed and new themes either replaced or were created to represent new perspectives.

Third, comparing and contrasting themes to look for connections among them, while continuing to refine. Visual relationships became apparent in the software, such as relative size and proximity among the themes led to refinement and re-categorization textual codes. In cases where connections were apparent axial coding, defined as a "process of grouping your open codes is sometimes called axial coding or analytical coding." (Merriam, 2016, p. 206), was used to identify relationships such as parent-child or peer relationships.

Fourth, organizing themes according to meta-themes and placing them into an overall thematic structure, while continuing to refine themes and meta-themes. As the interview data are further refined by axial coding into meta-themes, they became further refined by comparing them against the ETMCS competency domains and statements, which created the preliminary domains for the CLD framework. Since the interview questions asked specific examples of ETMCS competency statements a set of complex instructional design examples and activities were revealed which tied the interview and survey data into a more cohesive thematic competency framework structure.

Fifth, selecting illustrative quotes from the transcripts to exemplify themes developed in steps 1-3.This step required/5 a subjective analysis of what examples are representative and important to highlight in the research report. The results of this step can be viewed in Chapter 4, page 114, in the Phase three results: Semi-Structured Interview Data section.

Sixth, considering each theme and meta-theme in light of the whole and continuing to refine. Themes were renamed, and often merged with other themes to create a new meta-theme. Examination and refinement of similarities between data obtained from the interviews and the ETMCS survey themes continued.

Seventh, considering the whole in light of each theme and meta-theme and continuing to refine. This step involved going back and reviewing codes and their underlying data in a continual process of comparison between the clarification obtained from interview and data gathered during the ETMCS survey questions. This comparison then was questioned in light of the emerging CLD domains and each of their competencies.

Eighth, examining the coherence of the overall thematic interpretation and refining the overall structure (Yanchar, 2014, p. 276). At the completion of this eight-step process, a revised framework of CLD competencies was apparent. Criticality factors obtained from the survey data guided this understanding; however, the qualitative data obtained from the interviews supplied examples, processes, and personal opinions that provided context and depth to the themes that comprised the preliminary CLD framework.

Phase 4: Framework Internal Validation

Phase four involved internal validation of the CLD competency framework. Richey and Klein (2007) define internal validation of a design and development model as validating the integrity of the design model, its components and its processes. Ten panelists were recruited to serve on the panel. Nine completed all rounds. Validation was conducted using an expert panel employing the Delphi method (Daniels, et al., 2012; Hassan, Keeney, & McKenna, 2000). The Delphi technique was selected for its ability to be conducted using technology capable of timely and efficient data collection from a geographically dispersed panel. This method was also selected due to flexibility of the method. Researchers have employed Delphi techniques in a wide array of research including structuring of models (Linstone and Turloff, 1975) and development of descriptive frameworks (Skulmoski, Harman, & Krahn, 2007).

The panel consisted of experts with varying experience in the design of CLDs. The panel was selected using a purposive sample strategy (Hasson, 2000). The panel consisted of nine instructional design experts with extensive experience in the design of CLDs. Eight of the nine panelists held doctoral degrees in their specialization, while the remaining panel member held two master's degrees and extensive personal experience with CLD design. Adler and Ziglio (1996) suggest four requirements for possessing "expertise": (1) Knowledge and experience with the issues under investigation; (2) capacity and willingness to participate; (3) sufficient time to participate in the Delphi; and (4) effective communication skills. All panel members were provided information that ensured, according to Adler and Ziglio's criteria, their ability to participate fully on the panel. The Delphi process followed the application of the Delphi method used by York and Ertmer (2011) in their research of instructional designer heuristics.

Expert Panel (Delphi) Technique

Three rounds of panel feedback were employed for validation of the framework. The first round was a slight variation of the classical Delphi method developed by Norma Dalkey of the RAND Corporation (Skulmoski, Harman, & Krahn, 2007). Unlike the classical Delphi method which starts with a single question, this validation consisted of a question regarding each competency. The question asked about each competency was whether it should be considered essential, desirable, or neither (not included in the framework). The notional framework competencies were presented in a 5-point Likert scale format with comment fields available for each category of competencies. To maximize efficiency of design, the validation's interface mirrored much of the features employed for the ETMCS survey.

Rowe and Wright (1999) list four features to the classical Delphi method:

The first feature is maintenance of panel member anonymity. The Delphi panel responses were evaluated using the eSurv.org Web 2.0 survey platform. Anonymity has been maintained amongst panel members by two means: (1) through use of personalize ID codes and (2) by providing access to only aggregated results to the panel members during rounds two and three. Post-dissertation confidentiality was maintained with all data by the researcher as described in the next section about storage of research survey data.

The second feature is iteration through multiple rounds. Three rounds were employed to reach consensus. Competency items were added to the validated framework and removed for further consideration once consensus was reached for that item.

The third feature is controlled feedback. Feedback comments received from panel members during each round were included (with no attribution to any panel member) with each competency framework item for viewing in the next round.

The final feature is the statistical aggregation of group responses. The aggregate responses for each round were provided to panel members in the next round. This allowed each panel member the opportunity for reflection and possible modification of their competency evaluation.

Expert Panel Consensus

By its very nature, expert panel consensus varies substantial, ranging from 55% to 100% (Powell, 2003) in some cases. However, most of the studies reviewed for this research tended to report a range of 67% to 80%. Hallowell and Gambastese (2010) say it isn't practical to expect a single consensus threshold for all expert panels using the Delphi method, while Hsu and Sandford (2007) state that researchers must define consensus beforehand. In this study, consensus is defined as having 75% or greater panel members agree on the rating for an essential competency. Consensus for desirable competencies was defined at a lower rate of 67%. Thus, with a panel consisting of nine members, consensus was reached for essential competencies once 7 of the 9 members rated a competency essential and when 6 of 9 rated a competency as either essential or desirable. Consensus was determined for both inclusion and exclusion of competency items from the framework. Positive consensus competencies (essential or desirable) were added to the framework, while negative consensus competencies ("Neither") were removed from further evaluation.

Nine experts were recruited to participate in the Delphi panel. Panel members were considered expert due to their years of experience within the Instructional Design profession, their instructional design-related advanced degrees, and their experience with the design of one or more category of CLD. The number of panel members ensured that more than one dissenting panel member was required to negate consensus. Nine panel members would require 3 panel members to drop the competency's percentage below 75%, which would negate consensus of the item

Storage of Research Data

Protection of anonymity and confidentiality was foremost in the mind of this researcher. Toward that end the following actions, which are consistent with those take for the semi-structured interviews, were taken to ensure data security:

1. Participant data has been securely stored throughout the research process and will continue to be stored for 36 months after completion of the research.
2. Only the researcher has had access to legacy data that contains personally identifiable information. These data were collected on a single computer that was only used by the researcher.
3. Survey data was collected and stored by the eSurv.org website that connects through a Secure Socket Layer (SSL) server, requiring a password for access.
4. A removable hard drive houses all survey and interview data. Survey and analysis data were downloaded to the removable hard drive from eSurv.org.

Summary

Chapter 3 provides an overview of this study's four phases. The phases consist of a validated online survey instrument, semi-structured interviews, framework development, and framework validation. The survey was conducted online using the functionality of esurv.org and based on the ETMCS survey instrument (Ritzhaupt & Martin, 2014; Ritzhaupt & Kumar, 2015). Practicing instructional designers and educational technologists were identified through LinkedIn connections. LinkedIn offered a wide pool of instructional designers and educational technologists including practitioners from numerous work environments, including professional services, government, military, healthcare, K12 schools, corporate, non-profit, and higher education domains.

The survey consisted of three sections: (1) an introduction and explanation of the research, (2) demographic questions, (3) level of experience questions, and (3) a rating of all 105 ETMCS competencies. The ETMCS survey instrument was developed based on analysis of educational technology job postings and then validated by presenting the survey instrument to working professionals for evaluation of each competency statement using a five-point criticality scale which was based on a Likert scale with one representing a competency statement having the lowest level of importance and five the highest level of importance (Ritzhaupt & Martin, 2014).

A preliminary CLD competency framework was created during the second phase. The preliminary framework was constructed by organizing competencies identified as either essential or desirable based on each competency's median and mode values calculated during the survey phase.

The third phase consisted of a series of semi-structured interviews which clarified the findings reinforced survey data and gave breadth to the narrative provided about the framework in this document. Interview questions consisted of a set of open-ended questions, with follow-up questions varying according to individual responses to the initial set of prescribed questions. The fluidity of this approach is consistent with that suggested by Yanchar (2014). These questions fostered a better understanding of the personal experiences of respondents who have participated in the design of CLDs. Toward that end, this chapter discusses the participant selection criteria, interview approach, data analysis, and qualitative coding approaches taken during this design and development research. A discussion of the Quirkos data analysis software was provided to illustrate how the software was used to facilitate various processes in the data analysis.

Anonymity of data from all research phases was facilitated through daily backup and storage of data in both a primary hard drive and an external hard drive dedicated to this research and available only to the researcher. The chapter concludes with discussion about delivery formats, research milestones, and required resources.

Chapter 4
Results

This chapter presents the results obtained in each of the four phases of this research: Survey Administration, Preliminary Framework Development, Semi-Structured Interviews, and Framework Internal Validation. Results are discussed sequentially by phases.

Phase 1: Survey Administration

Invitations to participate in the online survey were sent to 2,401 of the researcher's LinkedIn professional connections. 583 respondents initially agreed to participate. Of the 583 respondents, 485 completed all or most demographic and experience questions, while 420 completed the full survey consisting of the demographic and experience level questions, along with 105 competency questions. The cumulative responses are divided into three sections: Respondent Demographics, Respondent Experience, and Competency Ratings. Though 583 consented to complete the survey not all respondents navigated through the survey to every question. This drop-out rate accounts for the variance in N values provided for each of the following survey questions. Additionally, a varying number of respondents chose to skip answering specific questions, while proceeding further in the survey and answering subsequent questions.

Respondent Demographics

<u>Respondent nationality</u>: Four-hundred sixty-seven respondents answered all or part of the survey, while 98 skipped answering the nationality question. Survey responses were received from ten countries, with 44.79% from the United States, 15.83% from India, 11.78% from Canada, and 4.25% from both the United Kingdom and Australia. Other responses originated from Egypt, Russia, Singapore, New Zealand, and France. Several respondents included the United States, Canada, India, Australia, and the U.K. in the "Other country" response option. Table 3 shows the respondent nationality data.

Table 3
Respondent Nationality

Nationality	Responses	Percentage
United States	224	44.71%
India	81	16.17%
Canada	57	11.38%
United Kingdom	22	4.39%
Australia	19	3.79%
Other (Egypt, Russia, New Zealand, Singapore, and France)	98	19.56%

Note. The total number of responses (N) for this question was 467.

<u>Official job title</u>: Of the 482 total respondents, 476 responded to this question. A majority held titles of instructional designers, or a close facsimile of that. Other job titles fit into two other primary categories: educational institution roles (e.g., principal, faculty, grad student) and managerial roles working in various work domains (e.g., manager, supervisor, and director). Table 4 summarizes this data, detailing the various job titles in the sample, while also indicating both the per title response, its percentage of the whole, and the total N for this set of questions, which is shown below the table.

Table 4
Respondent Job Titles

Title	Responses	Percentage
Game Designer	3	0.62%
Higher Education	18	3.73%
Independent Contractor	27	5.6%
Instructional Designer	337	61.92%
K12	5	1.03%
Management	74	15.35%
Miscellaneous	3	0.62%
No Answer	6	1.24%
Technical	9	1.87%

Note. The total number of responses (N) for this question was 482.

Supervisory responsibilities. CLDs often require a multitude of professions working together. In such cases, some level of management/supervision is necessary for proper communication and collaboration. Table 5 shows the response rates to the question asking if supervisory duties were part of their job description.

Table 5
Supervisory Duty Data

Supervisory Duties	Responses	Percentage
No	299	58.14%
Yes	170	41.86%

Note. The total number of responses (N) for this question was 469**.**

Supervisory duty often falls on instructional designers who may be called “Senior” or “Lead” Designer. Similarly, in large scale work environments often associated with CLDs an instructional designer may only perform managerial functions while others in their team perform typical instructional design duties. In such cases an instructional designer may have an entirely different job title indicating some level of management. To better understand this aspect of the survey sample, a follow-up question inquired whether respondents were charged with any supervisory responsibilities. As indicated in Table 5, of the 469 respondents who answered this question roughly 41%

perform some degree of supervisory duties, while 58.14% did not perform supervisory duties.

Gender. It is interesting to note that ninety-six of the 469 (N) respondents felt it necessary to withhold their gender for this survey, choosing not to answer this question.

Table 6
Respondent Gender

Gender	Responses	Percentage
Female	272	58.14%
Male	197	41.86%

Note. The total number of responses (N) for this question was 469**.**

Questions in the next section deal with the level of respondents' general instructional design experience as well as their experience designing CLDs.

Respondent Experience

Instructional design experience: 469 participants responded to the survey's question about their years of ISD experience, while 96 declined to answer the question. Fifty-one percent reported more than 10 years of experience in instructional design or closely related professions, with 88+% having more than three years of experience.

Table 7
Instructional Design-related Experience (in years)

Years of ISD Experience	Responses	Percentage
10+	239	50.96%
4-6	91	19.40%
7-9	87	18.55%
2-3	42	8.96%
0-1	10	2.13%

Note. The total number of responses (N) for this question was 469**.**

Experience designing CLDs: 467 respondents indicated their levels of experience with various types of CLDs. The options presented to the respondents included educational simulations, mobile learning, and six additional options. Respondents were provided nine options plus an open-ended option labeled "Other," which was composed of a wide-ranging variety of CLDs. Table 8 indicates the experience respondents have designing each type of CLD.

Table 8
Experience with CLDs

Complex Designs	Responses	Percentage
Educational Simulations	354	20.53
Branching logic scenarios	343	19.90
Educational games	280	16.24
Mobile Learning environments	242	14.04
Level 3 or 4 IMI	215	12.47
Adaptive training systems	114	6.61
Virtual reality	62	3.60
Other	59	3.42
Augmented reality	55	3.19

Note. The total number of responses (N) for this question was 467.

Four hundred eighty-three respondents answered the question, while 100 declined to answer the question. All eight of the options returned reasonable levels of experience. In addition, 59 responses defined Other complex learning designs.

<u>Experience in various work environments</u>: Four hundred seventy-eight respondents answered the question indicating their experience in various work environments. Table 9 indicates that the corporate work domain was the most common instructional design environment, with the higher education domain as the next most common. Professional service firms and independent contractors comprised the next tier of work environments. Government and military work domains were the other work environments with significant percentage responses. The open-ended Other option includes instructional designers working in healthcare, K-12 education, cyber/virtual

education, banking, finance, insurance, non-profit, construction, manufacturing and banking work environments. 414 of the respondents indicated they had worked in multiple work domains during at some point in their career. Other work domains included healthcare, K12 Education, and cyber/virtual education, banking, finance, insurance, non-profit, construction, and manufacturing (Table 9).

Table 9
Work Domain Experience

Work Domain	Work	Percentage
Corporate work domain	205	30.6
Higher education domain	169	25.22
Independent contractors	80	11.94
Professional services firms	76	11.34
Military work domain	48	7.16
Government work domain	48	7.16
Other work domains	44	6.57

Note. The total number of responses (N) for this question was 462**.**

Essential and Desirable Competency Ratings

The ETMCS rated competencies on a five-point Likert scale, resulting in ordinal statistical data. The median and mode were selected as the most appropriate values for measuring central tendency of ordinal (ranked) data sets (Terrell, pp. 50-51).

Essential competencies were defined as those whose measures of central tendency returned only values of “Very Important” (4) or Essential (5). Desirable competencies were defined similarly to essential competencies, except there was allowance for one measure returning a value of “Important” (3). ETMCS competencies that returned any median or mode value less than “Important” (3) were excluded from the framework.

Twenty-six competencies did not meet the defined criteria for essential or desirable and were therefore excluded from the preliminary framework.

A total of 76 essential and desirable competencies were included in the initial framework. A total of nine knowledge competencies, 12 skill competencies, and 18 ability competencies returned median and mode values sufficient to be deemed essential competencies. There were 24 knowledge competencies, nine skill competencies, and four ability competencies that returned median and mode values sufficient to be considered desirable competencies. Tables 10 – 15 list knowledge, skill, and ability (KSA) competencies by their survey question number ("ETMCS #") and indicate the calculated mode and median values of the essential and desirable competencies.

Essential Knowledge Domain Competencies

The ETMCS survey asked respondents to choose from among 43 competencies. Of those knowledge competencies defined as essential, nine returned median and mode values of 4 or 5 on the Likert scale, and were considered essential if either the mode or median values were within the Very Important (4) and Essential (5) scale values.

Essential knowledge competencies are listed in Table 10. Three of the essential competencies deal with theory associated with instructional design, three are technology-centric, two deal with laws, and one relates to assessment.

Table 10
Essential Knowledge Competencies

ETMCS #	Knowledge Competency	Median	Mode
16	Cognitive theories of learning	4	5
17	Motivation theories (e.g., ARCS)	4	4
18	Adult learning theory	4	5
22	Accessibility (e.g., Section 508)	4	4
23	Copyright laws	4	5
25	Assessment methods	4	5

Essential Knowledge Competencies (continued)

ETMCS #	Knowledge Competency	Median	Mode
38	Screen recording software (e.g., Captivate or Camtasia)	4	4
39	Educational authoring software (e.g., Captivate or Articulate)	4	5
40	Course/learning management systems (e.g., Blackboard or Moodle)	4	4

Note. The total number of responses (N) for these competencies was 439.

Desirable Knowledge Domain Competencies

Knowledge competencies that returned at least one central tendency of three (Important) are defined as desirable competencies. Twenty-two knowledge competencies returned mean and mode values that met this definition. Nineteen of these competencies dealt with software and technology, while two dealt with standards, and one dealt with law (Section 508). Table 11 lists the desirable knowledge competencies, their median and mode values, and provides a note indicating the total number of respondents (N).

Table 11
Desirable Knowledge Competencies

ETMCS #	Knowledge Competency	Median	Mode
19	Models and principles (e.g., Dick and Carey)	3	3
20	Mayer's multimedia principles	3	3
21	Project management body of knowledge (PMBOK)	3	3
24	Computer networks	3	3
27	Word processing software (e.g., Word)	4	3
28	Spreadsheet software (e.g., Excel)	3	3
29	Presentation software (e.g., PowerPoint)	*3*	*3*
32	Web authoring/design tools (e.g., Dreamweaver)	*3*	*3*
33	Desktop publishing software (e.g., InDesign)	*3*	*3*
34	Bitmap image software (e.g., Photoshop, Fireworks)	*3*	*3*

Desirable Knowledge Competencies (continued)

ETMCS #	Knowledge Competency	Median	Mode
35	*Vector image software (e.g., Illustrator)*	*3*	*3*
36	Audio software (e.g., Audacity)	3	3
37	Video software (e.g., Premiere)	3	3
39	Streaming video (e.g., Windows Media Server)	3	3
41	Content management systems e.g., Joomla)	3	3
43	Game engines (e.g., Unity)	3	3
44	Client-side scripting languages (e.g., JavaScript)	3	3
46	Cascading Style Sheets (CSS)	3	3
47	Markup languages (e.g., HTML/HTML5/XHTML/XML)	3	3
53	Accessibility software (e.g., JAWS)	3	3
54	Web 2.0 technology (e.g., Wikis, Blogs, Podcasts, etc.)	3	4
55	Assessment software	3	4
56	Virtual classrooms (e.g., Elluminate! Live)	3	5

Note. The total number of responses (N) for these competencies was 439.

Essential Skill Domain Competencies

Twenty-one skill competencies were identified as essential for the instructional design of CLDs. Twelve essential competencies were identified. Six of the essential skills are related to communication skills, with four related to organization and management skills, and two related to actual design skills. Table 12 lists the essential skill competencies.

Table 12
Essential Skill Domain Competencies

ETMCS #	Skill Competency	Median	Mode
59	Interpersonal communication skills	5	5
60	Written communication skills	5	5
61	Oral communication skills	4	5
62	Customer service skills	4	5

Essential Skill Domain Competencies (continued)

ETMCS #	Skill Competency	Median	Mode
63	Negotiation skills	4	5
65	Project management skills	4	4
66	Time-management skills	5	5
67	Organizational skills	4	5
69	Trouble-shooting skills	4	5
75	Storyboard design skills	4	4
77	Interviewing skills	4	5
79	Editing and proofing skills	4	4

Note. The total number of responses (N) for these competencies *was 446.*

Desirable Skill Domain Competencies

Table 13 displays nine skill competencies identified as desirable from the online survey. Six of the nine deal with software and technology, one is a psychomotor skill, and one relates to supervisory skills. While the essential skill competencies were primarily concentrated in communications and management, the desirable skill competencies, with the exception of statistical analysis and typing, tended to be more technical in nature and likely performed by a graphic artist or media specialist.

Table 13
Desirable Skill Domain Competencies

ETMCS #	Skill Competency	Median	Mode
64	Statistical analysis skills	3	3
68	Web design skills	3	4
70	Graphics design skills		
71	Animation design skills	3	3
72	Video production skills	3	3
73	Print design skills	3	3
74	Game and simulation design skills	3	3
76	Typing skills	3	3
78	Budgeting and cost estimation skills	3	3

Note: The total number of respondents for this question (N) is 435.

Essential Ability Domain Competencies

Eighteen ability competencies were identified essential for the instructional design of CLDs. These competencies are listed in Table 14.

Table 14
Essential Ability Domain competencies

ETMCS #	Ability Competency	Median	Mode
81	Apply multimedia design principles to design and development	4	5
82	Create effective instructional products	5	5
81	Apply multimedia design principles to design and development	4	5
82	Create effective instructional products	5	5
83	Apply sound instructional design principles	5	5
84	Develop accessible instructional products	4	5
85	Conduct a needs assessment	5	5
86	Conduct a task analysis	4	5
88	Work with asynchronous technology	4	4
89	Sit at a computer for extended periods	4	5
91	Work well with others (in teams)	4	5
92	Work independently	4	5
93	Work on multiple projects (multi-task)	4	5
95	Conduct evaluation (formative/summative)	4	5
96	Develop and administer sound assessments	4	5
97	Operate computer hardware	4	5
98	Adapt and learn new technology and processes	5	5
99	Work with diverse constituencies (e.g., SMEs and clients)	5	5
100	Work under deadlines	5	5
101	Prioritize work	5	5
99	Work with diverse constituencies (e.g., MEs and clients)	5	5

Note: The total number of respondents for this question (N) is 435.

Desirable Ability Domain Competencies

Four ability competencies were identified as desirable for the instructional design of CLDs. These ability competencies are listed in Table 15. Three of the competencies deal (at least peripherally) with technology. The fourth competency deals with management functions.

Table 15
Desirable Ability Domain competencies

ETMCS #	Ability Competency	Median	Mode
87	Work with synchronous technology	4	3
90	Manage teams	3	4
94	Work in multiple operating systems (e.g., Mac/PC/Linux)	3	3
102	Teach online	3	3

Note: The total number of respondents for this question (N) is 435.

Phase 2 Results: Preliminary Framework Development

The preliminary CLD framework (Table 16) was constructed by bringing together all essential and desirable competencies for analysis. The combined competencies were grouped into seven higher order domains. The domains identified: Standards and Requirements, Analysis and Assessment, Design Models and Methods, Learning Theories, Communication and Collaboration, Software and Technology, and Organization and Management. Table 16 provides an overview of the draft framework's two tiers: the seven higher order domains and each domain's associated competencies. As discussed earlier each competency is also identified as one the two levels of criticality: essential and desirable.

Table 16
Preliminary CLD Competency Framework

Domain / Competency	**Criticality Level**
1. Standards and Requirements	
Knowledge of Learning Object Standards (e.g., SCORM; xAPI)	Essential
Knowledge of Copyright Laws	Essential
Ability to design accessible instructional products	Essential
Knowledge of Accessibility (e.g., Section 508)	Essential
Ability to teach online	Desirable
2. Analysis and Assessment	
Ability to conduct a needs assessment	Essential
Ability to conduct evaluation (formative/summative)	Essential
Ability to conduct a task analysis	Essential

Table 16. Preliminary CLD Competency Framework (continued)

Domain / Competency	**Criticality Level**
Knowledge of assessment methods	Essential
Ability to develop and administer sound assessments	Essential
Statistical analysis skills	Desirable
3. Design Models and Methods	
Knowledge of ISD models and principles	Essential
Possess editing and proofing (QA) skills	Essential
Storyboard design skills	Essential
Troubleshooting Skills	Essential
Ability to apply sound instructional design principles	Essential
Ability to create effective instructional design products	Essential
Ability to adapt and learn new technology and processes	Essential
Ability to work independently	Essential
Possess exemplary typing skills	Essential
Possess game and simulation design skills	Desirable
Possess web design skills	Desirable
Possess video production skills	Desirable
4. Learning Theories	
Ability to apply multimedia design principles to design and development	Essential
Knowledge of Mayer's multimedia principles	Essential
Knowledge of Motivation theories	Essential
Knowledge of adult learning theories (e.g., Andragogy)	Essential
Knowledge of cognitive theories of learning	Essential
5. Communication and Collaboration	
Ability to work with diverse constituencies (e.g., SMEs and client stakeholders)	Essential
Possess written communication skills	Essential
Exhibit interpersonal communication skills	Essential
Exhibit oral communication skills	Essential
Possess negotiation skills	Essential
Possess interviewing skills	Essential
Ability to work well with others in a team environment	Essential
6. Software and Technology	
Ability to competently operate computer hardware	Essential
Ability to sit at a computer for extended periods	Essential
Knowledge of screen recording software (e.g., Camtasia)	Essential
Knowledge of Instructional Design using Learning Management System software (e.g., Blackboard; Moodle)	Essential
Knowledge of instructional design using educational authoring software (e.g., Captivate; ZebraZapps)	Essential
Ability to design instruction for asynchronous technology	Essential
Possess skill designing instruction using storyboarding software	Essential
Knowledge of presentation software (e.g., PowerPoint)	Desirable

Table 16. Preliminary CLD Competency Framework (continued)

Domain / Competency	**Criticality Level**
Ability to employ synchronous technology	Desirable
Draft instructional design documents using word processing software	Desirable
Print design skills	Desirable
Create instructionally sound online assessments using software	Desirable
Knowledge of audio software (e.g., Audacity)	Desirable
Knowledge of Web 2.0 technology (e.g., Wikis, discussion forums, and blogs)	Desirable
Knowledge of web authoring tools (e.g., Dreamweaver)	Desirable
Knowledge of computer networks	Desirable
Knowledge of bitmap imaging software (e.g., Photoshop; Fireworks; GiMP)	Desirable
Knowledge of instructional design for virtual classrooms	Desirable
Knowledge of instructional design using markup languages (e.g., HTML5; HTML; XML)	Desirable
Knowledge of Instructional Design using streaming media	Desirable
Knowledge of instructional design using video production software	Desirable
Knowledge of instructional design using Content Management Systems (CMS)	Desirable
Knowledge of Instructional Design using vector image software (e.g., Illustrator)	Desirable
Possess Instructional Design skills using animation software (e.g., Flash; Edge Animator; Toon Boon)	Desirable
• Knowledge of computer hardware	Desirable
Knowledge of spreadsheet software (e.g., Excel) for instructional design data analysis	Desirable
Possess graphic design skills for Instructional Design of CLDs	Desirable
Knowledge of accessibility software (e.g., JAWS) for instructional design	Desirable
Knowledge of Instructional Design using Cascading Style Sheets (CSS)	Desirable
Ability to work with multiple operating systems (e.g., Mac; PC; Linux)	Desirable
Knowledge of Instructional Design using client-side scripting languages	Desirable
Knowledge of Instructional Design using Desktop Publishing software (e.g., InDesign)	Desirable
Knowledge of Instructional Design using Game Engines (e.g., Unity)	Desi7rable
7. Organization and Management	
Ability to manage personal time	Essential
Possess organizational skills	Essential

Table 16. Preliminary CLD Competency Framework (continued)

Domain / Competency	**Criticality Level**
Ability to manage work priorities	Essential
Possess project management skills	Essential
Ability to work under deadlines	Essential
Possess customer service skills	Essential
Demonstrate ability to work on multiple projects (multi-task)	Essential
Knowledge of project management software (e.g., Project)	Desirable
Demonstrate ability to manage teams	Desirable
Possess budgeting and estimating cost skills for instructional design contracts	Desirable
Ability to Apply Project Management body of knowledge (PMBOK) to the management of complex instructional designs	Desirable

Phase 3 Results: Semi-structured Interviews

Once the preliminary framework was constructed from the central tendency values of each surveyed competency, it became important to understand the individual competencies in greater depth. Eight participants who completed the ETMCS survey participated in semi-structured interviews. Though the sample's size was relatively modest, their homogeneity of work experience and education revealed a set of generally consistent responses leading to a level of data saturation. The following sections include responses from interview participants regarding two general areas discussed in each interview: the meaning of complexity as it pertains to instructional designs; and real-world examples demonstrating application of CLD framework competencies during CLD.

Interview Responses for Essential Competencies

Research question number two asks: "What are the perceptions of instructional designers regarding the KSAs that are needed to competently create CLDs?" This research question was explored initially in the survey and subsequently by asking each interview participant why specific competencies within the seven domains were considered essential for the design of CLDs. Interview participants were asked to provide their views on each of the essential competencies included in the initial framework. Representative quotations from interview participants are provided later in this chapter.

Characteristics of CLDs

Research question number five asked: “What characteristics are perceived to define a CLD by professionals working in the instructional design field?” This question was addressed by inclusion of an that required an open-ended response in the set of questions related to experience in the survey and subsequently explored during the phase three interviews.

Since this research involved identification of *CLD*s it was appropriate to clarify what characteristics respondents used to describe *complex* designs. Querying participants about complexity provided a deeper understanding of the working ISD professionals’ perception of complexity as it relates to their profession. Data were collected and queried using Quirkos CAQDAS software. Non-linear pathways, feedback, and qualitative load were factors mentioned by the interview subjects.

Statements made during interviews described complexity in similar ways, such as interactivity, branching, and feedback, as exemplified by the following two quotes from two research participants: “Designed [complex] learning interventions which offers multiple branching paths or options for the user navigation, algorithmic structures for simulated system or process behaviors, or pedagogical models that provide artificial or intelligent responses to learner actions” (Respondent JH7273, 2018). Another respondent also zeroed in on the difference between passive reception of learning and active input-response behavior between the learner and learning system:

> You can have a whiz bang simulation [where] everything looks real, the avatars look real, the sights and the sounds are the same thing, but if all the learner is doing is watching and it's not responding, if you input something you just go next, how complex is that? It may have complex graphics and it may look good, but for me, complexity is tied to learner input and response to that learner input. (13463589, personal communication, 2018)

Complexity Due to Technology

Perhaps the most obvious factor involved in instructional design complexity originates incorporation of ever-changing software and technology in the design and development environment. “Multiple learning objectives with more than one path through the material, multiple interactions, SCORM/xAPI tracking, high bandwidth content, etc.” (ja1972, personal communication, 2017).

Other respondents immediately started listing types of CLDs, as indicated by these responses:

- “…game-based learning, augmented reality, virtual reality, just-in-time delivery of learning, competency-based learning” (am5038, personal communications, 2017)
- “Branched elearning that may or may not include gamification,” (lb2017, personal communications, 2017)
- “…one that involves multiple modes of instruction - including (but not limited to) simulations, demos, review quizzes, short paragraphs, case studies, scenarios” (lm2946, personal communications, 2017)

However, several participants indicated it’s not just the technology that makes designs complex, it is the intermeshing of technology into the educational design that is crucial:

> It's a matter of how you can integrate technology in education, because in my opinion it is not like using technology in education. This is a process of changes on both sides. The classic in-class methods and design are no longer suitable when it comes to technology in education. On the other side technology need to develop understanding of educational needs to be able to better support it. (MF25, personal communications, 2017)

Complexity Due to Performance-based Content and Assessment

Another key take-away regarding the nature of CLDs is the general agreement that learning in a complex design occurs at a level beyond basic knowledge and comprehension (Bloom, et al. 1956) and resides squarely in the realm of performance objectives and assessment. The following statement clearly states this: “A learning design comprised of simulations and on-the-job performance to measure high-level cognitive, affective or motor skills. The solution requires extensive performance based-evaluation to measure desired outcomes.” (dm2913, personal communication, 2017)

Complexity Due to Geographic Dispersion

Complex instructional designs often require an array of different professions working together. Due to today’s communication technology advancements, teams often consist of members scattered around the globe. This reality was mentioned regularly during interviews, such as the following quote describing the team he or she worked with: “…large numbers of employees scattered over a large geographic area with a very diverse background and experience” (sm8498, personal communication, 2017). The reality impacts the efficiency and accuracy of communication between team members (as well as stakeholder), as explained by this statement:

> That sort of direct communication can really save time and make things more efficient. Otherwise, you end up with people sending emails, waiting for responses, and misinterpreting things. It's that face to face explanation and interaction that have really helped our team exceed. (sm8498, personal communication, 2017)

Fortunately, some of this inefficiency and misinterpretation can be mitigated with advanced communication technology like video/teleconferences and instant messaging.

But not all instructional designers have easy access to these types of technologies, so geographic dispersion remains a potential barrier, especially for complex designs.

Complexity Due to Multiple Modalities

Several respondents included modalities as a factor in determining complexity: (1) One respondent (bf1234, personal communication, 2017) responded in part by quoting a dictionary definition: “Complex designs are …composed of many interconnected parts; compound; composite. I'd probably say a design that involved multiple and multi-modal instructional and assessment activities.” (2) Another respondent stressed how important it is for instructional designers to “make sure that you can apply those theories and those different modes and methods to any project that you are assigned.” (13454604_1b, personal communication, 2018), while a third respondent clarified how this competency helps learners, stating:

> …you can help them get there through different modes, so maybe you have an auditory learner, and you want to include audio. Maybe you have a learner who's visual, and you want to include some video of the procedure or process or a piece of it, and then you need to have the narrative to connect both parts to the whole. So, you can reach more people, and you can be efficient, and quick on the job if you know those tools well. (13454604-1b, personal communication, 2018)

Complexity Due to Process

Other respondents introduced a different perspective, specifically that the instructional design process (or method) is more complex. This complexity can be due to the need for a more flexible design process than one static and linear in nature. These agile design processes are based on two fundamental assumptions: (1) New ideas, barriers, and changing requirements will change the end-product over time, and (2) Regular changes such as those just mentioned often winds up producing a product different in many aspects than what was envisioned at the beginning of the project. This requires a more iterative design and development process, with shortened stakeholder feedback and design loops. Agile processes such as Scrum and Extreme Programming (XP) are used by many software development teams and have worked their way into instructional design processes such as Allen Interactions' Successive Approximation Model (SAM).

> Right, because in a Scrum team you're looking at you're in an agile development team where the design is evolving. The design can evolve, that's great, but that instructional message, you must have an idea of what that instructional message is. (13463589_1-2, personal communication, 2018)

Also, the design and development processes often require different skills and technologies such as those that was mentioned subsequently:

> Complex designs require that instructional designers possess the knowledge and skills to allow them to include a multitude of modern technologies into the design and development process they are responsible for. That content must be multi-modal, multi-faceted (i.e. branching, video, audio, simulations, graphics, images, etc.), interactive, thought provoking, and cognitively stimulating. (ds1951, 2018)

With a general understanding of the wide-ranging aspects that may be involved in design of CLDs, it became important to understand the actual competencies necessary to competently address complexity in all its forms.

Framework Domain 1: Standards and Requirements Competencies

Eight Standards and Requirements domain themes emerged during analysis of the interview transcripts. The most predominant themes included SCORM (with a sub-theme of xAPI), Editing and QA, Professional Development, and Adaptation. Other themes included Copyright laws, HTML 5, and Sound ISD practices. Within that context, each Standards and Requirements domain's essential competencies are discussed and supported by relevant quotations pulled from interview transcripts.

Knowledge of Learning Object Standards (e.g., SCORM; xAPI)

Historically, tracking of online learning content would be performed by a Learning Management System (LMS). However, the need for tracking specificity has increased, requiring greater flexibility in what should be tracked. This has given rise to alternative approaches. The standard for content organization and tagging has long been the Shareable Content Object Resource Model (SCORM), first with SCORM 1.2 then followed with SCORM 2004. The Advanced Distributive Learning (ADL) initiative has moved beyond the constraints imposed by SCORM and moved on to the Experience API (xAPI). According to both the ADL (adlnet.gov) and xAPI (xapi.com) websites, xAPI provides advantages over legacy SCORM specifications by communicating a wider range of experiences a learner has, both online and offline, and consistently captures data so that it can communicate with a wide range of technologies. This means also that xAPI has changed its focus of content delivery from commercial LMS solutions to that of a Learning Record Store (LRS), which is an open source server designed to retrieve and store xAPI data. LRSs have also started to morph into Learning Analytics Platforms (LAPs), which allow inclusion of reporting dashboards, learning analytics, and recommendation engines. This provides much greater flexibility in the type of data stored, the way in which it can be tracked, its advanced reporting capabilities, and ability to share this data such as adaptive and mobile learning can be easily designed and development. A working level understanding of specifications like SCORM/xAPI is considered essential to ensure the course design provides content to the LMS/LRS that closely follows the specification

> Yeah, so as much as I feel like you don't have to know how to program these things [SCORM/xAPI], it's important to know if your contract calls for it, it's

> important to know that this involves creating small chunks of information that can be reused, and then I feel like it's also important, because in the web authoring tools, you're going have some options that you can set up to make sure that the LMS is reading your course and recording things the way you want it too. (13454604, personal communication, 2018)

Knowledge of Copyright Laws

With the increased dependence on online sources of information and free stock image websites, there is an increased legal (and ethical) risk associated with use of text and image content without attribution to the author/artist. Whether the omission of attribution is purposeful or not, CLDs can be substantially more expensive to design and develop, so the addition of legal repercussions makes this an extremely important competency for all professionals associated with the design and development of CLDs:

> Including copyrighted material without consent can create legal issues for the instructional designer and his/her company, "…you need to be aware of some consequences that you might put your program at risk of some kind of lawsuit if you don't understand copyright." (1338353, personal communication, 2018)

While knowledge of copyright laws is not a new competency nor exclusive to complex designs, it does become more of an issue given today's advanced technologies providing almost immediate access to copyrighted text and graphic image media, as stated below:

> We have a lot of information at our fingertips now. You can go online, and you can get information and you see information and you can put it in your courseware. I think people need to be cognizant of the fact that not paying attention of copyright laws can get you into trouble, can get your company into trouble. Of course, I'm coming from the management perspective on that. (13463589, personal communication, 2018)

Knowledge of Accessibility (e.g., Section 508)
Ability to design accessible instructional products

Two themes emerged regarding accessibility: the lack of knowledge of what accessibility entails and how to design so that the content is accessible. Respondent 13457694 discusses both issues in the following statement:

> Developing accessible instructional products. I think it's important. I think it's essential to know. I don't think enough of us know, understand accessibility, but I do think it's essential that you understand what's going to work for people who are visually impaired or various learners. I think that matters. (13457694, personal communication, 2018)

Framework Domain 2: Analysis and Assessment Competencies

Eleven Analysis and Assessment domain themes emerged during analysis of the interview transcripts. The most predominant theme dealt with team collaboration and communication which included sub-themes of Team Specialization and the counter-intuitive sub-theme titled Independent Work. Other key themes included Oral Communication, Written Communication, Client Communication, Interpersonal Communication, Written Communication, Technology and Communication, Negotiation, and Interviewing. Within that context, each Analysis and Assessment domain's essential competencies are discussed and supported by relevant quotations pulled from interview transcripts.

This domain in the initial framework consisted of five essential competencies and one desirable competency. When each participant was asked why s/he considered the competencies essential, their response was recorded and transcribed. Statistical analysis skills were the only Analysis and Assessment Domain competency deemed desirable. When each participant was asked why he or she considered the competencies Essential, their responses were recorded and transcribed. Representative responses follow below.

Ability to Conduct a Needs Assessment

Needs assessments are typically the first analysis related activity that is performed by an instructional designer for it serves as the basis upon which all design and development rests. In many cases, a needs assessment may determine that a checklist or Electronic Performance Support System (EPSS) is the appropriate design for the existing situation. However, when considering the types of CLDs this research has examined, the solution may be a blended approach involving multiple elements, one of which may be training. Alternatively, the optimal solution may not involve training at all. respondent 13383536 voices this opinion in the following statement:

> That needs assessment you think is the first thing that you really need to do. It's crazy to think that somebody would not do that. We want to know why we need it. Why do we even develop anything? Maybe the training is not the answer, maybe training is not the type of solution that is needed. Conducting a needs assessment is important because if you don't understand it, you may develop training, but then it's not going to fix the problem. (13383536, personal communication, 2018)

Ability to Conduct Evaluation (Formative/Summative)

Survey and interview responses covered both formative and summative evaluation methods. Two perspectives of evaluation were presented by the subjects: (1) evaluation as a scored assessment and (2) evaluation that determines the effectiveness of the instructional product. Since CLDs typically evaluate at the higher Kirkpatrick levels basic assessments like multiple choice tests and check-on-learning formative assessments is less appropriate than usability and effectiveness evaluation. However, this makes the response that effectiveness and usability evaluation are seldom pursued in the field, since client stakeholders often don’t want to pay for it. The following quotation from respondent 13463589 highlights this common issue:

> I will tell you being in business in doing this for 18 years now, is that how long I've been doing this, 18 years? I've only been involved in a few formal evaluation projects where you [actually] use the Kirkpatrick evaluation method to evaluate how effective courseware is for your learning environment. (13463589, personal communication, 2018)

It is worth noting that both formative and summative evaluation can be provided by the complex learning system through real-time feedback to the learner (formative) and successful completion of the required performance (summative). This was highlighted by respondent 13453356 in the following statement about game-based learning:

> what's key in game-based learning is that games are all about providing formative feedback and in any game, when you're doing any action, if you're clicking here, you'll get some type of feedback, if you're right and wrong or something's going on, so games give feedback like a million times a minute, whereas in schools or in typical learning programs, you barely get any formative feedback. (13453356, personal communication, 2018)

The following quotation from respondent 13463589, with 18 years of experience highlights the importance of this competency: “I've only been involved in a few formal evaluation projects where you [actually] use the Kirkpatrick evaluation method to evaluate how effective courseware is for your learning environment.” Respondent 13463589 went on to indicate that effectiveness and usability evaluation are seldom pursued in the field, since client stakeholders often don’t want to pay for it. Since CLDs typically evaluate at the higher Kirkpatrick levels, basic assessments like multiple-choice tests and check-on-learning formative assessments are less appropriate than usability and effectiveness evaluation. This makes elevates the criticality of this competency.

Ability to Conduct a Task Analysis

CLDs often include complex systems that require the learner to repeat both operational and maintenance tasks that can be both sequential and branching in nature. One of the key tools for ensuring procedures are simulated correctly is through extensive task analysis. Respondent 13454604 explained the key aspects of a task analysis in the following quote:

> Right. You would really go deep into the analysis with observation, interviews, task analysis. Just making sure that you have input from the Subject Matter Experts, so the person who's already gained mastery of that tool to help you kind of foresee the best practices and then the common errors that would occur for someone trying to learn the mastery of that system. The analysis part was very extensive. (13454604, personal communication, 2018)

In some cases, respondents such as 13454446 detailed activities involved with an extensive task analysis, which included on-site meetings with operators and maintainers, and performing actual tasks on the actual equipment:

> And we met with the actual operators and maintainers of the equipment, because the project involved not only an operator training but also a maintainer training, and during that visit, during that site visit, we actually got with the equipment and basically performed what an operator would do on a typical day, and then we also tore some of the stuff down, broke it down for maintenance, and then we recorded what we did. (13454446, personal communication, 2018)

Knowledge of Assessment Methods
Ability to Develop and Administer Sound Assessments

Both the knowledge and skill competencies listed above relate to a common instructional design element - assessment. Two themes were apparent when considering why these competencies were viewed as essential. First. The respondents strongly believed in an absolute requirement to match assessment items to the content's learning objectives. The following quote is representative of the instructional designer's need to match assessments to the learning objectives.

> Because you can go down some rabbit holes and you can make … [a] whiz-bang simulation, right, but are they going to teach what you want them to teach. You need to know how you're going to assess it upfront before you build it. (13463589, personal communication, 2018)

The second major theme was the respondents' experience with personnel who lacked the knowledge and/or experience to develop sound assessments but had been tasked with developing assessments. In some situations, this may be due to lack of knowledge. Other situations may present a marginalization of ISD principles importance due to watered-down contractual requirements. In either case, instructional designers remain a bulwark against the reduction in value of proper assessment. Knowing how to build appropriate assessments was expressed clearly by respondent 13454604:

> For me, as a designer, a lot of times, I don't have the luxury of having somebody who's a psychologist on a team to help build out assessments. I need to know, based on the goal of the instruction, and the business outcome, how am I going tie those two together by making sure I assess the learner's knowledge in the context of the business need. (13454604, personal communication, 2018)

Alternative assessment methods were another topic addressed regarding this competency. The game-based learning perspective of respondent 13453356 represents the performance nature of assessment common to many types of CLDs.

> … Because dealing, especially with game-based learning and how do you assess the learning, so it's not like you get a quiz after every mission or something like that to assess but it's how we assess and can we assess in the game as you're playing the game, can the game itself be an assessment?" (13453356, personal communication, 2018)

The analysis and assessment domain of competencies includes many similar competencies needed for the design of all learning solutions. However, due to complexity typically found in CLDs such as game-based learning, simulations, adaptive learning, and mobile solutions, instructional designer competencies need to adapt to this complexity to ensure design and development of an effective learning solution.

Framework Domain 3: Design Models and Methods Competencies

Eleven Design Models and Methods domain themes emerged during analysis of the interview transcripts. The most predominant theme dealt with "Feedback." Other key themes included Chunking, Sequencing, Strategies, Iterative, Levels and layers, Multimedia, Failure, ADDIE, and Agile. Within this context, each Design Models and Methods domain essential competencies are discussed and supported by relevant quotations pulled from interview transcripts.

The domain in the initial framework consisted of nine essential and three desirable competencies. Desirable competencies in this domain included the following: possess game and simulation design skills; possess web design skills; and, possess video production skills. When each participant was asked why s/he considered the competencies essential, their response was recorded and transcribed. Representative examples of their responses follow.

Knowledge of ISD Models and Principles

When referring to ISD models and principles, there were two discussion threads during the interviews. First was the traditional, linear based ADDIE model for instructional design. Respondent 13444572 (personal communication, 2018) represents this thread, saying "…that's the only model for learning. You say instructional design and I'd probably say eight out of ten designers would be like, oh, ADDIE. They don't even understand but, oh, ADDIE." The second thread consisted of discussions about alternative design and development models and methods, such as Agile.

Possess Editing and Proofing (aka Quality Assurance) Skills

All instructional design products involve some level of writing, and CLDs are no exception. Editing and proofing competence affects the end-user's comprehension and concentration when interacting with a simulation, game or other CLD, as indicated in the following quotation from respondent 13444572:

> I take great pride in something being edited and proofed properly. I say that kind of half-jokingly. I believe it's important for the user not to be distracted by a misspelled word or by a sentence that just doesn't read properly. (13444572, personal communication, 2018)

In many cases document preparation and accuracy become more important due to the complexity of the subject, objective, or system involved. In those cases, editing and proofing skills are likely to involve more than reviewing text-based documents and often include visual logic flow charts and spreadsheets for documents (refer also to Storyboard design skills discussion) related to multiple types of presentation modalities. This is typically done by the instructional designer or a peer, but sometimes by an editor.

> In a team environment, so a lot of times you'll do peer reviews of the content just because sometimes you'll look at a page for so long that you see what you want to see, and just having your peer proofread it for you will pick up on something that maybe isn't quite right. In other cases, it might be a professional editor who's on the team, but that's rare. (13454604, personal communication, 2018)

Storyboard Design Skills

Storyboarding is alive and well within the design activities of CLDs, but the level of specificity is often different. Complexity also makes this competency more important, as mistakes can have a larger impact of the presentation of the learning content, as noted in the following statement:

> Let's take the storyboard for an example. If I say, storyboard one, two, three goes next to storyboard 700 for some reason, because we branched, I need to make sure there's no mistake there, and that it doesn't say, you go to 701, because otherwise,

> when the course is completed, it will go to the wrong place, and I think that in the more complex designs, you have way more content, so of course, you'll have a lot more branching, and things that are linked, and the storyboard is a great place to do that, but if there's any mistakes, then it doesn't help anybody. (13454604, personal communication, 2018)

Branching logic can be storyboarded textually, however a visual software tool is much easier to understand, especially when passing the document to another member of a multi-discipline development team that only understands the situational context provided in the document. To mitigate potential issues, visual software tools are available to storyboard more complex, branching paths. Respondent 13444572 discussed the instructional design process of designing multiple branches for troubleshooting scenarios:

> One trick to understanding a troubleshooting tree would be understanding every potential path. You can't have any dead ends. You can't have any infinite loops. What we would do if we develop something like this is draw it out. There's different software that will allow you to visually map the tree branch. You have to kind of walk through the logic before you even begin to develop the process. You must know where you started, where you're going, and every possible choice in between before you could even start developing that path forward. (13444572, personal communication, 2018)

Troubleshooting Skills

Troubleshooting involves implementation of procedural rules that that must be identified in some type of storyboarding documentation. This competency is particularly important for both maintenance and operational procedures of complex systems like those found in health care, heavy industry, Information Technology (IT), and the military. Introduction of simulated faults, requires the instructional designer to analyze potential learner missteps and design potential alternate paths that will require learners to troubleshoot in order to complete a task, as noted below:

> … if there was a fault in the system that came up for mechanical reasons, so they didn't know exactly what they were going encounter at any given time, and I think that's what made it more complex, was they had to do some decision-making and

> troubleshooting in order to complete the task. (13454604, personal communication, 2018)

Respondent 13454604_1b then pointed out that incorporating troubleshooting into a learning system adds complexity to the feedback mechanisms that must be analyzed and implemented to guide the learner through the troubleshooting process.

> …troubleshooting ideas that they could step through, whether it would be go back, or whether it would be, you know, turn the X, Y, Z dial off, and then do whatever, so it was specific feedback at the time that the fault occurred, or at the time that the mistake occurred, and then helping them get back on track through one or two different methods that they could choose from that would both work. (13454604, personal communication, 2018)

Ability to Apply Sound Instructional Design Principles
Ability to Create Effective Instructional Design Products

Respondents agreed that application-level knowledge and creation of sound instructional design procedures are required no matter what complex product is being designed. Respondent 13444572 underscores this opinion through the following quotation:

> You can't create an effective instructional product unless you apply sound instructional design principles. I would say that's a typical learning system or complex. I would say more so complex because there's more things happening. If you don't have those things tied together, then I don't think it's gonna be [an effective] learning design. (13444572, personal communication, 2018)

Ability to Adapt and Learn New Technology and Processes

Technology and therefore the processes necessary to enact the capabilities of a technology are constantly changing in today's instructional design field. One of the issues raised is the tendency of either companies or instructional designers to get stuck using the same process, ignoring what might be a better technology and instructional design process given the specific requirements of a CLD. If nothing else is true about CLDs, it is that ability to adapt to new technology and collaborate in the design and development process is essential. Respondent 13463589 provides an example of a process where team members stay within the confines of their own technology comfort zone and fail to collaborate with one another:

> All right. Some teams will … Their process is this. The instructional designer writes the storyboard, writes the graphic request, gives it to the artist, gives it to the programmer, and the programmer and the artist develop the artwork and the courseware. That's it. Then it's the instructional designer's job to go through and make a list of what was wrong and it's also the instructional designer's job upfront to understand how it must work. [Artists and programmers say:] "just tell us what we have to do, and we'll do it." (13463589, personal communication, 2018)

Ability to Work Independently

Several respondents differentiated the scope and type of competencies required for an instructional designer working on a complex learning system while in a team environment versus working as an independent contractor. Respondent 13444572 described the myriad of skills required to work independently and explained how difficult this can be to design CLDs independently:

> If you were not on a team and you were trying to develop an IMI that was completely hardware based and you were putting 3D models in, then I suggest you learn how to create the 3D models and unwrap and texture them and put them back together and render them. To do animation and put that animation into an interactive multimedia along with audio. You would need every single one of those skills and not just to be okay with it. If you wanted to make a [complex and] professional product, you would need to be basically an expert. That's a wide variety of skills to be excellent at. A jack of all trades, master of none, I don't know how you would really do that unless that's all you did. (Respondent 13444572, personal communication, 2018)

Possess Exemplary Typing Skills

While accurate speech recognition engines are now available for audio transcription, adoption of this software technology is far from universal. Therefore, use of the keyboard for input was deemed essential by respondents. Both survey and interview participants viewed this competency as an assumption.

Framework Domain 4: Learning Theory Competencies

Seven Learning Theories domain themes emerged during analysis of the interview transcripts. Three themes were predominant. These themes dealt with Motivation theories, Andragogy, and Cognitive Theories. The Cognitive theories themes included several discussions regarding cognitive load theory. Within that context, each Learning Theory domain's essential competencies are discussed and supported by relevant quotations pulled from interview transcripts.

The preliminary framework consisted of five essential Learning Theories domain competencies. Essential competencies in his domain includes Cognitive learning theory, motivation theory, and adult learning theory. When each participant was asked why s/he considered the competencies essential, their response was recorded and transcribed. Representative examples of the responses follow.

In an overarching statement, respondent 13457694 provided two reasons for including these theories as essential competencies. The first is to avoid personal bias and instincts impacting the design:

> In my worldview of what instructional design does. Adult learning theory I think is critical. Honestly, the cognitive theories of learning, motivation theory, I could have put them all in there. What I think is important is understanding what the theories are for two reasons. One is because that helps you think about when you're designing things that work because we all have instincts about how to explain something, but it could very well be that what you want to do is more your own personal bias as opposed to what really works for learners. That's part of it. (13457694, personal communication, 2018)

The second rationale for following appropriate learning theories is that it provides a sound foundation for not only designing but also defending the design decisions to various stakeholders. This is expressed in the following statement:

> The other part that I think makes it essential for instructional design is when you're communicating with clients, whether it's your subject matter experts or their stakeholders or with a team or anybody like that, to help them understand why you're doing what you're doing. Because if you can tell people how the theory worked, I found people are much more willing to say, okay, we'll figure out how to make that work. (13457694, personal communication, 2018)

Ability to Apply Multimedia Design Principles to Design and Development
Knowledge of Multimedia Principles

The preceding knowledge and application level competencies were both considered essential for design of CLDs. Responses to questions about their rating covered two perspectives: First, some respondents work on contracts where the available media is already identified, so the competencies relate to best-case matching of available media to content. In this type of environment, knowledge of multimedia is assumed.

> I think they [multimedia principles] are extremely helpful and crucial when designing the process that me and my team develop. I think that the CLDs that I've been exposed to and I've worked on. I'm always including multimedia and those principles have, in every case, impacted our product. To not view it as essential, based on what I've done, I can't even fathom that. I marked that as essential for that reason. (13444572, personal communication, 2018)

The second perspective dealt with specific multimedia principles defined by Mayer (2009). One of these is the redundancy principle caused by employing two or more related media elements that require multiple sensory import channels to process, which inhibits the learner's ability to absorb the content due to cognitive overload. This was expressed in the following interview statement:

> Redundancy is huge. Redundancy or split attention or the continual effects referring to where you're putting information on the screen. It's one of those things where if you consider usability, the design of these principles has that. You don't really see it when it has it. It's when it's not there, when it's not that incorporated, that's where you're like, "Something's off about this". (13444572, personal communication, 2018)

Knowledge of Motivation Theories

Discussion about motivation theories centered on two key areas: intrinsic motivation and game-based learning. These respondents concentrated on the requirement of motivation that originates from the learner them self (intrinsic), as described in the following interview response from respondent 13463589:

> There is an intrinsic motivation and without that intrinsic motivation, your learner is just there. The learner needs to be motivated. I think motivation is essential to learn. I've always believed that whether it's complex learning or whether I've got a classroom full of students. They [must] be motivated or they're zoning out." (13463589, personal communication, 2018)

Though the issue of motivation theory is critical to all forms of CLDs, it was most often brought up during the discussions about game-based learning. In this statement, intrinsic motivation is raised as an important component of game-based learning:

> When you dig into why people keep playing [games] day after day and spending hour after hour, it's more about all the intrinsic motivators and a lot of the theories. A lot of [those] theories are all about the intrinsic motivators …. (13453356, personal communication, 2018)

Respondents also provided several approaches for ensuring how to identify instructional design methods for enhancing learner intrinsic motivation through fun and the integrating four characteristics: social, purpose, autonomy, and mastery (SPAM). These are addressed in the following two statements:

> In educational games, you need the player to learn the content at the school and have fun at the same time. It's easy for us to ... We could just make an instructional design tutorial, right? We could just make a tutorial to teach the learning objectives, but it's not fun. But when we're creating the educational gaming experience, we want to think, how can we add this fun into it, whether it be serious fun, easy fun, hard fun, social fun, so that's where it comes in, you think "How can I add the fun into this type of experience?" (13453356, personal communication, 2018)

> … the good games that we're playing all the time are intrinsically motivating … I use this acronym, SPAM, to remind me to always look for what is intrinsically

> motivating about any activity, so whether it be a game or anything that I'm doing or that I'm reviewing. SPAM is social, purpose, autonomy, and mastery ... (13453356, personal communication, 2018)

Knowledge of Adult Learning Theory

Respondents cited several reasons why adult learning theory was considered a critical competency. The first reason mentioned during the interview discussions dealt with the differences between pedagogy and andragogy, as represented in the following quotation:

> …you're going to be teaching adults versus non-adults. The pedagogy versus andragogy, you know. The pedagogy for many adults is not something that is going to work for them. They prefer to kind of do their own thing and be guided by self rather than an instructor. (13248514, personal communication, 2018)

The second reason mentioned during the interviews was that most CLDs are designed for adults, not children. Therefore, andragogy is more appropriate than pedagogy. Respondent 1344572 discussed this in the following:

> The way I view that [adult learning theory] as essential is not that you can't develop complex learning systems for pedagogical purposes for younger audiences. I believe that to truly have a complex system being utilized to its fullest by your target audience. You're going to be hitting adults who are using computers who at least understand complex learning. Whether they understand it or not, they are receiving it and building on it. That's why that's essential. That's [adults] my target audience usually and I can't imagine trying to develop complex learning systems for a child. (1344572, personal communication, 2018)

Knowledge of Cognitive Theories of Learning

Responses to this competency during the interview sessions consisted of two trains of thought: cognitive theory (in general) and cognitive load theory. Cognitive load theory was a regular topic of discussion, especially for several instructional designers working on military contracts. One interview participant mentioned how important is was to be aware of cognitive load theory when working with all the complex training conducted in the military training environment: “I think it is [cognitive load theory] more important than motivational theory, just to be honest. At least in the military learning realm, which is kind of encompassing of most complex learning systems in my experience.” (13444572, personal communication, 2018)

The second train of thought dealt with the immense amount of information an instructional design team wrestles with when working on complex instructional systems in a team environment. This mountain of data needs to be recognized and mentally parsed between intrinsic, germane, and extraneous load factors in order to avoid cognitive overload:

> I think understanding [a lot] of information, there's that intrinsic cognitive load they get just from trying to consume the information. Then, they have the extraneous, all the little bits around there. Then, you have germane. I think if you don't at least understand what each of those terms mean, then maybe you should go find someone who does. That's going to be very important when you're in that team environment. (13444572, personal communication, 2018)

Framework Domain 5: Communication and Collaboration Competencies

It is worth noting that Ritzhaupt and Kumar (2015, p. 59) viewed communication as an essential skill, saying: “Seven of eight participants interviewed asserted that communication skills and the ability to teach were paramount to their job roles, far more important than technical skills, because technologies could be learned on the job.”

Twelve Communication and Collaboration domain themes emerged during analysis of the interview transcripts. The most predominant theme dealt with collaboration and communication within design and development teams, which included sub-themes of Team Specialization and the counter-intuitive sub-theme titled independent work. Other key themes included Oral communication, Written communication, Client communication, Interpersonal communication, Communication

Technology, Negotiation, and Interviewing. Within that context, each Communication and Collaboration domain's essential competencies are discussed and supported by relevant quotations pulled from interview transcripts.

This domain in the initial framework consisted of seven essential competencies. When each participant was asked why s/he considered the competencies essential, their response was recorded and transcribed. Representative examples of the responses follow.

Ability to Work with Diverse Constituencies (e.g., SMEs and client stakeholders)

The design of CLDs often calls for instructional designers to deal with other team professionals, their company management, Subject Matter Experts (SMEs), and the clients. Each stakeholder group will not necessarily have the same goals, outlook, requirements, or expected project completion timeframe. Yet the instructional designer, along with their project manager often must navigate these treacherous waters to deliver an instructional product that meets all stakeholder needs. This is enunciated well by one of the respondents:

> Work with diverse constituencies, this is the different stakeholders. You want to be able to do that and see why there's different needs there. They all come with different needs or different priorities. All these different constituencies are about the different priorities that each one of them have, but you need to have them all work together. You need to compromise and appreciate and communicate. (13383536, personal communication, 2018)

Possess Written Communication Skills

CLDs requires a greater degree of specificity than traditional linear training and the instructional designer is often tasked with documenting the design specifics. Written documentation will be required that describes every nuance of the design from the learning strategy to the learning assessment and beyond. This may include descriptions of the multiple paths determined by learner decisions, feedback that must be communicated (often in both visual and textual ways), and scripts. This information is typically found in some type of design document, an example of which is described in the following statement:

> That [Game design document] covers every single thing that goes into a program, so if you're creating like a mobile educational game, so it's everything about the learning objectives, the assessment, the audience, and then describes the entire gameplay, all the mechanics, what goes on every single step there and then the development, who you need, when it's gonna happen, the milestones, the testing plan, so it covers everything to do with the whole project. Typically, I guess depending on the size of the game project, it can be anywhere from, you know, it can be a small novel once you're finished. (13453356, personal communication, 2018)

Exhibit Interpersonal Communication Skills

CLDs typically involve design teams consisting of multiple professionals working together. This require instructional designers to listen and make every attempt possible to understand the perspective of each member of the team. Similarly, CLDs likely involve several different stakeholders with varying perspectives. Communicating with both internal and external sets of stakeholders requires effective interpersonal communication, which makes this competency essential to the successful design, development, and delivery of these learning designs.

> Interpersonal communication ... Well, interpersonal communication skills, I think it's very important in, well, anything, right? But especially in the design process when you're working with another design or designer and then also when you're working with external people, like graphics people and then especially with your customers, so if it's a school, or if it's a teacher, or if it's a counselor, if it's an administrator, being able to communicate this kind of ambiguous term, game-based learning, and helping them understand why and how it can be effective, it requires a lot of good interpersonal skills and interpersonal communication skills. (13453356, personal communication, 2018).

Interpersonal communication is a foundational element of collaboration, which is discussed separately as another essential competency. One of the respondents addressed this relationship directly, stating “You also need to be able to collaborate. I think interpersonal skills… I think that that is paramount to collaboration, right, and understand each other and be able to work together in a group” (respondent 13463589, 2018).

Exhibit Oral Communication Skills

Addressing how teams impact the type of communication necessary for complex designs, the following statement points out the need for oral communication in team environments:

> Yeah. A lot of people, they don't have time to read a bunch of stuff. When you're collaborating with a group, you want to be able to speak. You want to be able to say what you mean and get your message out. (13463589, personal communication, 2018)

Possess Negotiation Skills

Two perspectives of the negotiation competency were identified during the interviews. Respondent 13383536 (2018) briefly discussed both in the following quotations, first regarding negotiation with clients: “Negotiation skills are important when the customer doesn't understand important ideas or .... They don't understand maybe the volume [scope] of something because they haven't experienced it” (13383536, personal communication, 2018). The second aspect of negotiation skills this respondent found important was negotiation with subject matter experts (SMEs): “SMEs are used to certain things. They never see new ways, so negotiation skills are about being able to influence others without pushing it.” (13383536, personal communication, 2018)

Possess Interviewing Skills

Interviewing subject matter experts and clients has long been an accepted practice in gathering pertinent data for instructional design projects. Historically, much instructional content has consisted of existing legacy content from manuals and academic texts. However, with the added complexity in many of today's learning systems are being designed without the aid of established texts or technical guides. This creates a design environment where the interviewing competency is even more essential.

> When you're either doing analysis or designing something, you need to be able to walk that subject matter expert back over the learning curve. You need to be able to ask the questions and understand the information that's coming in. I think interviewing is essential. (13463589, personal communication, 2018)

Ability to Work Well with Others in a Team Environment

As discussed earlier, teams are often dispersed geographically or work during different shifts (e.g., compressed work weeks). This puts a stress on the team's communication and collaboration process. In cases like these, respondents highlighted the importance of collaboration using regular meetings. This has proven especially important for agile development processes, where daily meetings (on-site or virtual) are considered part of the standard team schedule. Respondent 13463589_1-2, 2018 discusses successful design and development teams that took this approach.

> Then, you have other teams where you have the programmer and the artist and the designer sit down together upfront and they say, "This is what we're going for. I wonder if we could do this." You have an environment where somebody says, "Hey, yeah, that'd be really cool but what if we did this?" The most productive and the most successful projects I've ever been on [had a] process that allowed for and even relied on collaboration so that's an example. (13463589, personal communication, 2018)

Another respondent tied this competency to the communication competencies that were addressed earlier in this domain.

> I think it's because of the ability to work in teams. If you're going to do a simulation or a level three simulation, you're going to be working in a team because not one person is going to possess all the skills needed besides just pure instruction design. You're going to be working with subject matter experts and simulation experts, possibly game designers, 3D modelers, and so it's the ability to communicate back and forth with a team of people. (1345446, personal communication, 2018)

Other discussions dealt with teleconferencing and video conferencing. A third respondent discussed working in a team that was geographically dispersed and using chat technology to collaborate in (near) real-time.

> We IM constantly. Any team you're in, usually depending on the project, there's a team Skype chat that's always open. If you have something you need to say to the team, you just type that in, and you'll usually get something at least every day. Sometimes the project manager will just have something they need to ask me, so they'll send a quick Skype. Sometimes it needs a phone call, so we'll jump on Skype and talk to each other. (13457694, personal communication, 2018)

Framework Domain 6 - Software and Technology Competencies

Six main Software and Technology domain themes emerged during analysis of the interview transcripts. The themes included Tools, Networks, Web. 2.0, Learning New Technology, Audio-Video, and HTML Development Software. Two of these main themes contained sub-themes: The Tools theme included 5 sub-themes (Storyboarding, Authoring Software, Communication Tools, and LMS. The main theme of Learning New Technology had one sub-theme titled Troubleshooting. Within that context, essential competencies for the Software and Technology domain are discussed and supported by relevant quotations pulled from interview transcripts.

The initial framework derived from the online survey consisted of seven essential and twenty-six desirable competencies. When each participant was asked why s/he considered the competencies essential, their response was recorded and transcribed. Representative examples of the responses follow.

Ability to Competently Operate Computer Hardware

This competency can be approached from two perspectives: the ability to competently operate keyboards, a mouse, and other hardware components of a system, and it can be viewed from a more macro level perspective. This macro perspective is often used when understanding the operation of a complex learning system that is composed not only of keyboards and mice but also networks and firewalls, plus alternate means of interaction with the computer (e.g., gestures, speech recognition). The following statement by one of the respondents touches on this second perspective.

> I was just trying to think what computer networks and computer hardware depending on complex system. When I work in the simulation industry, virtual simulation, then it was all about being able to have a network of computers that would work together to figure out the achievement of some training outcome. (13383536, personal communication, 2018)

Ability to Sit at a Computer for Extended Periods

Though this competency is becoming less common due to ergonomic and Human Resource-sponsored wellness programs, it remains ubiquitous and too significant a practice to ignore that instructional designers regularly input data from a sitting position. This puts great strain on the back and overall posture, which can impact performance. Every respondent recognized its importance but also lamented the reality sometimes responding in a sarcastic way when asked about this competency: “Never. Never sat at a computer for 12 hours a day to get this out on time.” (Respondent 13454604, 2018)

Knowledge of Screen Recording Software

When considering this competency, there are again two perspectives: knowing how to operate basic functions, and knowing which functions are imperative for a given contract deliverable. This is particularly the case when considering delivery in a mobile learning environment, when form factors vary significantly from that of desktops. Knowledge of how to adjust the screen to fit a specific form factor it essential as well as knowledge of what screen recording software includes that functionality and flexibility. This is suggested in the following respondent quote:

> When you go in a mobile situation, you're faced with more technical challenge there and that is … and it's a design. There's definitely a design challenge as well where you have to have a design that will accommodate a much smaller [mobile format] screen. (13463589, personal communication, 2018)

Knowledge of Instructional Design Using Learning Management System Software (e.g., Blackboard and Moodle)

Most online learning systems were delivered and tracked using either a Learning Management System (LMS) or a Content Management System (CMS). Though current technology like the Experience API (xAPI) have supplanted the LMS as the leading edge of delivery technology, this change will not occur overnight. As a result, many CLDs will continue to be provided through LMS technology. For this reason, this competency continues to be viewed as essential, as stated below:

> A year ago, we had the decision of leading our company toward using html 5 and we used the different tools that were available. For those of us already familiar with Captivate, we just lean on it even more heavily because it outputs SCORM compliant information that [works] with multiple LMSs with no trouble. (13444572, personal communication, 2018)

Knowledge of ISD Authoring Software (e.g., Captivate, Articulate, and ZebraZapps)

Not all CLDs require knowledge of authoring software, such as those designed within a team environment that encourages specialization of competencies and a broader spectrum of roles. Still, the advent of enhanced authoring software functionality and usability makes these tools more essential for everyday instructional designer use, as noted by one of the respondents.

> Being in the realm of experience that I have, Captivate is my go-to tool. I've used others (i.e., Articulate, ZebraZapps). Those are good tools but having some familiarity with one of those pieces of software, I think is essential to creating a CLD. (13444572, personal communication, 2018)

Ability to Design Instruction for Asynchronous Technology

Asynchronous technology switches instruction from a teacher-centric approach to a learner-centric one where the instructional designer creates content that allows each student to learn at their own pace, as stated here: “…but with the asynchronous portion of it, excuse me, you are really guiding that toward the individual learner, saying, I'm going be able to instill something in this course that lets people go at their own pace.” (1345604_1b, personal communication, 2018)

Another perspective of the essential nature of asynchronous technologies is how this facilitates team/stakeholder communication, such as described in the following statement:

> Time zones, if your customer, and I've had customers who were on the West Coast and I'm on the East Coast, there could be a three-hour time difference. You have to be cognizant of that and you have to be able to say, "Hey, I'm going to put this information down" or, "I'm going to record our conversation” or, "I'm going to record a meeting and I'm going to put it online for you to view because you can attend that meeting but I'm going to put it here" or, "I'm going to put a note here." (13463589, personal communication, 2018)

Possess Skill Designing Instruction Using Storyboarding Software

One theme that was raised about storyboarding was the rationale for selection of the storyboarding tool Some instructional designers/teams use specialized or proprietary software tools while other use Commercial off the Shelf (COTS) solutions such as those described in the following statement:

> “We typically use either PowerPoint or Word. The reason we've done that is at the storyboard phase, that allows both our SMEs to still be involved because they understand the software easily enough. They can draw a text box and write the comment in or something to that effect. It also allows more complex multimedia teams on that side to say it is kind of what I was thinking,” (13444572, personal communication, 2018).

This perspective often becomes subservient to the "whiz-bang" capabilities of specialized and proprietary tools. However, this response points out an important aspect of complex instructional designs: the need for a team-based approach. It is important to remember that not all team-members will have the same level of competency with various software tools so COTS tools may often be the best option for a project team.

Framework Domain 7: Organization and Management Competencies

Ten Organization and Management domain themes emerged during analysis of the interview transcripts. The main themes included Configuration Management, Time Management, Data Organization, Budget, Personnel Management, Project Management, Course Management, Design Management, Prioritizing Tasks, and Team Management. Within that context, each Organization and Management domain's essential competencies are discussed and supported by relevant quotations pulled from interview transcripts.

The domain consisted of seven essential and four desirable competencies. When each participant was asked why s/he considered the competencies essential, their response was recorded and transcribed. Representative examples of the responses are generally included with each competency description in the sections that follow.

Ability to Manage Time

Instructional designers typically work according to stringent timetables, as outlined in integrated master schedules (IMS) or Kanban boards in agile design and development teams. Completing tasks within allotted timeframes requires close monitoring of design priorities and managing time for individual line items that often change with evolving designs. While this competency requirement is not new, CLDs often require management of more Schedule line items than traditional linear designs.

> Time management became so crucial because we needed to basically work ahead because we knew it would change. Outside of what the customer wanted, just with this internal input, we had to manage the time and build in time into our process for something that would definitely change. (13444572, personal communication, 2018)

Time management is not solely about the individual instructional designer, it also relates to team consensus and project management. Team time management becomes especially important when designing complex solutions, as pointed out in the following statement: “Time management is not just using your own time individually to do whatever you need to do, your tasking. It's also time management more at a higher level: How do we use the team effectively?” (13383536, personal communication, 2018)

Possess Organizational Skills

One of the potential issues that CLDs poses is the amount of data inherent in many systems. These systems often require maintenance and/or operational sequences of steps, each of which must be documented. Also, many CLD systems are composed of many components. Conversely, though soft skill learning designs may not have many components, the logic-based pathways that learners might follow can accumulate significant amounts of data which can significantly increase the complexity of this type of design. In both cases, keen organizational standards and skills are needed to efficiently and effectively organize and manage the design of CLDs, as noted below:

> …organizational skills, yeah, because you're going to come across an immense amount of data and information. You need to be able to organize that information in a place where you can see it and be able to put it in a place where other people can see it and have access to it. (13463589, personal communication, 2018)

Interviews respondents pointed out that not everyone on a team has the same organizational approach and ability, so certain basic team rules should be specified for all members to follow:

> People don't know how to organize things sometimes. Sometimes it's just naming these folders correctly. Maybe going through together as a team. Maybe we should have the same folder structure or ... To me it's basics that, as a team, you need to address so that we're all on the same page. (13383536, personal communication, 2018)

A different respondent identified the need to assign appropriate personnel to ensure the team will be able to navigate through the avalanche of potential data involved in the design of CLDs.

> I think organizational skills; you want to have a place to go to see what's being designed. You want to have a place to go for the technical manuals and you want it organized in such a way as people understand what they're looking at. I have an example of a time when we had subject matter experts on the team. One of them was in a design role because he was good, and he had the military background and he understood the content. He took all the technical manuals and organized them in different folders per specialty. (13463589, personal communication, 2018)

Ability to Manage Work Priorities

Two aspects of this competency arose during the interviews: internal and external priorities. The first statement by a respondent addresses the internal team/individual set of priorities.

> I also understand that the other side of this question is can you prioritize your work in the development of a CLD? The… example I would use is let's make sure our text to speech engine is pronouncing a word a certain way before we worry about the close captioning timing. Okay, let's prioritize our work that way. (13444572, personal communication, 2018)

The second statement deals with the, often divergent, priorities of external stakeholders. Instructional design teams often meet this type of issue, which impacts the internal team's pre-existing set of priorities.

> Each one of them [Subject Matter Expert: SME] basically are pushing for one priority or what they think is the highest priority. You need to adapt; you need to be able to adapt. See sometimes with these some priorities are more important at a point in time and some other time things are different. You need to give more priority to other elements. (13383536, personal communication, 2018)

Possess Project Management (PM) Skills

The previous essential competency discussed how priorities often vary according to the different role (ISD, PM, or client) the options are viewed from. The Project Manager's project perspective may vary from that of the typical ISD, creating conflict. The following respondents statement addresses this situation:

> That's the part that I don't think ISDs understand that they don't get to take off the ISD hat because that's what they do. So, they sometimes miss things that may not necessarily be obvious to them because they are thinking like an ISD, and not necessarily like an outsider, or observer, or student. (13248514, personal communication, 2018)

There are occasions where instructional designers are also called on to assume project management duties. The following statement notes this fact and expands on the previous respondent's statement:

> …oftentimes instructional designers become project managers and there'll be some back and forth on that. So, I think it's mainly because of the systems theory. I think it's important that project management and instructional design, I think there needs to be a close relationship there. (13454446, personal communication, 2018)

Ability to Work Under Deadlines

Deadlines are the foundational requirement when discussing any learning system design and development project. Integrated Master Schedules (IMS), Work Breakdown Structures (WBS), and KANBAN boards all establish deadlines for constant monitoring of project health. It's a fact of life for contact work but becomes more difficult, and therefore essential, to master as the complexity of the project increases. No matter what the circumstances are, the deadline must be met, as described in the following statement:

> … when you are on a contract, because you know, the company really needs each person ... they put a proposal out that says, we're going spend this many hours creating this course, and so if the designers have some ramp up time, that may of been figured in, but if something goes wrong, or if something's delayed from the customer, and your ramp up time is shorter, you somehow have to still meet the deadline. (13454604, personal communication, 2018)

One respondent related meeting deadlines to time management and troubleshooting competencies related to meeting deadlines: "… so to me, working under tight deadlines is ... it's being able to manage your time, but it's also being able to troubleshoot things and get over hurdles in a faster period of time as well." (13454604, personal communication, 2018)

Possess Customer Service Skills

Some respondents believed the customer service competency is strongly related to interpersonal communication and negotiation competencies.

> I think from an ISD standpoint, not to say that customer service could be the most essential, because ideally, that's what you're doing. You're providing something to our customers, but maybe from an ISD standpoint, because you're not the customer service rep. That's not necessarily your skill set, but you still ... Any time you interact with a customer, you're basically providing customer service (13454446, personal communication, 2018).

> Customer service skills, yeah, absolutely. That's not just with your customer but that's with the other people on the team. Hey, people have bad days. Sometimes, people just have bad days and you need to be able to deal with that. (13463589, personal communication, 2018)

Ability to Work on Multiple Projects (multitask)

There are two aspects of multitasking that arose from the interviews. The first dealt with the fact that instructional designers are often working on multiple projects in various stages of development. The importance of being able to multitask is expressed in the following interview statement:

> Everybody used to have to multitask and you do have to do that in instructional design because you have a project. You may be working on a project that's in different stages. You may be working on three lessons at once. One of them is in the storyboard stage. One of them has graphics that you need to look at and maybe another one's already been programmed. (13463589, personal communication, 2018)

The second multitasking aspect that emerged involved learner multitasking caused by the design that can result in cognitive overload. Instructional designers need to be aware of this possibility due to the complexity and multi-modal aspects of current educational delivery technologies. This issue is associated with multimedia theories that address the multimodal channel inputs (Mayer, 2009) that must be managed by instructional designers through their selection and mix of media used in the design, as described by the following statement from one of the respondents:

> … you don't want to overload the user as they are learning something new. Then for example, … you either read or you speak…. The learner learns best when he's concentrating on one [channel]… This multitasking is not proven to be effective in terms of retention. (13383536, personal communication, 2018)

Phase 4 Results: Framework Internal Validation

Ten experts were recruited and agreed to participate in the competency framework validation (Appendix H). Two members dropped out before completing the first round, after which one additional expert joined the panel. The final nine panelists completed all three rounds. Consensus for essential competencies was obtained when a minimum of 75% panel members (7 of 9) rated the competency essential. Consensus for desirable competencies was obtained when 67% or more of the panel members (6 of 9) rated the competency as either desirable or essential. Table 17 provides the running and cumulative totals of essential and desirable competencies included in the framework.

Expert Panel (Delphi) Results by Round

Consensus was reached after three rounds were completed. Table 17 shows the ascending competency totals that reached consensus from Round 1 to Round 3. As Table 17 shows, the panel reached consensus on 19 essential and 16 desirable competencies in round one, and 9 more essential and 15 desirable competencies in round 2. Two additional essential and 18 desirable competencies obtained consensus in the third and final round, producing a total of 30 essential and 49 desirable competencies in the framework. Appendix I contains the full list of essential and desirable competencies.

Table 17
Competency Consensus – Cumulative and Running Totals by Round

Domain \ Round	Competencies - Consensus by Round					
	Round 1		Round 2		Round 3	
	Essential	Desirable	Essential	Desirable	Essential	Desirable
1-Standards and Requirements	0	1	1	3	1	5
2-Analysis and Assessment	5	1	5	1	5	2
3-Design Models and Methods	4	3	8	3	8	4
4-Learning Theories	2	0	2	0	2	5
5-Communication and Collaboration	3	0	3	0	5	2
6-Software and Technology	0	8	2	21	2	27
7-Organization and Management	5	3	7	3	7	4
Running Totals	19	16	28	31	30	49

Preliminary versus Validated Framework Results

Eight Design Models and Methods domain competencies, seven Organization and Management domain competencies, five Analysis and Assessment, and five Communication and Collaboration domain competencies were validated essential from the survey results, while five Standards and Requirements, five Learning Theories, and 27 Software and Technology domain competencies were rated desirable. In comparison, the essential competencies resulting from the Phase 1 survey and the Phase 4 Delphi panel vary in several of the domains. Table 18 compares the results of the Phase 1 survey and Phase 4 Delphi framework. Even though the totals from both samples returned similar (78 versus 79) number of competencies, not all individual domains returned the similar numbers in the Essential and Desirable competencies. More striking is the near inverse nature of the disparity between Essential and Desirable data in several domains (e.g., Standards and Requirements and Learning Theory domains) and the totals for both categories of competencies. Finally, it is noteworthy that only one Standards and Requirements competency and two Software and Technology competencies were considered essential by the expert panel.

Table 18
Preliminary and Validated Frameworks

Domain	Preliminary		Validated	
	Essential	Desirable	Essential	Desirable
1.Standards and Requirements	4	1	1	5
2. Analysis and Assessment	5	1	5	1
3.Design Models and Methods	9	3	8	4
4.Learning Theory	5	0	2	5
5.Communication and Collaboration	7	0	5	2
6.Software and Technology	7	26	2	27
7.Organization and Management	7	4	7	4
Total	**43**	**35**	**30**	**49**

The ETMCS survey results in phase two excluded twenty-six competencies based on their median and mode values. However, there was no method by which individual suggestions could be objectively selected for inclusion in the framework during the survey phase. The consensus-building methodology inherent to expert panels provided an opportunity to solicit edits and suggestions for adding new competencies to the preliminary framework. As a result, four competencies from the preliminary framework were edited and six new competencies were added to the final framework. Several domains show significant difference between the survey and Delphi panel competencies. These differences are noted below:

- The Standards and Requirements and the Learning Theory domains exhibit an almost inverse profile between what the survey sample and the Delphi panel rated as either essential or only desirable competencies.
- The remaining five domains exhibit similar proportions of essential versus desirable competencies.
- The expert panel results tended to rate fewer competencies essential when compared with the initial framework derived from the survey.

Table 18 indicates that five of the seven domains returned fewer essential competencies from the validation process when compared against the number determined from the survey results. Also, the total number of essential competencies (43 versus 30) reinforce this rating tendency.

Though software and technology are major drivers of the complexity that inhabit most CLDs, both the ETMCS survey and Delphi panel ratings indicate that most individual software or technologies are desirable but not essential.

Final Delphi Panel-Validated Framework

Essential and desirable competencies of the validated framework are provided as a list in Appendix I. The list includes the seven competency domains, with thirty essential and forty-nine desirable competencies.

Summary

Chapter 4 provided the results to the four phases of this research: Survey administration, preliminary framework development, semi-structured interviews, and framework internal validation. The phase one survey was based on the ETMCS validated survey instrument. In addition to the ETMCS, demographic and experience data was collected. 420 respondents completed the full survey of 105 questions. Survey data indicated a geographically dispersed sample spread over ten countries, primarily residing in the United States, India, and Canada. Most of the respondents were experienced instructional designers (ten+ years of experience), with 90% having worked in the field for more than seven years. A wide range of work environments was represented in the results, including higher education, corporate, professional services, government, military, and independent contractors. Most of the respondents had instructional design experience with multiple types of CLDs.

Construction of the preliminary CLD framework was based on the central tendency data obtained from the Likert scale items contained in the ETMCS survey instrument. Based on the median and mode data, two categories of competencies were defined: essential and desirable. The two categories of competencies were then identified as either knowledge, skill, or ability (KSA) competencies, returning 76 total essential and desirable competencies.

Each of the qualifying competencies was then organized into one of seven domains: Standards and Requirements, Analysis and Assessment, Design Models and Methods, Learning Theory, Communication and Collaboration, Software and Technology, and Organization and Management. The preliminary framework consists of the seven domains and its associated essential and desirable competencies.

The third phase of this research consisted of semi-structured interviews of volunteers from the ETMCS survey. Open-ended questions were asked concentrating on eliciting more data on their perceptions of the nature of two areas of interest: (1) the nature of complexity in instructional designs, and (2) the rationale for rating specific ETMCS competency items as essential for CLD work. This phase served to flesh out the results obtained from the ETMCS instrument by providing context through examples.

Internal framework validation was conducted using the Delphi method. The panel completed three rounds to reach consensus. During that time, several new (or revised) competencies were suggested and confirmed by the panel. This altered the final number of competencies from that of the preliminary framework. The validated CLD framework consisted of the same seven domains, but with 39 essential and 40 desirable competencies for a total of 79 competencies.

Chapter 5
Conclusions, Implications, Recommendations, and Summary

Conclusions

In general, this research addressed the five research questions posed at the beginning of the study. This section will consider each of the research questions and discuss to what extent this research answered each question, as well as discuss the implications, strengths, weaknesses, and limitations of the study.

Research Question One

Research question 1 asked: "What competency models or frameworks relevant to the creation of CLDs have been reported in the literature?" This question sought to identify competency frameworks that identified competencies (i.e., knowledge, skills, and abilities) related specifically to the creation of complex learning designs. Though the literature did reveal numerous frameworks dealing with instructional design competencies, none were found that specifically identified competencies related to the creation of CLDs. The IBSTPI framework did describe specializations within the instructional design profession, noting that expanded roles, distributed expertise, and increased design complexity required specialization within the profession (Koszalka, et al., 2012). The specializations presented required an increased emphasis on some of the general competencies provided in the IBSTPI competency framework. While these elements are factual, the framework did not increase the specificity of the competencies in order to account for these changes. Results of this research provide greater specificity on competencies associated with CLDs.

Research Question Two

Research question 2 asked: “What do instructional designers perceive as the necessary competencies for the creation of CLDs?” This question sought to identify the perceptions of working instructional design professionals about what competencies were needed to create complex learning designs. This question was addressed in three of the four phases of this research: the online survey, the semi-structured interviews, and the expert panel rounds. The survey identified competencies that were defined as either essential or desirable, while the semi-structured interviews further developed an understanding of the instructional designers’ perceptions. The Delphi panel, composed of experts in the creation of a range of CLDs, served to validate the preliminary framework created from the earlier phases of the research. This validation resulted in the final CLD competency framework detailed in Chapter four, which consists of seven competency domains and 79 competencies (30 essential and 49 desirable).

Research Questions Three and Four

Research question 3 asked “What competencies are identified by instructional designers experienced in CLDs are also included in the 2012 IBSTPI Instructional Designer Competency Framework?” Research question four asked a similar question: “What competencies identified by instructional designers experienced in CLDs are not accounted for in the IBSTPI organizations’ 2012 Instructional Designer Competency Framework?” Both questions were addressed by the design of the framework.

Table 19 compares the CLD and IBSTPI frameworks side-by-side.

Table 19
Comparison of CLD and IBSTPI Frameworks

CLD Framework	Competencies Essential	Competencies Desirable	IBSTPI Framework	Comp.	Perform. Statement
Standards and Requirements	1	5	Professional Foundations	5	28
Analysis and Assessment	5	2	Planning and Analysis	4	20
Design Models and Methods	8	4	Design and Development	7	26
Learning Theory	2	5	Evaluation and Implementation	3	14
Communication and Collaboration	5	2	Management	3	17
Software and Technology	2	27	Competencies and Performance Statements	22	105
Organization and Management	7	4			
Domains and Competencies	30	49			

The IBSTPI framework is considered the gold standard of professional standards and competencies for instructional designers, which McLean and Scott (2011) describe:

> The IBSTPI competencies are now commonly used to set standards and define professional training programs in both academic and corporate environments. They provide a basis for drafting job descriptions and describing roles and are in themselves a research resource with a bibliography listing the key literature of instructional design (p. 564).

In order to cover the full scope of a professional field the IBSTPI framework is somewhat generic, making it relevant across a broad set of use cases. This research produced a CLD Framework that focuses on complex learning design and is applicable to a narrower spectrum of use cases directed specifically at a category of instructional design work. does not have this requirement. Rather it was directed specifically at a category of instructional design work. As such this research can be viewed as a subset of the broad IBSTPI model and an attempt to expand the knowledge base provided by already existing competency frameworks of that ilk.

Both frameworks' narrative and competencies recognize the changes occurring in the instructional design profession due to differences in learners, expectations, methods, and technology. However, a major difference between the CLD Competency Framework and the IBSTPI Instructional Designer Competencies framework is the initial steps taken to construct each framework. The IBSTPI framework construction started with four levels of analysis, the first being the job role (Koszalka, Russ-Eft, & Reiser, 2012, p. 10), whereas the CLD framework began by examining the competencies required for successful complex learning design and development efforts. In effect, this comparison results in a top-down approach (IBSTPI - identifying job roles first) versus a bottom-up approach (CLD - starting with requirements for complex learning designs).

Nevertheless, similarities are found in management, analysis, and design and development methods competencies. Both frameworks include a management domain. Unlike the IBSTPI model, the CLD framework examines management from a perspective beyond project timelines, costs, and personnel. This perspective includes consideration for the impact of multi-discipline teams and large amounts of data and documentation required for CLD. Competencies for configuration management and data management become more important with increased complexity of design associated with CLDs.

The CLD framework places an enhanced importance on communication and collaboration competencies. This focus may be attributed to the common requirement inherent in many geographically dispersed and multi-profession teams required to design and develop this era's complex designs.

Another difference between the two frameworks is the greater specificity regarding technology competencies that impact instructional designer's roles and the need for instructional designers to quickly adapt to new and different technologies.

Research Question Five

Research question five asked the following: "What characteristics do professionals working in the instructional design field believe defines complexity in a CLD?" This research question was addressed during the survey phase. Respondents were asked a question about what made an instructional design complex. Follow-up questions were then asked during the semi-structured interviews of phase two.

Two themes were present: complexity was viewed from both the instructional designer's perspective as well as the learner's perspective. A full section in Chapter 4 dealt with the results of these questions. Four characteristics of complexity were identified through these inquiries: (1) complexity due to technology, (2) complexity due to performance-based content and assessment, (3) complexity due to geographic dispersion (of both design teams and learners), and (4) complexity due to design differences in design processes (e.g., agile not linear and concurrent not static).

Strengths of this Research

Design and Development Research Approach

This four-phase inquiry into a specific subset of competencies for the instructional design of CLDs is a key strength of this Design and Development research. This assertion is based on the use of both qualitative and quantitative methods in performing the four phases of this research.

Learning Design Perspective

Instead of creating a framework based on analysis of job descriptions this framework begins with the requirements of CLDs and builds from that point upward. This makes this framework specific to a category (complex) of instructional design solutions rather than that of the whole of instructional design. While complex learning design incorporates instructional design competencies common to all instructional design applications, it requires competencies not specifically addressed in more generic frameworks. This research provides both a quantitative and qualitative view of what working instructional design professionals find essential for today's CLDs.

Geographically Dispersed Survey Sample

While other studies, as reported in the Review of Literature, have relied on a narrowly focused sample population (i.e., instructional designers working in higher education), the use of LinkedIn connections allowed this research to cast a wide net that is represented in the breadth and depth of the demographic and experience profiles reported in the survey. This research reflects perspectives from working professionals across 10 countries and a wide range of learning environments.

Survey Sample Size

The 420 respondents who completed the full survey exhibited a high level of experience, with 88% having more than three years of experience, which was expected by this researcher based upon decades of experience leading to anecdotal assumptions. This assumption seems to be born out with the multiple types of CLDs each respondent reports experience with, which hints at a high level of relevance for the data collected since experienced instructional designers are more likely to be tasked to work on complex designs.

Validation of the Framework

The final competency framework that emerged from the Delphi panel validation included many software and technology-related competencies. However, of the 29 competencies related to software and technology, only two were considered essential by the panel. The two competencies deemed essential by the Delphi panel contrasts with the seven deemed essential in the online survey (Table 20). This highlights the strength of the four-phased approach used in this research. Without the Delphi panel validation, it's quite possible the Software and Technology domain would dominate the essential competency findings.

Implications

This competency framework was designed from the ground up viewing competencies from a perspective of an instructional design process that can effectively create the CLDs common today. This is an approach that differs from most other competency frameworks that are designed from analysis of generic job postings or commonly accepted practices of this profession. Given the specialized requirements common to many instructional design contracts, it seems appropriate that future frameworks consider viewing competencies through the lens of the end-product, rather than the standardized job titles of instructional design personnel.

Because CLDs often involve sophisticated technologies, most competencies in this framework are centered on various technological skills. However, because of the complexity of the learning design (Koszalka, et al., 2013), multi-discipline teams (rather than singular ISDs) are typically involved in the design and development process. As a result, technological competencies are not often associated with the duties of an instructional designer. Rather, another member of the design and development team, such as a graphic artist or a programmer, is responsible for providing the team's technological competence.

The CLD framework reflects a different facet of technology that is important for all instructional designers to master: the adaptability to learn new software and technologies as well as the terminology and vernacular of different professions in these multi-discipline teams. The instructional designer must be fully engaged with the development team as the CLD evolves, ensuring the design adheres to instructional validity. The need for instructional validity provides the basis for analysis and evaluation competencies.

Due to the inherent complexity of CLDs, designs require a greater emphasis on complex analysis (Hirumi, et al., 2010) of both the internal and external conditions of learning. The specific CLD framework domain allocated to Analysis and Assessment supports the implication that complex learning designs elevate the importance of analysis.

Though design competencies, such as multimedia design, usability, and visual layout, were included in the CLD framework, they are far less in number than technological ones. The preponderance of technology-related bias doesn't minimize the importance of competencies like multimedia design, usability, and visual layout. Rather, the discrepancy should be expected given the educational technology roots of the base ETMCS survey. Two results substantiate this assertion: First, the results of both the survey and expert panel indicated that few Software and Technology competencies are viewed as essential to CLDs. This implication is verified in the final framework: Of the 29 validated framework competencies in the Software and Technology domain, only one, "Basic knowledge of Microsoft Office Suite (e.g., Word, Excel, PowerPoint)," was deemed essential by the expert panel. Beyond the Office Suite, one other technology competency is viewed as essential in the final framework. It is found in the Design Models and Methods domain: The "Ability to adapt and learn new technology and processes." Recognizing the differences illustrated by these two competencies is key to understanding the nature of working on CLD projects. When presented with a smorgasbord of possible software and technology options, no ISD will ever be proficient in every technology. This requires the essential competency of adaptation.

The implication of adaptation is that though technology is ubiquitous in the ISD field, recognition of the criticality of adaptation requires institutions that graduate new instructional designers or companies that update employee skillsets avoid concentrating on technology to the detriment of traditional ISD competencies. However, the existence of so many technology-based competencies also implies the need for the traditional domain competencies to integrate and align with advancements in technology.

Limitations and Weaknesses of this Research

Several limitations were inherent within this study. First, though the online survey reached participants across the globe, for logistical reasons, the subjects participating in the semi-structured interviews all worked in the United States. Second, because this research studied a multitude of CLDs, the cumulative results represent a high-level framework that rates competencies as either essential or desirable. This research was not able to mirror the IBSTPI framework, which provides a third level labeled Performance

Statements in its framework. This limitation can be mitigated if follow-up research is conducted by a team (rather than an individual researcher), allowing researchers to reconcile individual interpretations of interview data and interact with a larger interview sample size.

While this research compiled similarities of the type and criticality of competencies needed for the design of complex designs, it did not address the differences between various learning designs and their scale of complexity. For example, competencies required for simulation design differ in some respects from some of the competencies required for mobile learning.

Due to the sequential nature of research, several new competencies proposed by panel members and validated by the full expert panel were not explored in greater depth during the semi-structured interviews. While this should be considered a limitation, the impact is likely minimal since most of the competencies in question either were edits of pre-existing competencies originating from the survey or were more in-depth competencies tangentially related to existing aspects of the parent domain.

A final limitation originates from the ETMCS survey. This survey was designed for a target audience of educational technologists. The authors, Ritzhaupt and Martin (2014), used a definition of educational technologists that specifically included instructional designers; however, the heavy slant toward multimedia technology resulted in less focus on competencies common in current CLD such as social media, visual design, interface design, and usability. Though it was covered somewhat by the inclusion of multimedia theory, the application level was not specifically called out by the survey or brought up by respondents or Delphi panel members.

Recently, Ritzhaupt, Martin, Pastore, & Kang (2018) have conducted new research and have expanded the scope of competencies included in the original ETMCS instrument. An updated and expanded survey instrument has evolved from the original called the ETCS survey instrument. This instrument rectifies much of the concerns about KSAs that have evolved, such as social media competencies. This does not minimize the inherent weakness of this research, as the update to the ETMCS was not available at the time this research was being performed. Follow-up research into the impact of the updated Ritzhaupt et al. ETCS framework would be worthwhile

Recommendations

Competencies within the Analysis and Assessment framework domain, such as task analysis and needs assessment, are far more critical when designing a multi-layered serious game or a maintenance training simulation. However, as noted in some of the interviews, this domain is often overlooked in contracts whether due to budget or personnel skill constraints on the contractor. Recognition of this reality increases the criticality for accentuating it in corporate training and college degree ISD programs.

Follow-up research into the competencies required for individual types of CLDs is recommended. As noted in Chapter three, this framework does not fully replicate the structure of the IBSTPI competency framework due to the omission of performance statements for each competency. This deficiency can be rectified through a more extensive series of in-depth interviews (similar to Koszalka, et al. (2013), targeting individual types of CLD competencies (e.g., branching logic scenarios, adaptive learning, game-based learning, virtual reality, and simulations). Since there are likely common threads of competencies for most if not all CLDs, it is recommended that an ascending scale of complexity be used in the sequencing of individual types of CLDs. For example, in the three types of CLDs just mentioned, an ascending sequence of branching logic scenarios would reveal a base set of competencies, which likely would then be added to in game-based learning designs, and similarly with educational simulations. A common thread may also appear when examining a series of multi-modal learning designs such as augmented reality and alternate reality-based learning solutions. In both cases, this type of approach should provide the data necessary to properly identify performance statements necessary to add a final level to this framework for emerging aspects of complex instructional design.

Two competency domains are specifically worthy of additional research within the specific context of complex instructional design: Communication and Collaboration and Analysis and Assessment. Both domains were recurrent themes in all phases of the research. For many experienced instructional designers, used to leading the design effort, collaborating with multiple disciplines in an agile process may represent a new competency to their instructional design process. The second domain worthy of additional research is the Analysis and Assessment domain. Given the complex nature of many learning designs, it’s easy to lose sight of the learner. Having analyzed the requirements and assessed the needs of the learner, the instructional designer is best qualified to safeguard the instructional integrity of the learning system.

Learner-based factors such as good visual design standards, user interaction, interface layout, and usability are important subjects for formative and summative evaluation of the end-product. It is recommended that future research specifically explore these learner-centric competencies at a performance statement level. It is also recommended that ISD training include these competencies in their curriculums.

One of the implications discussed earlier in this chapter noted the difference in rating the expert panel assigned to the ability to adapt to new software and technology versus the rating they assigned to competencies that concentrated on specific technology. Adaptability was validated as essential. Given this information, training organizations should review their curriculum to ensure adaptability is promoted, through both cognitive and performance strategies, in every technology-related course.

Though input from instructional designers from numerous countries was included to develop this framework, the semi-structured interviews revealed the logistical issues inherent in real-time exchange between geographically dispersed persons (Churcher, Downs, and Tewksbury, 2014). Due primarily to time-zone logistical issues, future inquiries using real-time qualitative research should first be piloted with interview subjects living in in similar time zones. Alternatively, a team of instructional design researchers spread out in different time zones could collaborate for a more global research effort. In either case, efforts to broaden this research to other geographic regions is recommended as the ubiquity of more CLDs spreads globally.

Summary

Chapter 1 provided some background on the origin of instructional systems design (ISD). ISD experiences were traditionally based on the assembly-line approach adopted by the U.S. military during WWII. As such, instructional design models reflected the linear nature of assembly line processes. However, with the advent of advanced authoring and communication technologies and a new generation of learners, more complex and nonlinear designer experiences are becoming more common. Though instructional design knowledge, skills, and abilities (competencies) have been periodically updated by professional organizations, specific competencies appropriate for the more complex, contextual, and advanced instructional design experiences have not been explicitly identified. This omission was the incubation of this research and precipitated the goal of creating a competency framework for instructional designers creating CLDs. From that goal, five research questions were identified and addressed in the four phases of this design and development research. Chapter 1 also addressed the stance of this researcher, provided a formal problem statement, and listed assumptions, limitations and delimitations, as well as provided definitions of key terms and acronyms.

Chapter 2 reviewed literature regarding several areas of interest; the nature of complexity, existing competency frameworks, relevant learning theory, and types of CLDs. Chapter 2 proceeded with an examination of the affordances and mediational aspects of human-computer interaction (HCI) and, because of the differences in how computers and humans process information, its potential importance for design and testing CLDs. Chapter 2 concluded with a discussion about the impact of design teams in the creation of CLDs.

Chapter 3 described this study's methodology through its four phases: Survey Administration, Preliminary Framework Development, Semi-Structured Interviews, and Framework Internal Validation. The Phase 1 survey included three sections of questions: respondent demographics, their experience, and responses to the 105 competencies included in the Educational Technology Multimedia Competency Survey (ETMCS). A five-point Likert scale measured central tendency data which were used to define competencies into one of two types: essential or desirable. Phase 2 consisted of designing the preliminary framework. Competencies not reaching the definition thresholds for *essential* or *desirable* were not included in that framework. Phase 3 employed semi-structured interviews to better understand the responses received from the survey, while Phase 4 employed a nine-person expert panel that employed the Delphi method to reach a consensus on the competencies included in the preliminary framework. Reaching a consensus on each competency validated the final CLD framework.

Chapter 4 provided the results to the four phases of this research. Phase 1 found that of the 2401 invitations sent to prospective participants, 583 responded, and 420 completed the 105 survey items. Demographic and experience data were collected that indicated the respondents were generally highly experienced both in years of seniority and experience with the design of CLDs. Survey responses originated from ten different countries, with the majority responding from India, Canada, and the U.S.

Responses to the competencies included in the ETMCS survey were organized into categories (domains) in Phase 2. This enabled construction of the preliminary framework which consisted of seven domains: Standards and Requirements, Analysis and Assessment, Design Models and Methods, Learning Theory, Communication and Collaboration, Software and Technology, and Organization and Management. The preliminary framework consisted of 44 essential and 35 desirable competencies.

The third phase of this research consisted of semi-structured interviews of volunteers from the ETMCS survey. Open-ended questions were asked concentrating on eliciting more data on their perceptions of the nature of two areas of interest: (1) the nature of complexity in instructional designs, and (2) the rationale for rating specific

ETMCS competency items as essential for CLD work. This phase served to flesh out the results obtained from the ETMCS instrument.

Internal framework validation occurred during phase four. The Delphi panel technique was selected for the internal validation process, with three rounds required for panel consensus. The final CLD framework consists of 39 essential and 40 desirable competencies within the same seven domains identified during construction of phase two's preliminary framework.

Addressing the Research Questions

Chapter Five provided several conclusions based on how the results of this study addressed the five research questions posed in chapter one. The following paragraphs address each of the research questions.

Research question one asked what competency modes or frameworks relevant to the creation of CLDs have been reported in literature. The Review of Literature (ROL) performed in chapter two produced a large number of existing instructional design and educational technology competency frameworks, both from professional organizations (e.g., IBSTPI) and individual researchers (e.g., York and Ertmer, 2011; Wakefield, Warren, and Mills, 2012; Yanchar and Hawkley, 2014). However, no competency framework was identified that specifically addressed the instructional design competencies required to efficiently and effectively create CLDs.

Research question two is addressed in three of the four phases: The ETMCS survey instrument utilized in phase one, the semi-structured interviews in phase three, and the phase four internal framework validation. Combined, these three phases identify the perceptions of working instructional designers regarding what competencies are required for creating CLDs. These perceptions formed the foundation upon which the CLD framework was constructed.

Research questions three and four which sought to understand what competencies were common to both the 2012 IBSTPI Instructional Designer framework (Koszalka, et al., 2012) and the CLD framework. Many commonalities were found in the two frameworks, specifically in management, analysis, and design methodology. A significant difference, however, is that the CLD framework considers the level and importance of communication and collaboration required for the team-centric approach common in CLD creation.

Research questions five inquired about the nature of complexity in CLDs. Four factors were brought up by many respondents: (1) geographic dispersion of team members, (2) type of content and assessment methods, (3) advanced technologies, and (4) design processes.

In general, instructional designers need to examine their current competencies due to the rapidly increasing rate in which complexity is becoming the norm in large contracts. The findings illustrate the need for working instructional designers to enhance their competencies regarding design processes (i.e., iterative; agile; concurrent), communication and collaboration with other professionals whose fields have different perspectives, vocabulary, and technology. Without such adaptation to the current trends, instructional designers may find themselves left out of the design process of CLDs.

Appendix A
IRB Memorandum

MEMORANDUM

To: David Schubert, College of Computing and Engineering

Cc: Marti Snyder, Ph.D.

From: Ling Wang, Ph.D., Center Representative, Institutional Review Board

Date: January 31, 2017

Re: IRB #: 2017-54; Title, "Toward a Competency Framework for Instructional Design of CLDs"

I have reviewed the above-referenced research protocol at the center level. Based on the information provided, I have determined that this study is exempt from further IRB review under **45 CFR 46.101(b) (Exempt Category 2)**. You may proceed with your study as described to the IRB. As principal investigator, you must adhere to the following requirements:

1) CONSENT: If recruitment procedures include consent forms, they must be obtained in such a manner that they are clearly understood by the subjects and the process affords subjects the opportunity to ask questions, obtain detailed answers from those directly involved in the research, and have sufficient time to consider their participation after they have been provided this information. The subjects must be given a copy of the signed consent document, and a copy must

be placed in a secure file separate from de-identified participant information. Record of informed consent must be retained for a minimum of three years from the conclusion of the study.

2) ADVERSE EVENTS/UNANTICIPATED PROBLEMS: The principal investigator is required to notify the IRB chair and me (954-262-5369 and Ling Wang, Ph.D., respectively) of any adverse reactions or unanticipated events that may develop as a result of this study. Reactions or events may include, but are not limited to, injury, depression as a result of participation in the study, life-threatening situation, death, or loss of confidentiality/anonymity of subject. Approval may be withdrawn if the problem is serious.

3) AMENDMENTS: Any changes in the study (e.g., procedures, number or types of subjects, consent forms, investigators, etc.) must be approved by the IRB prior to implementation. Please be advised that changes in a study may require further review depending on the nature of the change. Please contact me with any questions regarding amendments or changes to your study.

The NSU IRB complies with the requirements for the protection of human subjects prescribed in Part 46 of Title 45 of the Code of Federal Regulations (45 CFR 46) revised June 18, 1991.

Appendix B

Approval for Use of ETMCS Survey Instrument

Approval for use of the ETMCS survey items was obtained by contacting Professor Albert D. Ritzhaupt using email. The authorization email thread is provided as proof that prior authorization was obtained from Albert D. Ritzhaupt, the ETMCS principle investigator. This thread is reproduced sequentially by date, from the initial request to author's approval, and is shown below:

From: Dave Schubert <ds1727@nova.edu>

Sent: Monday, February 29, 2016

To: Ritzhaupt, Albert D. <aritzhaupt@coe.ufl.edu>

Professor Ritzhaupt,

My name is Dave Schubert. I am writing to ask permission for use of your educational technologist multimedia competency survey (ETMCS) survey instrument, as documented in the 2014 article published in the Educational Technology Research and Development journal titled: "Development and validation of the educational technologist multimedia competency survey."

I am a doctoral student working on my dissertation with Professor Martha Snyder at Nova Southeastern University's College of Computing and Engineering. Professor Snyder can be reached at <smithmt@nova.edu>.

My professional background is rooted in training and instructional design <https://www.linkedin.com/in/daveschubert?trk=nav_responsive_tab_profile>.

My dissertation deals with instructional designer competencies appropriate for competent performance designing CLDs such as educational simulations and games, augmented/virtual reality, mobile designs, and branching scenarios.

My idea paper has been accepted and I am currently writing my dissertation proposal. A short abstract of the proposed research follows:

This research proposes to develop a framework that adheres to a design and development model development research method. The proposed framework shall represent the essential competencies required for instructional designers involved in the design and development of complex instructional design projects. Though competency frameworks, such as those published by professional organizations, exist for typical instructional design efforts a review of literature revealed a lack of frameworks available for the instructional design of complex design categories such as educational games, augmented reality, mobile learning, and simulations. A mixed method approach is proposed that will employ the use of online survey tools in concert with semi-structured interviews.

I look forward to hearing from you.

Regards,

Dave Schubert

ds1727@nova.edu

From: Ritzhaupt, Albert D <aritzhaupt@coe.ufl.edu>

Sent: Monday, February 29, 2016

To: Dave Schubert <ds1727@nova.edu>

Subject: RE: Request for use of ETMCS

Hi Dave,

I have no problem with you using the items from our survey.

Cheers,

Albert

From: Dave Schubert <ds1727@nova.edu>

Sent: Monday, February 29, 2016

To: Ritzhaupt, Albert D. <aritzhaupt@coe.ufl.edu>

Professor Ritzhaupt,

I appreciate your willingness to let me use the ETMCS survey items. I was happy to keep you posted of my progress and give notice of the results from my research.

Regards,

Dave

From: Ritzhaupt, Albert D <aritzhaupt@coe.ufl.edu>

Sent: Monday, February 29, 2016

To: Dave Schubert <ds1727@nova.edu>

Subject: RE: Request for use of ETMCS

Hi Dave,

I look forward to reading it!

Cheers,

Albert

Appendix C

Initial Contact with Survey Participants

The cover letter text, shown below, was included in the invitation to participate in research sent to self-identified instructional designers and educational technologists with established LinkedIn connections to this researcher.

"**To**: [LinkedIn instructional designer connections]

Hi [first name]. As a 1st level LinkedIn connection I'd like to invite you to participate in a survey conducted for my Ph.D. dissertation research investigating what competencies are required for the instructional design of complex, technology-mediated learning designs.

Data collected from your responses will remain confidential and no personally identifiable information was included in any publications that result from this study. Also, if you want to learn more about this research into our shared field and choose to participate, the results were made available to you at the conclusion of the research.

If you're interested in this topic and might want to participate in the 30-45 minute online survey (with optional follow-up phone interviews), then visit the following link to learn more about this research:

https://eSurv.org?u=complex_ISD_competencies.

Regards,
Dave Schubert, Instructional Designer and Ph.D. Candidate
Nova Southeastern University

Appendix D

Survey Instrument Screenshots

Appendix D presents various screenshots depicting the online survey interface. The online survey's first screen (Figure 3) introduces the research to the respondents. It provides general information about the research, defines key terminology, and provides historical context for the research.

About this Research

NSU NOVA SOUTHEASTERN UNIVERSITY
www.nova.edu

The title of this research is "*Toward a Competency Framework for the Instructional Design of Technology-mediated Complex Learning Solutions.*" To understand the goals of this research, two phrases from this title are defined:

1. **Instructional design:** This refers to instructional designs that must account for the potential of multiple outcomes and pathways that are determined by learner interaction with interdependent design elements.
2. **Technolology-mediated complex learning solutions:** This phrase refers to advanced instructional design solutions (as defined above) that incorporate computers, hardware, networks (LAN, WAN, or internet-based), mobile, virtual/augmented reality, or other technological-based mediating components. This definition does not preclude blended solutions, but does rule out instructional designs for classroom-only instructor-led instruction.

These definitions would seem to include many different types of complex learning solutions. A partial list might include instructional simulations (both software and/or hardware-based), game-based learning, augmented reality, algorithm-based adaptive learning systems, virtual reality, mobile-based tours, and rule-based branching logic scenarios. This incomplete list does not preclude other types of complex solutions, so please include any types that are not specifically mentioned.

The context of this research

The increased impact of 21st Century communication and computer technology has dramatically "moved the needle" on what is possible for an instructional designer to create. As a result competencies that worked well in a "Click Next to Continue" electronic leraning enviornment are often insufficient in today's networked and ubiguitous technologically-dominated world. Competency frameworks that were created only a decade ago do not necessarily indicate what instuctional designer's need to be able to know and do to perform their work competently.

So the goal of this research is to identify what competencies are needed in these more complex instructional designs that, because of technology, are enabling more complexity. If you are involved with advanced instructional design activities, then this is an appropriate research study for you to participate in.

"Toward a Competency Framework for the Instructional Design of Complex, Technology-mediated Learning Solutions"
Dissertation research. ©2017: David Schubert, ".

Figure 1. Survey Introduction

Figures 1 and 2 delve into the approach used by the survey. They also describe how collected data is stored and kept confidential.

Context and Confidentiality

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Confidentiality of Responses
All answers to this survey will be kept confidential. Only the researcher will review and have access to the individual results of this survey, and those results will be kept in a locked safe stored in a secure location. Results will be aggregated so no individual names will be used in the final dissertation report or any follow-on article or periodical. This research has been reviewed and approved by the Nova Southeastern Institutional Review Board (IRB).

Survey Components
This survey consists of two parts, as described below:

- **Part 1** will ask about your level of experience with complex learning solution designs as well as various demographic questions.
- **Part 2** will present lists of instructional design competencies. Each competency items will have an associated with a 5-point Likert scale inquiring about the importance of each competency for the design of complex, technology-mediated learning solutions.

N-IPT - Not important
S-IPT - Somewhat important
IMPT - Important
V-IPT - Very important
ESS - Essential

Following the 5-point scale will be an open-ended question, which will allow you to comment on the competency, make suggestions for additional competencies, or clarify how that competency is applied in your work. Your comments and suggestions will be extremely helpful for construction of a representative competency framework.

Please continue to the next page.

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Figure 2. Survey Confidentiality

Figure 3 obtains participant consent by presenting a consent statement followed by a checkbox where the participant agrees to participation based upon that consent statement. Figure 4 presents one of the first set of questions from Section 1 of the survey. Section 1 asks for personally identifiable information, such as name, contact information. Also, demographic and level of experience data are sought in this section.

Consent to Participate

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"I have read the description of this research and the Informed Consent statement described on the previous pages. I fully understand the intent and information requested by this survey and voluntarily consent to participate. All of my questions concerning this research have been answered. If I have any questions in the future about this study, they will be answered by contacting the Principal Investigator by email or phone or by contacting the Nova Southeastern Institutational Review Board (IRB), as provided on the previous page.

*** "I have read the informed consent shown on the privious page and fully understand the contents of this document and voluntarily consent to participate. All of my questions concerning this research have been answered. If I have any questions in the future about this study, they will be answered by the Principal Investigator listed above.**

"I understand that selecting the "Agree" checkbox signifies my consent to participate in this study."

○ **I agree to participate in this study.**

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Figure 3. Survey consent

Part 1: Some information about you

This section will ask you several questions about you so that analysis of data will help theresearcher better understand the relationship of answers with various demographic markers. Data will be coded and gathered collectively. Data will be stripped of Identifying characteristics (names, etc.) and held in a separate, secure setting. All data shall remain confidential and not be shared with anyone, except when combined as cumulative statistics or referred to by a userID automatically assigned by eSurv.org.

*** 1. Please select an identifying username that consists of 2 letters followed by 4 numerals. For example: ds1953.**
This will help ensure confidentiality of your responses.

*** 2. Please type your last name with initial Cap followed by lower case letters. Example: "Doe"**

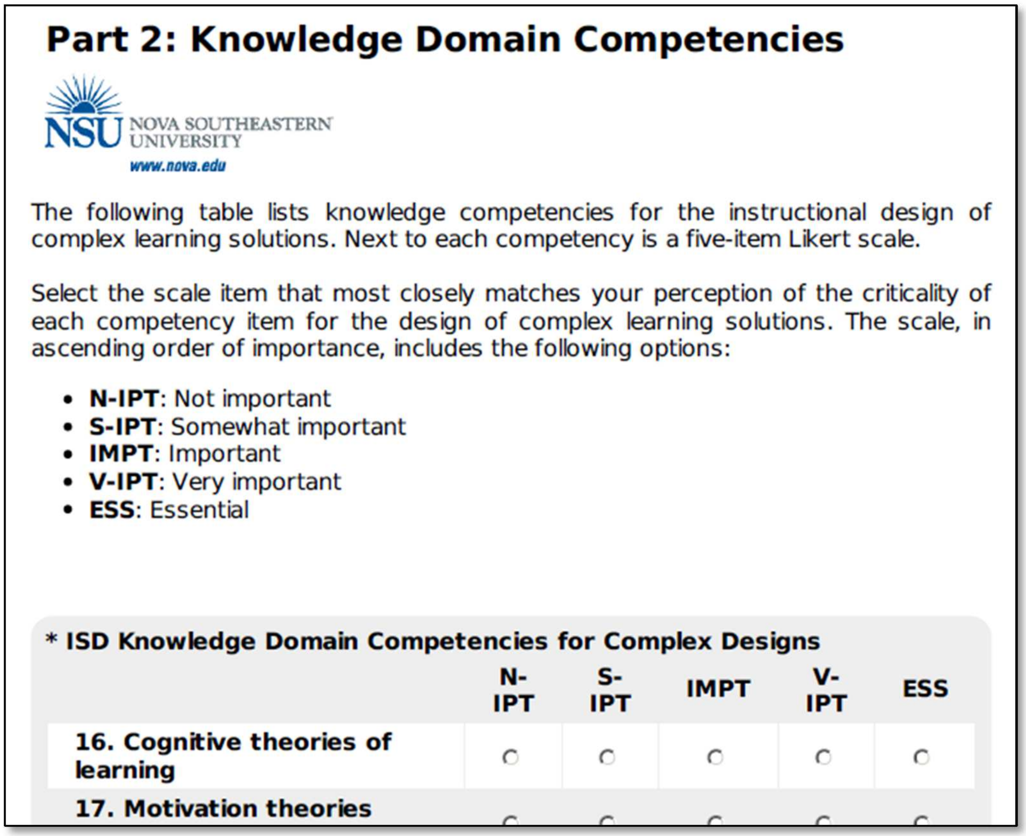
*** 3. Please type your first name with an initial Cap followed by lower case letters. Example: "Jane."**

4. What is your country of residence?
- ○ **United States**
- ○ **Canada**
- ○ **India**
- ○ **United Kingdom**
- ○ **Australia**
- ○ **Other country (Please identify)**

*** 5. What is your official job title at work?**

Figure 4. Respondent Personal Data

Part 2 of the survey dealt with rating of each competency provided in the ETMCS survey instrument. In Figure 5, we see the first Knowledge domain competencies situated in a radio-button selection matrix. This process allowed for efficiently rating each competency on the 5-point Linkert scale.



Part 2: Knowledge Domain Competencies

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The following table lists knowledge competencies for the instructional design of complex learning solutions. Next to each competency is a five-item Likert scale.

Select the scale item that most closely matches your perception of the criticality of each competency item for the design of complex learning solutions. The scale, in ascending order of importance, includes the following options:

- **N-IPT**: Not important
- **S-IPT**: Somewhat important
- **IMPT**: Important
- **V-IPT**: Very important
- **ESS**: Essential

*** ISD Knowledge Domain Competencies for Complex Designs**

	N-IPT	S-IPT	IMPT	V-IPT	ESS
16. Cognitive theories of learning	○	○	○	○	○
17. Motivation theories	○	○	○	○	○

Figure 5. Example Likert Scale

At the end of the Likert scale sections, the survey thanked participants and invited them to participate in Phase 3, a series of semi-structured interviews (Figure 6).

Thank you

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Thank you for completing this survey.

To gain a better understanding of this survey's results a random sample of participants will be asked to participate in two optional follow-on activities:

1. Two 30-45 minute interviews. These interviews will be conducted via video or teleconferencing technology and at a time convenient to you.
2. Participate as a Delphi panel expert to validate the results of this this research.

If you are willing to volunteer for either of these activities, please indicate your preferred method of contact (phone or email). Volunteers will be randomly selected for participation.

NOTE: Like the survey, data collected during follow-on interviews and Delphi panel validation will be kept confidential by this researcher and may only be used for follow-on research or the publication of aggregate results. Your User ID, not your personal name, will be used to distinguish individual responses in the research. Only the researcher will have access to both your UserID and actual name and contact information. Your information will be kept confidential and securely stored.

Are you interested in learning more about the results of this research?

- ○ **Yes**
- ○ **No**

Additional data collection may be required to clarify findings obtained during this research. Are you willing to participate further? If so, please indicate which of the following two activities you would consider participating in:

- ☐ **Phone interviews**
- ☐ **Online Delphi (expert) panel**

Figure 6. - Interview and Delphi panel Recruitment

Appendix E

ETMCS Survey Results

The ETMCS was first published in Educational Technology Research and Development by Ritzhaupt and Martin (2014). A few items that specified software were updated, replacing outdated software with current software (e.g., Authorware replaced by Captivate and Articulate).

A five-point Likert scale was used to gather data from each survey item listed in the three competency domains (Knowledge, Skill, and Ability). Central tendency (median and mode) data for all competencies are listed in Tables 21-23 due to their importance of identifying the essential competencies that constitute the CLD framework. Tables 10, 12 and 14 provide the competencies defined as essential for instructional design of CLDs.

Table 20
Demographic Data

Question	Response	%
Gender	Female	58.1
	Male	41.9
Years of Instructional Design (or related fields) experience	0-1 year	2.5
	2-3 years	6.7
	4-6 years	18.9
	7-9 years	18.3
	10+ years	51.6
Country of residence	United States	44.8
	India	15.8
	Canada	11.8
	United Kingdom	4.4
	Australia	4.4
	Other	19.7
Work Domain Experience	Corporate	30.4
	Higher Education	24.9
	Independent Contractor	11.8
	Professional Services Firms	11.5
	Military	7.2
	Government	7.3
	Other (Healthcare & Non-profit)	6.9
Official job title	Instructional Designer	39.6
	Senior/Lead Instructional Designer	23.2
	Manager/Director/Administrator	12.4
	Consultant/Advisor/Coordinator	7.4
	Professor/Teacher/Faculty	3.2
	Other	13.3
Experience with CLDs	Educational simulations	20.5
	Mobile learning environments	14.1
	Augmented reality	3.1
	Branching logic scenarios	19.8
	Adaptive training systems	6.7
	Educational games	16.2
	Virtual reality	3.6
	Level 3 or 4 interactive multimedia instruction (IMI)	12.5
	Other	3.5

Table 21
Survey Knowledge Competencies

Knowledge Competencies	Median	Mode
Cognitive theories of learning	4	5
Motivation theories (e.g., ARCS)	4	4
Adult learning theory	4	5
Instructional design models/principles (e.g., Dick and Carey)	3	3
Mayer's multimedia principles (e.g., Modality principle)	3`	3
Project management body of knowledge (PMBOK)	3	3
Accessibility (e.g., Section 508)	4	4
Copyright laws	4	5
Computer networks	3	3
Assessment methods	4	5
Computer hardware	3	3
Word processing software (e.g., Word)	3	3
Spreadsheet software (e.g., Excel)	3	3
Presentation software (e.g., PowerPoint)	3	3
Database software (e.g., Access)	2	2
Web authoring tools (e.g., Dreamweaver)	3	3
Desktop publishing software (e.g., PageMaker)	3	3
Bitmap image software (e.g., Photoshop)	3	3
Vector image software (e.g., Illustrator)	3	3
Audio software (e.g., Audacity)	3	3
Video software (e.g., Premiere)	3	3
Screen recording software (e.g., Captivate or Camtasia)	4	4

Survey Knowledge Competencies (continued)

Knowledge Competencies	Median	Mode
Educational authoring software (e.g., Captivate or Articulate)	4	5
Course/learning management systems (e.g., Blackboard or Moodle)	4	5
Content management systems (e.g., Joomla)	3	3
3D modeling tools (e.g., Maya)	3	2
Game engines (e.g., Torque)	3	3
Client-side scripting languages (e.g., JavaScript)	3	3
Flash (and ActionScript)	2	2
Cascading Style Sheets (CSS)	3	3
Markup languages (e.g., HTML, HTML5, XHTML, and XML)	3	3
Project management software (e.g., Microsoft Project)	3	2
Virtual environments (e.g., SecondLife)	2	2
Server-side scripting languages (e.g., PHP)	2	1
Programming languages (e.g., C++)	2	1
Learning object standards (e.g., SCORM)	3	4
Accessibility software (e.g., JAWS)	3	3
Web 2.0 technology (e.g., Wikis, Blogs, Podcasts, etc.)	3	4
Assessment software	3	4
Virtual classrooms (e.g., Elluminate! Live)	3	5
Streaming video technology (e.g., Windows Media Server)	3	3
Other	3	1

Note. N for each skill competency is 454.

Table 22
Survey Skill Competencies

Skill Competency Items	Median	Mode
Interpersonal communication skills	5	5
Written communication skills	5	5
Oral communication skills	5	5
Customer service skills	4	4
Negotiation skills	4	4
Statistical analysis skills	3	3
Project management skills	4	4
Time-management skills	4	5
Organizational skills	4	5
Web design skills	3	3
Trouble-shooting skills	4	5
Graphics design skills	3	3
Animation design skills	3	3
Video production skills	3	3
Print design skills	3	3
Game and simulation design skills	3	3
Storyboard design skills	4	5
Typing skills	3	3
Interviewing skills	4	4, 5
Budgeting and cost estimation skills	3	4
Editing and proofing skills	4	5
Other	3	1

Note. N for each skill competency is 430.

Table 23

Survey Ability Competencies

Skill Competency Items	Median	Mode
Work with synchronous technology	4	3
Work with asynchronous technology	4	4
Sit at a computer for extended periods	4	5
Manage teams	3	3
Work well with others (in teams)	5	5
Work independently	5	5
Work on multiple projects (multi-task)	4	5
Work in multiple operating systems (e.g., Mac/PC/Linux)	3	3
Conduct evaluation (formative/summative)	4	5
Work under deadlines	5	5
Prioritize work	5	5
Teach online	3	3
Teach face-to-face	3	2
Develop and administer sound assessments	4	5
Operate computer hardware	4	5
Adapt and learn new technology and processes	5	5
Work with diverse constituencies (e.g., SMEs and clients)	5	5

Note. N for each ability competency is 420.

Appendix F
Interview Consent Form

Consent Form for Participation in the Research Study Entitled "Toward a Competency Framework for the Instructional Design of Complex, Technology-mediated Learning Designs"

Funding Source: None

IRB protocol #: 2017-54-Web

Principal investigator (PI): David Schubert, Ed.S.

University email: ds1727@nova.edu

Personal email: cyberdiver@mac.com

Phone number: 407-580-6663

For questions/concerns about your research rights, contact:

Human Research Oversight Board (Institutional Review Board or IRB)

Nova Southeastern University

(954) 262-5369/Toll Free: 866-499-0790

IRB@nsu.nova.edu

What is the study about?

David Schubert is engaged in satisfying the dissertation requirements for a Doctor of Philosophy (Ph.D.) at Nova Southeastern University's College of Computing and Engineering (CCE), with a specialization in Computing Technology for Education (CTE). The title of his dissertation research is "Toward a Competency Framework in the Instructional Design of Technology-mediated CLDs."

The purpose of this study is to identify competencies required for successful design of complex, technology-mediated designs that include (among many examples) game-based learning, educational simulations, augmented reality, virtual reality, branching logic scenarios, and other learning designs you may be familiar with. There are four phases to this research: the online survey, the telephone/Skype semi-structured interviews, the construction of a competency framework, and a Delphi panel validation of the competency framework.

Why are you asking me?

It is expected that approximately 10-12 participants were involved in this interview phase. You been contacted because of your affirmative response to a survey question that inquired about your willingness to participate in the interview phase. Other factors included the following:

6. You indicated your current (or previous) job title as either “Instructional Designer,” “Learning Designer,” “eLearning Specialist,” “Game Designer,” “Educational Technologist,” or similar titles that indicate work duties equivalent to that performed by instructional designers.

7. You have at least three years of experience in the role as an instructional designer or equivalent job title.

8. You are available for online or in-person interviews.

9. You have indicated performing design work on at least one CLD in your work environment.

10. You have identified competencies for the design of CLDs in their responses to this study’s ETMCS survey instrument.

What will I be doing if I agree to participate in these interviews?

This phase consists of two 30-45-minute online Skype interviews based on the results obtained from the online survey you previously participated in. The aggregated results of all survey responses were provided you before the interview so you can look them over.

Approximately 5-10 open-ended questions was asked during the first interview. Based on your responses several follow-up questions may then be asked to clarify or expand on your initial response. Questions will ask whether you agree or disagree with some or all the aggregate responses obtained from the survey. For example, you might see that a specific competency is viewed by most respondents as extremely important for the design of complex, technology-mediated learning designs, but in your experience that competency is unnecessary. Or you may find that competencies you believe are extremely important are not viewed as important in the aggregate responses. In both cases, follow-up questions may seek to better understand your views by asking you to recall instances where a competency was either necessary or unneeded.

Should a second interview be necessary it will serve as a follow-up to the first and allow for a deeper exploration through general discussion and/or further examples explaining your viewpoint.

Is there any audio or video recording?

This research project will include audio and possibly video recording (if enough internet bandwidth is available and you agree to its use) of the interview. This is done so that an accurate transcript may be produced for later analysis by the researcher.

Audio (and/or video) recordings was available to be heard/viewed by the researcher, the dissertation chair, and the IRB (if required). The recordings were transcribed by the researcher either through manual transcription or use of dictation software. Transcripts was imported to software for qualitative data analysis. The recording and collected written data were kept securely in a locked safe. Data was kept for 36 months (SPECIFY) and wiped after 36 months from the removable hard drive within which is shall be stored. Because your voice (or your image and your voice) was potentially identifiable by anyone who hears (or hears and sees) the recording, your confidentiality for things you say (or do) on the recording cannot be guaranteed although the researcher will limit access to the recording as described in this paragraph.

What are the dangers to me?

Minimal risk is envisioned. However, unauthorized access to the audio/video recordings may breach the intended level of confidentiality. The procedures or activities in this study may have unknown or unforeseeable risks.

For research involving more than minimal risk, include explanations as to whether compensation or medical (or other) treatments are available if injury occurs. If such treatment was provided, indicate what it consists of, or where further information may be obtained.

If you have any questions about the research, your research rights, or have a research-related injury, please contact David Schubert. Alternatively, you may contact the Nova Southeastern Institutional Review Board through the contact information included on page 1 of this document.

Are there any benefits for taking part in this research study?

There are no direct benefits for participating in this series of interviews.

Will I get paid for being in the study? Will it cost me anything?

There are no costs to you, or payments made for participating in this series of interviews.

How will you keep my information private?

Nova Southeastern University's Institutional Review Board (IRB), regulatory agencies, the dissertation chair may review research records. All information obtained in this study is strictly confidential unless disclosure is required by law.

To maintain confidentiality, interview responses was mapped to the user ID that was assigned by the survey software employed in phase one, rather than the participant's real name. The personal ID you selected in the survey will also be mapped to this data, for easier recall in any correspondence you may initiate during or after the interviews have been completed. Data, consisting of the Interview recordings and transcripts, was kept on a removable hard drive and stored nightly in a locked safe which will only be directly accessible to the Principal Investigator. This data was maintained for a minimum of 36 months from the conclusion of the research.

What if I do not want to participate or I want to leave the study?

You have the right to leave this interview at any time or refuse to participate. If you do decide to leave or you decide not to participate, you will not experience any penalty. If you choose to withdraw, any information collected about you **before** the date you leave the study was kept in the research records for 36 months from the conclusion of the study and may be used as a part of the research.

Other Considerations:

If significant new information relating to the study becomes available, which may relate to your willingness to continue to participate, this information was provided to you by the Principal Investigator.

Voluntary Consent by Participant:

By signing below, you indicate that

- This series of two interviews has been explained to you
- You have read this document
- Your questions about this research study have been answered
- You have been told that you may ask the researchers any study related questions in the future
- You have been told that you may ask Institutional Review Board (IRB) personnel questions about your study rights
- You are entitled to a copy of this form after you have read and signed it
- You voluntarily agree to participate in the study entitled "Toward a Competency Framework for the Instructional Design of Complex, Technology-mediated Learning Designs"

Participant's Signature: ______________________ Date: ____________

Participant's Name: ________________________ Date: _____________

Signature of Person Obtaining Consent: ___________________________

Date: _________________________________

Appendix G

Example Semi-Structured Interview Questions

The following open-ended questions are examples of those that was asked during the interview sessions. Questions was adjusted according to the individual results from the ETMCS survey responses. Questions are divided into opening and follow-up question examples:

1. You indicated on the survey that you have worked on a complex instructional design project.

a. Will you discuss what your role was in a project?

b. What might you do during a typical workday during on that project?

2. This study is interested in knowledge, skills, and attitudes/abilities (competencies) you needed order to perform in the complex instructional design project(s) you've been involved in.

a. Will you talk a little about why you consider that important?

b. How did that KSA manifest itself in the design process?

c. What types of knowledge or skills did you need to brush up on to function sufficiently in these projects?

3. Tell me about a typical workday when you were designing CLDs.

a. What typical tasks did you perform?

b. Who did you work with?

c. What new skills did you need to master?

4. Did you work on a team with other professionals?

a. What types of professionals did you work with in these teams?

b. Were there challenges you encountered working in a multidiscipline team?

c. How you resolved these challenges?

5. Are there any knowledge competencies in the online survey that you think are important for designing CLDs?

6. Are there any skill competencies in the online survey that you think are important for designing CLDs?

7. Are there any ability competencies in the online survey that you think are important for designing CLDs?

Appendix H
Recruiting the Expert Panel

Establishment of the Delphi panel consisted of two steps: First, identification and recruitment. potential panel members were identified through three sources: Personal contacts, LinkedIn and referrals recommending local University faculty expert in CLDs. The initial message mirrored that of the initial contact used to recruit survey participants. LinkedIn connections were contacted using the LinkedIn messaging system, while personal contacts and university faculty were contacted by email. Ten potential panel members were contacted with all agreeing to participate after receiving a more detailed email explaining the research and their role in that research. An explanation of their rights and expectation of confidentiality was also provided.

The initial message mirrored that of the initial contact used to recruit survey participants and (for recruitment of faculty) included a referral message. The based message follows:

To: [prospective panel member]

Hi [first name]. As someone I consider an expert in the instructional design field, I'd like to invite you to participate in a 2 round Delphi study conducted for my Ph.D. dissertation research. I am investigating which competencies are perceived to be important for the instructional design of complex, technology-mediated learning designs.

Data collected from your responses will remain confidential and no personally identifiable information was included in any publications that may result from this study. Also, if you want to learn more about this research into our shared field and choose to participate, the results were made available to you at the conclusion of the research.

Second step: The second step provided additional information for the panel member to decide whether to participate or not. A hypertext link in the initial communication will direct the prospective panel member to the online Delphi panel where the following additional information is provided and a checkbox indicating informed consent is provided to access the competency framework:

Title of the Study: "Toward a Competency Framework for Instructional Design of Technology-mediated, CLDs."

Principal Investigator: David Schubert

Address: c/o Nova Southeastern University, Graduate College of Computing and Engineering, 3301 College Ave, Fort Lauderdale, FL 33314

Description of the Research: David Schubert is engaged in satisfying the requirements for a Doctor of Philosophy (Ph.D.) at Nova Southeastern University's College of Computing and Engineering (CCE), with a specialization in Computing Technology for Education (CTE). The title of his dissertation research is “Toward a Competency Framework in the Instructional Design of Technology-mediated CLDs.” There are already competency frameworks for general instructional design of linear, web-based instruction. However, no framework has been proposed for CLDs. The purpose of this study is to identify competencies required for successful design of complex designs that include (among many examples) game-based learning, educational simulations, augmented reality, virtual reality, branching logic scenarios, and other learning designs you may be familiar with. There are four phases to this research. Three of these phases, the online survey, semi-structured interviews, and construction of the competency framework have been completed. This letter invites you to participate as part of a Delphi panel to validate the competency framework constructed from the first three phases of the research.

Should you agree to participate in this panel, it will involve your input in at least two, but not more than three, evaluation rounds. The competency framework will consist of knowledge, skill, and attitude/ability (IKSA) competency items. The list KSA competency items originate from a list of already validated instructional designer KSAs for general instructional designs. Based on your professional experience, you were asked to evaluate the importance of each competency item for the design of complex, technology-mediated learning designs. Your responses were based on a 5-point Likert scale. Of equal importance, should you believe important competency items are missing from this framework, there was an open-ended question at the end of each KSA list for you to include your insights and general comments.

There is little risk anticipated involved in participation in this Delphi panel, and there are no direct benefits to you for agreeing to participate. Please understand even though there are no direct benefits to you, participation will enhance the instructional design profession's knowledge base relating to complex, technology-mediated learning designs that are progressively altering the role and skillset required of instructional designers. Should you submit request the results of this research, a copy was made available to you upon the completion, acceptance, and release of this doctoral research.

Cost & Remuneration: Participation is entirely voluntary. No remuneration was provided to panel members. However, access to final research results was made available to those who complete all the Delphi panel's rounds.

Right to Withdraw: You have the right to refuse to participate and may withdraw from the panel at any time.

Confidentiality: Information obtained in the Delphi panel responses is strictly confidential unless disclosure is required by law. All data was secured in a locked safe in a location only accessible by the Principal Investigator. A user ID was assigned by the Delphi panel software site to maintain confidentiality of your responses. Your name will not be used in the reporting of information in publications or conference presentations.

Questions: Should you have questions about the Delphi panel process you may contact the principal investigator by email at ds1727@nova.edu or cyberdiver@mac.com.

To participate in this Delphi panel, please verify the statement shown below and select the checkbox affirming that statement.

"I have read this letter and fully understand the contents of this document and voluntarily consent to participate. All my questions concerning this research have been answered. If I have any questions in the future about this study, they were answered by the Principal Investigator listed above.

"I understand that selecting the "Agree" checkbox signifies my consent to participate in this study. " I agree to participate."

Appendix I
Internal Framework Validation Results

1. Standards and Requirements Domain
    a. Essential Competencies
        i. Possess editing and proofing (QA) skills
    b. Desirable Competencies
        i. Ability to teach online
        ii. Knowledge of Learning Object Standards (e.g., SCORM; xAPI)
        iii. Ability to design accessible instructional products
        iv. Knowledge of Copyright Laws
        v. Knowledge of Accessibility standards (e.g., Section 508)
2. Analysis and Assessment
    a. Essential Competencies
        i. Ability to conduct a needs assessment
        ii. Ability to conduct evaluation (formative/summative)
        iii. Ability to conduct a task analysis
        iv. Knowledge of assessment methods
        v. Ability to identify optimal instructional product fidelity during media selection phase of analysis.
    b. Desirable Competencies
        i. Statistical analysis skills
3. Design Models & Methods Domain
    a. Essential Competencies
        i. Knowledge of ISD models and principles
        ii. Ability to apply sound instructional design principles
        iii. Ability to create effective instructional design products
        iv. Ability to adapt and learn new technology and processes
        v. Troubleshooting skills
    b. Desirable Competencies
        i. Possess exemplary typing skills
        ii. Possess web design skills
        iii. Possess video production skills
        iv. Ability to work independently
4. Learning Theories Domain
    a. Essential Competencies

        i. Ability to apply multimedia design principles to design and development
        ii. Knowledge of cognitive theories of learning
    b. Desirable Competencies
        i. Knowledge of Learner-Motivation theories
        ii. Knowledge of adult learning theories (e.g., andragogy)
        iii. Knowledge of multimedia design principles (e.g., Clark or Mayer)
        iv. Knowledge of affective domain theories (NEW: suggested by panel member)
        v. Knowledge of psychomotor skill instructional theories (NEW: suggested by panel member)
5. Communication & Collaboration Domain
    a. Essential Competencies
        i. Ability to work with diverse constituencies (e.g., SMEs and client stakeholders)
        ii. Possess written communication skills
        iii. Ability to work well with others in a team environment
        iv. Exhibit oral communication skills
        v. Possess customer service skills
        vi. Possess negotiation skills
        vii. Possess interpersonal communication skills
    b. Desirable Competencies
        i. Exhibit oral communication skills
        ii. Possess interviewing skills
6. Software and Technology
    a. Essential Competencies
        i. Basic knowledge of Microsoft Office Suite (e.g., Word, Excel, PowerPoint)
    b. Desirable Competencies
        i. Knowledge of Instructional Design using Learning Management System software (e.g., Blackboard; Moodle)
        ii. Knowledge of web authoring tools (e.g., Dreamweaver)
        iii. Knowledge of bitmap imaging software (e.g., Photoshop; Fireworks; GiMP)
        iv. Knowledge of instructional design using markup languages (e.g., HTML5; HTML; XML)
        v. Knowledge of instructional design using Content Management Systems (CMS)
        vi. Knowledge of Instructional Design using vector image software (e.g., Illustrator)

vii. Knowledge of Instructional Design using Desktop Publishing software (e.g., InDesign)
viii. Knowledge of Instructional Design using Game Engines (e.g., Unity)
ix. Knowledge of screen recording software (e.g., Camtasia)
x. Knowledge of instructional design using educational authoring software (e.g., Captivate; ZebraZapps)
xi. Ability to design instruction for asynchronous technology
xii. Possess skill designing instruction using storyboarding software
xiii. Knowledge of computer networks
xiv. Knowledge of instructional design for virtual classrooms
xv. Knowledge of Instructional Design using streaming media
xvi. Knowledge of computer hardware
xvii. Possess graphic design skills for Instructional Design of CLDs
xviii. Knowledge of accessibility software (e.g., JAWS) for instructional design
xix. Knowledge of Instructional Design using Cascading Style Sheets (CSS)
xx. Ability to work with multiple operating systems (e.g., Mac; PC; Linux) e of Instructional Design using Cascading Style Sheets (CSS)
xxi. Knowledge of Instructional Design using client-side scripting languages
xxii. Knowledge of programming languages such JAVA, AJAX, etc.
xxiii. Ability to competently operate computer hardware
xxiv. Ability to sit at a computer for extended periods
xxv. Possess media presentation layout design skills
xxvi. Knowledge of how to incorporate visual, audio, video, and animation elements to enhance learner experience
xxvii. Knowledge of Web 2.0 technology (e.g., Wikis, discussion forums, and blogs)
xxviii. Knowledge of Emerging Technologies such as mixed reality, procedural maintenance simulation, virtual environment, VR, simulators, part-task trainers, etc.

7. Organization and Management Domain
   a. Essential Competencies
      i. Ability to manage personal time
      ii. Possess organizational skills
      iii. Ability to manage work priorities
      iv. Possess project management skills
      v. Ability to work under deadlines
      vi. Demonstrate ability to work on multiple projects (multi-task)
   b. Desirable Competencies
      i. Knowledge of project management software (e.g., Project)

ii. Possess budgeting and estimating cost skills for instructional design contracts
iii. Ability to Apply Project Management body of knowledge (PMBOK) to the management of complex instructional designs
iv. Demonstrate ability to manage teams

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