A Model of Expert Instructional Design Heuristics Incorporating Design Thinking Methods

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Abstract

Novice instructional designers have limited experience working with ill-structured problems, and often do not possess the mental models to effectively analyze, manage, and communicate the overall design process of new instructional design projects (Wedman & Tessmer, 1993; Rowland, 1992; Perez & Emery, 1995; Liu, Gibby, Quiros, & Demps, 2002). In their 2016 article of expert instructional design principles applied by experienced designers in practice, York and Ertmer proposed the following questions for future research, "(a) Can we teach principles to novice instructional designers? (b) What methods should we use to provide this information?" (York & Ertmer, 2016, p. 189). This research further explored these questions and offers a new model of expert instructional design heuristics incorporating design thinking methods. The purpose of this study was to identify design thinking methods that aligned with heuristics of expert instructional design practitioners, and to design and develop a new model of heuristics and design thinking methods, which could assist novice instructional designers as they enter the instructional design field. The literature outlines challenges reported among novice instructional designers throughout the instructional design process, which includes their ability to solve ill-structured problems; conduct thorough analyses; collaborate in teams; negotiate priorities; generate a variety of ideas for solutions; overcome resource, budget and time constraints; communicate and manage projects with stakeholders; and prototype, iterate and pilot new design solutions (Rowland, 1992; Hoard, Stefaniak, Baaki, & Draper, 2019; Roytek, 2010; Liu, Gibby, Quiros, & Demps, 2002; Chang & Kuwata, 2020; Tracey & Boling, 2014; Perez & Emery, 1995; Williams van Rooij, 1993). The model offers novice instructional designers

specific methods and combinations of methods to use for every stage of the instructional design process. As instructional designers implement design thinking methods within the context of their daily situations, they should become more comfortable and begin to adapt the methods to meet their individual needs for each stage of their process.

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General Audience Abstract

Instructional design is a system of procedures for developing education and training curricula in a consistent and reliable fashion (Branch & Merrill, 2011; Branch & Kopcha, 2014). It embodies an iterative process for outlining outcomes, selecting teaching and learning strategies, choosing support technologies, identifying media, and measuring performance (Branch & Kopcha, 2014). Instructional designers use models of instructional design and instructional development to communicate tasks and procedures of the instructional design process (Andrews & Goodson, 1980).

Over the years, numerous models of instructional design have been developed and adapted to meet the varying needs of instructional designers and developers. There is a consensus that most instructional processes consist of five core elements or stages: analysis, design, development, implementation, and evaluation, which are commonly referred to as ADDIE (Seels & Glasgow, 1990; Branch & Kopcha, 2014). While often considered generic, the ADDIE framework contains a useful set of common criteria, which most designers state as important or necessary as a part of any instructional design process (Pittenger, Janke, & Bumgardner, 2009; York & Ertmer, 2011; 2016).

Novice instructional designers have limited experience working with ill-structured problems, and often do not possess the mental models (prior experience) to effectively analyze, manage, and communicate the overall design process of new instructional design projects (Wedman & Tessmer, 1993; Rowland, 1992; Perez & Emery, 1995; Liu, Gibby, Quiros, &

Demps, 2002). In their 2016 article of expert instructional design principles applied by experienced designers in practice, York and Ertmer proposed the following questions for future research, "(a) Can we teach principles to novice instructional designers? (b) What methods should we use to provide this information?" (York & Ertmer, 2016, p. 189). This research further explored these questions and offers a new model of expert instructional design heuristics incorporating design thinking methods. For this study, heuristics were defined as generalized stages of an instructional designer's process and design thinking was defined as a human-centered design process for solving complex problems. The purpose of this study was to identify design thinking methods that aligned with heuristics of expert instructional design practitioners, and to design and develop a new model of heuristics and design thinking methods, which could assist novice instructional designers as they enter the instructional design field. The literature outlines challenges reported among novice instructional designers throughout the instructional design process, which includes their ability to solve ill-structured problems; conduct thorough analyses; collaborate in teams; negotiate priorities; generate a variety of ideas for solutions; overcome resource, budget and time constraints; communicate and manage projects with stakeholders; and prototype, iterate and pilot new design solutions (Rowland, 1992; Hoard, Stefaniak, Baaki, & Draper, 2019; Roytek, 2010; Liu, Gibby, Quiros, & Demps, 2002; Chang & Kuwata, 2020; Tracey & Boling, 2014; Perez & Emery, 1995; Williams van Rooij, 1993). The model offers novice instructional designers specific methods and combinations of methods to use for every stage of the instructional design process. As instructional designers implement design thinking methods within the context of their daily situations, they should become more comfortable and begin to adapt the methods to meet their individual needs for each stage of their process.

Dedication

To my husband, Jesse Machac

Without you, I would be lost. Your support is unwavering. Your encouragement is genuine. And your love is never ending. Thank you for always being by my side. Our love is my most cherished gift.

To my sister, Suzanne Smith

Thank you for staying awake to talk to me when I drove home from class in the wee hours of the night. Thank you for listening when I simply needed to be heard. Thank you for pushing me when I wanted to quit, and for reminding me that in the end, it would be worth it. I am so lucky to have you as my big sister and my best friend.

To my mom, Marti Phillips

Thank you for teaching me what it means to be a strong woman who perseveres.

To my daughter, Leyton Machac

Up to this moment, most of your memories involve me working on my dissertation, or as you call it, “my reputation.” You recently asked me if I was afraid to fail, and I told you that I was, but that was no reason not to try. This world is so much brighter with you in it, sweet girl. Thank you for being patient as we worked together through trying times. You have been my greatest inspiration to persevere through this difficult yet rewarding journey.

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CHAPTER 1

Introduction and Need for the Study

When asked what it is that instructional designers do, a primary response of expert designers is that they solve problems (Ertmer, et al., 2008). In its most general sense, a problem is an unknown; a question raised for inquiry; a situation where one seeks to fulfill a need or goal; any instance where one identifies a need to search for new solutions (Jonassen, 1997; Arlin, 1989). Problems are defined by their problem domain, type, process, and solution (Jonassen, 1997). The domain of a problem is the content that defines the elements of a problem. The type of problem is comprised of concepts, rules, and procedures for which one must identify or follow to solve a problem. The problem-solving process is determined by the problem solver's understanding of the problem and their guidelines or heuristics for working within a situated problem or problem space. The solution represents the goal or outcome of the problem solver, which may be a convergent, single, solution, or a divergent, one of many, solutions (Jonassen, 1997). Instructional designers are presented with problems; they must be able to identify the problem; determine whether or not the problem presents a need for instruction; if yes, conduct a thorough analysis of the instructional problem or need; design, develop, and implement new solutions while concurrently evaluating the process with formative and summative evaluations (Ertmer, et al., 2008; Jonassen, 2008). Amalgamated within each of these processes is a need to transparently manage and communicate the details of the instructional design project with designated stakeholders (Rowland, 1992). The process is complex and iterative, which presents challenges for any instructional designer, but even greater obstacles for novices entering the field of instructional design practice.

Studies of instructional design practitioners have shown that experts tend to be better problem solvers than novices (Jonassen, 2008; Ertmer, et al., 2008). Experts often approach problem-solving processes by developing a big picture understanding of the problem while conceptualizing underlying principles or issues of the problem. Experts draw on past experiences to develop a clear picture of the problem and quickly identify potential solutions. This idea is supported by case-based reasoning research, which posits that experts approach new problems by referencing former cases or problem situations, and applying the information gained from former situations to new problems (Kolodner J. L., 1997). Novice instructional designers have limited experience working with ill-structured problems, and often do not possess the mental models to effectively analyze, manage, and communicate the overall design process of new instructional design projects (Wedman & Tessmer, 1993; Rowland, 1992; Perez & Emery, 1995; Liu, Gibby, Quiros, & Demps, 2002). Thus, novice instructional designers tend to rely heavily on systematic approaches of linear instructional design models to advance their processes (Reimann & Schult, 1996).

Expert instructional designers often rely on past experiences and prior knowledge to conduct analyses and manage new projects (Ertmer, et al., 2008). The knowledge attained from past or prior experiences, often referred to as 'fluid expertise,' comprises two major components of expertise: abstract knowledge and practical experiences (Bereiter & Scardamalia, 1993; Bonner, 2007). To translate principles of learning and instruction into the design, development, and evaluation of instruction, instructional designers will often use models as a reference to guide their work. Models are a "representation of reality presenting with a degree of structure and order" (Richey, 1986, p. 66). Models help create standards for design and aid practitioners in

translating theory into practice (Richey, 1986; 2005). They also help organize complex knowledge from a variety of sources for future research development (Richey, 1986).

There are two types of models used in instructional design: procedural models and conceptual models (Richey, 1986). Procedural models are prescriptive in nature and provide step-by-step guidance to a design process most often to solve an identified problem (Richey, 1986; 2005). Conceptual models are analytic in nature and aim to identify, define, and describe the relationships between variables (Richey, 1986; 2005). Conceptual models are often taxonomies, but can also exist as path diagrams, visualizations, or narrative descriptions (Richey, 1986; 2005). Most often, conceptual models are generalized to context and are developed based on experiential knowledge or a synthesis of a limited research base within the literature.

Unlike expert instructional designers who rely heavily on fluid expertise and mental models to determine next steps for new and existing instructional design projects (Ertmer, et al., 2008), novice instructional designers are less likely to possess prior knowledge, experience, or mental models for reference. As a result, novice instructional designers often report challenges solving ill-structured problems; conducting thorough analyses; collaborating in teams; negotiating priorities; generating a variety of ideas for solutions; overcoming resource, budget and time constraints; communicating and managing projects with stakeholders; and prototyping, iterating and piloting new designs (Rowland, 1992; Hoard, Stefaniak, Baaki, & Draper, 2019; Roytek, 2010; Liu, Gibby, Quiros, & Demps, 2002; Chang & Kuwata, 2020; Tracey & Boling, 2014; Perez & Emery, 1995; Williams van Rooij, 1993). Thus, a conceptual model that offers novice instructional designers strategic methods to overcome these stages of the process could prove helpful (Ertmer, York, & Gedik, 2009).

Design thinking as a process, has been used to assist practitioners with complex problem solving, which includes various stages of analysis, human-centered design, management, communication, collaboration, and evaluation (Brown, 2009; Liedtka, 2014). Brown (2009) defined design thinking as "bringing designers' principles, approaches, methods, and tools to problem solving" (p.1). Lockwood (2009) offered an expanded definition of design thinking: "a human-centered innovation process that emphasizes observation, collaboration, fast learning, visualization of ideas, rapid concept prototyping, and concurrent business analysis" (p.58). As depicted within their definitions, the operational practices of design thinkers and design thinking processes directly align with many of the instructional design processes for which novice instructional designers report challenges early in their practice.

Design thinking studies suggest that design thinking methods could offer strategic steps to overcome challenges that new instructional designers face while designing, communicating, and managing new design projects with subject matter experts and project stakeholders (Liedtka, 2014). Design thinking literature supports the idea that design thinking could help instructional designers better understand problems (Senge, 1994; Martin, 2009; Liedtka & Ogilvie, 2011), gain empathy for people and processes (Matthews, Williams, Yanchar, & McDonald, 2017), collaborate with team members (Simons, Gupta, & Buchanan, 2011), think more critically and creatively about ways to solve problems (Csikszentmihalyi, 1996; Owen C. , 2007), and evaluate and seek feedback on the success of performance and solutions (Lockwood, 2009; Liedtka & Ogilvie, 2011). The challenges faced by novice instructional designers directly align with the stated benefits of integrating design thinking processes and methodologies into every day design practices. Therefore, a new conceptual model of instructional design heuristics incorporating

design thinking methods, could offer a structure to guide novice instructional designers in the overall advancement of new and existing instructional design projects.

Purpose of Study

In their 2016 article of expert instructional design principles applied by experienced designers in practice, York and Ertmer proposed the following questions for future research, "(a) Can we teach principles to novice instructional designers? (b) What methods should we use to provide this information?" (York & Ertmer, 2016, p. 189). This research further explored these questions and offers a new model of expert instructional design heuristics incorporating design thinking methods.

While design thinking has been discussed in numerous studies in education, little attention has been given to the topic of design thinking as a process to enhance instructional design models and frameworks. This study sought to offer guidance for novice instructional designers entering the field of practice. The purpose of this study was to identify design thinking methods that aligned with heuristics of expert instructional design practitioners, and to design and develop a new model of heuristics and design thinking methods, which could assist novice instructional designers as they enter the instructional design field. The conceptual model developed in this study could help novice designers overcome many of the challenges they face with designing, managing, and evaluating new and existing instructional design projects. Although this model could enhance the instructional design process of any designer or developer, the target audience is instructional design students preparing to enter the field of instructional design and novice instructional designers with less than five years of experience working in the field.

Research Questions

The following research questions were addressed in this study:

1. What are the common stages of the instructional design process?
2. What are some challenges of novice instructional designers and how do they align with heuristics of expert instructional designers?
3. What is the relationship between instructional design heuristics and design thinking?
4. Which methods of design thinking align with heuristics of expert instructional designers?

Methodology

This study followed a type two conceptual model development methodology, as described by Richey and Klein (2007), including model development and model validation. The process included four phases. The first phase of the research included data collection through an extensive literature review, which explored common stages of instructional design processes, identified challenges of novice instructional designers and heuristics of experts in practice, explored design thinking research, and identified design thinking methods that closely aligned with instructional design heuristics. In the second phase, a proposed model for expert instructional design heuristics incorporating design thinking methods was developed based on the data from the literature review. The model was synthesized using the results of the literature review including identification of stages of the instructional design process, identification of heuristics of expert instructional designers, and selection of design thinking methods appropriate to promote each heuristic identified. In the third phase, model validation was conducted by

recruiting external reviewers within the areas of expertise in instructional design and design thinking who reviewed and provided critical feedback of the model. Responses from expert reviewers informed model revisions in the fourth phase of the study. Results of the study reflect reviewer responses and the discussion addresses responses from experts along with necessary revisions to the model.

Benefits to the Study

Recent studies of novice and expert instructional designers have explored the importance and role of instructional designers' ability to design, manage, and evaluate instructional design projects. Such studies have identified various challenges that are common among novices entering the field of practice. Expert design thinkers' processes for creating better problem solvers and creative thinkers (Liedtka, 2014; Martin, 2009) could help novice instructional designers think more critically about instructional problems, as well as design and evaluate creative solutions. The heuristics identified within the model of this study directly align with common terminology used in various instructional design models and frameworks. ADDIE, an acronym for analysis, design, development, implementation, and evaluation, is a framework commonly referenced by instructional designers to indicate their general stage within a project (Seels & Glasgow, 1990; Branch & Kopcha, 2014). Each heuristic is situated within the ADDIE framework, making it easy for designers to relate the heuristics to a specific stage of their familiar processes. The design thinking methods and combinations of methods selected for each heuristic within the model of this study are clearly explained and relatively simple to implement with proper planning and preparation. Thus, the model could serve as a playbook for novice designers beginning their new ventures as professional instructional designers.

Organization of this Study

Chapter One provides background information including the need and purpose of the study, research questions, benefits to the study, and a brief overview of the methodology. Chapter Two includes a literature review covering relevant information for the foundation of the conceptual model that was developed in this study. It explored the common stages of instructional design models and frameworks, identified challenges of novice designers and heuristics of experts, and introduced the topic of design thinking research and methodologies using peer reviewed books and articles. Chapter Three describes, in detail, the specific methodology used to conduct the study. Chapter Four offers results of design thinking research and identifies select design thinking methods that align with common stages of the instructional design processes, and heuristics of expert instructional designers. The data collected through the literature review was used to propose a detailed conceptual model. Chapter Five includes expert reviewers' responses to expert review questions and any additional comments offered by experts regarding the researcher's selections of design thinking methods and combinations of methods for each heuristic identified within the model. Finally, Chapter Six offers a description of modifications made to the model resulting from expert reviews, identifies limitations and study biases, discusses implications for practice, and explores opportunities for future research.

CHAPTER 2

Introduction

The following literature review was conducted to identify ways that design thinking methods could be used to enhance novice instructional designers' ability to solve complex instructional problems. The literature review explored the following research questions:

1. What are the common stages of the instructional design process?
2. What are some challenges of novice instructional designers and how do they align with heuristics of expert instructional designers?
3. What is the relationship between instructional design heuristics and design thinking?
4. Which methods of design thinking align with heuristics of expert instructional designers?

Review of the Literature

Stages of the Instructional Design Process

Instructional design is a system of procedures for developing education and training curricula in a consistent and reliable fashion (Branch & Merrill, 2011; Branch & Kopcha, 2014). It embodies an iterative process for outlining outcomes, selecting teaching and learning strategies, choosing support technologies, identifying media, and measuring performance (Branch & Kopcha, 2014). Instructional designers use models of instructional design and instructional development to communicate tasks and procedures of the instructional design process (Andrews & Goodson, 1980).

Instructional designers have long adopted instructional design models to guide their processes for learning and development. Origins of instructional design date back to the early needs of military and aerospace leaders needing to quickly train people for unchartered events and new technology developments (Dick W. , 1987). Silvern (1965) developed one of the first influential instructional design models, which relied heavily on general systems theory, while working with the military and aerospace industries. Silvern defined a model as a "graphic analog representing a real-life situation either as it is or as it should be" (AECT, 1977, p. 168). Other notable models developed during this time varied greatly; Barson (1967) developed a model that comprised a set of heuristics of instructional designers, while Markle (1964; 1978) developed a more prescriptive model that applied a systematic approach to instruction, which included components of trial and revision.

In 1980, Andrews and Goodson conducted a comparative analysis of 40 instructional design models. According to their analysis, instructional design models serve four purposes:

- Improving learning and instruction by means of the problem-solving and feedback characteristics of the systematic approach.
- Improving management of instructional design and development by means of the monitoring and control functions of the systematic approach.
- Improving evaluation processes by means of the designated components and sequence of events, including the feedback and revision events, inherent in models of systematic instructional design.

- Testing or building learning or instructional theory by means of theory-based design within a model of systematic instructional design (Andrews & Goodson, 1980, pp. 3-4).

Over the years, numerous models of instructional design have been developed and adapted to meet the varying needs of instructional designers and developers. There is a consensus that most instructional processes consist of five core elements or stages: analysis, design, development, implementation, and evaluation, which are commonly referred to as ADDIE (Seels & Glasgow, 1990; Branch & Kopcha, 2014). While often considered generic, the ADDIE framework contains a useful set of common criteria, which most designers state as important or necessary as a part of any instructional design process (Pittenger, Janke, & Bumgardner, 2009; York & Ertmer, 2011; 2016).

Analysis is the identification of the setting and learner needs (Branch & Kopcha, 2014). Expert designers report that analysis tasks are centered around four main ideas:

- Determining if instruction is the solution to the problem; commonly referred to as conducting a needs assessment (Rossett, 1987),
- Examining the project constraints (Jonassen, 1997; 2008),
- Understanding the learner/audience and their prerequisite knowledge (York & Ertmer, 2011; 2016; Campbell, Schwier, & Kenny, 2006), and
- Determining the objectives or goals of the project (Mager, 1984).

The analysis stage also includes establishing an understanding of the project scope and gaining consensus with the client on a statement of work, which minimizes miscommunication among designers and project stakeholders (York & Ertmer, 2011; 2016).

The **design** stage encompasses the design of a set of specifications for an effective, efficient, and relevant learner environment (Branch & Kopcha, 2014). Principles of the design phase are centered on three, key ideas:

- Solving the problem,
- Identifying potential learning activities, and
- Considering the technology (York & Ertmer, 2011; 2016).

Specific tasks of the design process include writing measurable objectives (Mager, 1984; Dick W. , 1996), classifying the type of learning or instruction (Briggs & Wager, 1979), specifying learning activities (Briggs, Gustafson, & Tillman, 1991), and specifying media (Reiser & Gagné, 1983). Experts from York and Ertmer's (2016) study identified the design phase as the time to "generate multiple possible solutions that will solve the problem" (p. 301). This principle aligns with Jonassen's (1997) findings regarding ill-structured problems, which typically have multiple solutions, of which the designer must choose and offer recommendations to the client. During this stage of the process, it is important to note that technology should not be a driver in design decisions; on the contrary, technology should be chosen to support the selected learning interventions and activities (Liu, Gibby, Quiros, & Demps, 2002).

Development refers to the development of all learner and learner management materials (Branch & Kopcha, 2014). This stage, which is sometimes referred to as the production stage, includes preparation of all learner and instructor materials as specified during design (Kemp, Morrison, & Ross, 1994). Critical components of this stage emphasize the importance of ensuring that content guides instructional decisions, not technology, and that continued

communication among designers, developers, and subject matter experts regularly occurs, and is documented accordingly (York & Ertmer, 2011; 2016).

The next phase is **implementation** of instructional strategies. In many instances, designers are not responsible for the implementation of materials; instead instructional materials are often handed off to teachers or trainers to carry out the instructional tasks. The Dick and Carey (1996) model excludes this stage from their model, and none of the experts in York and Ertmer's (2011; 2016) study identified principles related to implementation. However, some designers choose to include tasks to prepare the learning environment and engage students as a part of an implementation strategy (Branch, 2009). Common procedures include preparing the teacher and preparing the student.

Evaluation includes both formative and summative efforts to evaluate the development of instruction and the outcomes of learning (Dick W. , 1996; Branch & Kopcha, 2014). Formative evaluations are developed to inform the need for further revisions to instruction. Experts report the importance of conducting a pilot and working closely with a combination of subject-matter experts (SME) and non-SME's to formatively evaluate instruction throughout design and development stages. Summative evaluations assess the degree to which objectives are achieved and should be used to measure whether the stated learning was in fact, effective (Branch & Gustafson, 1998). More recent is the inclusion of an additional stage of revision or iteration, which encompasses the need to address and make changes throughout the instructional design process (Gustafson & Branch, 1997).

To summarize, ADDIE is an acronym used commonly among instructional designers to reference general stages of an instructional designers' process: analysis, design, development, implementation, and evaluation. It is considered a framework for design; it is not a formalized

model of instructional design. Expert instructional designers often reference the acronym as a means to quickly determine whether or not they have covered all their bases, and use the framework to discuss various stages of instructional design with non-designers who are unfamiliar with specific models and terminology of instructional designers' processes (Ertmer, York, & Gedik, 2009). Although ADDIE is considered somewhat generic, most instructional designers are familiar with the acronym, which makes it an effective tool for describing stages of instructional design among a diverse group of novice instructional designers.

Challenges of novice designers

There is an on-going conversation among expert instructional designers and educators regarding challenges faced by novice designers when entering the field of practice. It is plausible that they are simply novices, and new professionals in any field are certain to encounter some challenges as they develop their ability to work proficiently among their peers. Some researchers, however, point to the role of instructional design models taught within most higher education curriculum as being insufficient for preparing new designers for practice. Researchers such as Jonassen (2008; 1997) and Silber (2007) point to a lack of case-based problem-solving activities, and limited emphasis on principles of instructional design as contributing to the shortcomings of new designers. This review of the literature does not attempt to make a case for or against the role of instructional design models in higher education curriculum, but it does leverage the extensive work that these researchers have done to identify a variety of challenges commonly faced by new instructional designers.

Prior to exploring the challenges faced by novice instructional designers, it is important to first explain what distinguishes novice designers from experts. Studies use a variety of metrics to determine what constitutes novice versus expert instructional designers. Rowland's (1992)

study relied heavily on the advice of other designers to confirm expert status, and he reported that experts typically possess seven to 20 plus years of experience practicing in the field. Ericsson, Krampe and Tesch-Romer (1993) developed a numerical benchmark to determine expert status; the benchmark was 10,000 hours of work, which broke down to a typical timeline of 4-5 years for a designer working full-time, 40-50 hours per week. Ertmer et al. (2008) took a similar approach to Ericsson et al. (1993) in developing a threshold, which distinguished between experts and novices in their study of instructional design problem-solving. In both studies, researchers postulate that experts have acquired domain-specific experience, mental schemata, and psychomotor capabilities to maximize performance (Ertmer, et al., 2008; Ericsson, Krampe, & Tesch-Romer, 1993).

One of the most common problems reported among novice designers is the ability to solve problems within a variety of different situations. Real-world problems, often referred to as ill-structured problems, are typically situated in and emergent from a specific context (Jonassen, 1997). They are unspecified, lack in definition, and present no clear solutions (Chi & Glaser, 1985; Jonassen, 1997). It can be difficult for novice designers to determine first steps toward solving ill-structured problems. Specific elements of the problems are often unknown (Wood, 1983); goals, objectives, and outcomes are unclear and undefined (Voss, 1988); there is a lack of consensus among stakeholders regarding the underlying issues of the problem or whether there is a problem (Kitchner, 1983); and there are no evident solutions. In most instances, novice instructional designers are unlikely to have experience working with similar problems and report challenges conceptualizing the problem (Wedman & Tessmer, 1993). Their inability to gain a big picture understanding of the problem, often results in a lack of identification of barriers and

constraints to the problem that may have negative impacts on the overall success of the project (Rowland, 1992).

Design aloud studies reveal that novice designers propose fewer analysis tasks and activities (Ertmer, et al., 2008). Specifically, novice designers fail to identify and engage key stakeholders of projects and may negate steps to determine whether an instructional need exists (Hoard, Stefaniak, Baaki, & Draper, 2019). They possess limited prior experience to make a business case for the importance of analysis, which often results in a lack of empathy for learners and their current experience or processes (Roytek, 2010). When faced with resource, time, and budget constraints, novices are more likely to skip opportunities for idea generation, and instead adopt template solutions that are insufficient to meet the needs of the problem (Roytek, 2010).

Another challenge represented among novices is the inability to collaborate with teams on the design of new projects (York & Ertmer, 2011). Novices are less likely to include steps to engage and empathize with new members of a project, which may lead to unclear expectations of team members (Liu, Gibby, Quiros, & Demps, 2002). When faced with a need to prioritize, novices are less likely to negotiate priorities among stakeholders; they are more likely to tackle more than what is necessary and set unrealistic timelines for completion (Carroll J. M., 2000). Successful collaborations warrant extensive planning and preparation to ensure a comfortable balance of individual actions and team interactions. Novice instructional designers' limited experience designing such collaborations makes it difficult to anticipate the timing and needs of such interactions.

Aligned with collaborations is the need to brainstorm and generate multiple ideas for solutions within the design stage of instructional design (Liu, Gibby, Quiros, & Demps, 2002). The challenges outlined within this section are not unique to novices but are likely more

prevalent due to a lack of experience. One key challenge of the design process is that designers fail to invite others to the process of ideation; instead they work in siloed environments to develop individual ideas (Tracey & Boling, 2014; Chang & Kuwata, 2020). As a result, they are more likely to advance their first idea or solution, versus continuing to explore a variety of ideas. The design stage should be focused on learners as the center of all new ideas; however, it is within the design stage that designers are most likely to lose sight of the perspectives of their learners, and design for their own needs or intuitions (Tracey & Boling, 2014; Rowland, 1992). During this stage, it is important to gather feedback on the potential barriers or failures of an idea. It can be difficult for designers to hear critiques of their work. As a result, many overlook this stage, and proceed with stages of development and implementation. Once a designer has invested so much time and effort into a design, it can be difficult and expensive to make changes or improvements (York & Ertmer, 2016; Rowland, 1992).

In a perfect world, the stages of development, implementation, and evaluation would occur parallel to one another. These stages are perhaps the most critical stages to gather feedback, anticipate the needs of teachers/trainers and learners, test technology, and iterate designs to accommodate necessary changes and modifications (Keppell, 2001). Unfortunately, these stages of the process are often impacted by tight timelines, cuts to resources and budgets, and designer burn out. Although experts report the necessity of rapid prototyping and state the importance of conducting and evaluating a pilot, designers consistently fail to make a business case for either (Keppell, 2001; Wedman & Tessmer, 1993).

Arguably, one of the most important roles of a designer falls within their ability to communicate transparently, manage projects, and build trust among stakeholders and clients (Ertmer, York, & Gedik, 2009). Communication and project management skills fall outside of

most instructional design models, but their importance within the process is seldom debated. Many educators and expert practitioners have offered advice and best practices to assist novice designers in developing these skills, but they remain difficult to teach outside of real-world experiences (Rowland, 1992; Perez & Emery, 1995). When it comes to communicating, novice instructional designers are known to talk more than they listen and use jargon that is unfamiliar to their clients (Lindsey, 2007). Novices worry that they are inconveniencing subject-matter experts and overlook the need to verbally and visually verify information, and often fail to make plans for follow-up conversations (Pieters & Bergman, 1995). For similar reasons, they are less likely to take additional steps to gain empathy for clients and their needs (Lindsey, 2007).

Most novice instructional designers possess a graduate degree or higher, which positions them to also manage projects and sometimes people (Keppell, 2001; Williams van Rooij, 1993). Like the challenges of communicating, when managing projects, designers struggle to be honest and authentic with clients. This is not necessarily an issue of ethics or integrity, but one of a desire to do more than what is realistic, or for fear of negotiating priorities (Williams van Rooij, 1993). It is through difficult and honest communications that designers and managers gain trust with their team members and clients. To that, when novices attempt to accomplish too many priorities or set unrealistic expectations, they may quickly lose the trust of all those involved in a project. Another challenge is the tendency for novices to take the word of a client or subject-matter expert when kicking off new projects (Liu, Gibby, Quiros, & Demps, 2002). When novices fail to take steps to clearly identify problems and conduct the necessary analysis, they are more likely to solve the wrong problem; a costly and timely mistake (Stepich & Ertmer, 2009).

To summarize, recent studies of novice and expert instructional designers have identified various challenges that are common among novices entering the field of practice. Novice instructional designers have limited experience working with ill-structured problems and lack the frames of reference and experience that are necessary to conceptualize a problem and its underlying issues (Rowland, 1992). Novices are more likely to accept the word of clients or subject-matter experts, and consequently overlook the need to conduct a thorough analysis of learners, which includes gaining empathy for their needs and their processes (Hoard, Stefaniak, Baaki, & Draper, 2019; Roytek, 2010). Limited experience working with teams makes it difficult for novices to plan for collaborations, anticipate outcomes, and negotiate priorities among team members (Liu, Gibby, Quiros, & Demps, 2002). Novices are often solution-focused, and jump to solving the problem prior to fully understanding the problem making them less likely to invite others to the process of ideation and iteration (Chang & Kuwata, 2020; Tracey & Boling, 2014). Designers commonly experience challenges with resource, budget, and time constraints as they near the end of projects. Limited experience working with stakeholders through these challenges makes it difficult for novices to push for additional stages of rapid prototyping and evaluation as they near the end of a project (Perez & Emery, 1995). Lastly, novice instructional designers' limited experience communicating and managing instructional design projects, makes it difficult for novices to gain trust and assume leadership roles (Williams van Rooij, 1993).

Heuristics of expert instructional designers

Experts in the field of instructional design often state the importance of teaching instructional design models to students, because they offer a set of rules and procedures for instructional designers to use when approaching design problems in practice (Dick W. , 1996). Dreyfus and Dreyfus (1986) suggested that designers must follow the rules and procedures of

instructional design models until they have acquired their own mental models and past experiences to guide future projects. Rules and procedures of instructional design models are often explained as a series of actions or steps within a defined process (Dreyfus & Dreyfus, 1986). Some experts have argued the importance of teaching instructional design principles and heuristics within the context of authentic design problems (Silber, 2007; Jonassen, 2008). It is common for experts to use the terms 'heuristics' and 'principles' interchangeably. For this study, principles have been defined as guiding rules of an instructional designer's process such as, *"Invest as much time as you can in your audience analysis"* (York & Ertmer, 2016). Heuristics are defined as generalized stages of an instructional designer's process such as *Identify problems* or *Identify stakeholders* (York & Ertmer, 2011).

Through the years, experts have supported or argued against the role of instructional design models and frameworks such as ADDIE in guiding novice instructional designers' processes for approaching and solving instructional design problems. Regardless of stance, there is an abundance of literature that suggests that experts in practice commonly reference the stages of the ADDIE acronym as part of their descriptive process: analysis, design, development, implementation, and evaluation (Ertmer, York, & Gedik, 2009; Rowland, 1992). The following literature sought to identify specific principles and heuristics expressed as part of expert instructional designers' processes in practice. Stages of ADDIE are referenced throughout to help novices align principles and heuristics with a familiar framework.

Silber (2007) suggested that, when solving instructional design problems, instructional designers follow a set of heuristic principles, rather than procedural instructional design models: ''Instructional design, as experts do it, is a problem-solving process, not a procedure, made up of thinking processes and a set of underlying principles'' (p. 6). Similarly, Kirschner et al. (2002)

reported that although instructional design models may often inspire instructional designers, their activities do not typically reflect a systematic, step-by-step process; instead, designers rely more heavily on cognitive strategies and common rules-of-thumb or heuristics of their past experiences. While many deviations from instructional design models are likely due to specific project constraints, such as time and budget (Wedman & Tessmer, 1993), they also can be attributed to the unique set of design experiences the practitioner brings to the table.

Past studies have sought to identify heuristics of expert instructional design practitioners in an effort to improve instructional design education for novice designers (Perez & Emery, 1995; Liang & Schwen, 1997; Visscher-Voerman, 1999; Rowland & DiVasto, 2001; York & Ertmer, 2011; 2016). York and Ertmer conducted a Delphi study of expert instructional designer heuristics in 2011, which they further explored in their 2016 study examining instructional design principles applied by expert designers in practice (York & Ertmer, 2011; 2016). The panel reached a consensus on 61 principles that guide instructional design practice (Table 1). Among those 61, 32 were identified by York and Ertmer (2011; 2016) as closely aligned with the instructional design framework of ADDIE: analysis, design, development, implementation, and evaluation (York & Ertmer, 2011; 2016).

Table 1

C. S. York, P. A. Ertmer **(2011; 2016)***: Principle order based on mean rating of agreement (1–6) as to its importance to the ID process.*

1	"Know your learners/target audience" 5.88
1	"Determine what it is you want your learners to perform after the instructional experience What is the criterion for successful performance?" 5.88
3	"There are things that need to be determined at the front end in order to make you successful at the back end" 5.80
4	"Be honest with the client" 5.71
5	"When designing instruction, consider the context in which the learning will be applied. Ask yourself, 'How can I put learning into context?'' 5.68
6	"Negotiate the scope of the project with the client and create a statement of work upfront" 5.66

7	“When designing instruction, consider active learning. Ask yourself, ‘How can I make learners more actively engaged?’’ 5.65
8	“You have to be sensitive to the context and the culture of the client” 5.63
9	“Approach the design problem with the end in mind. What are the deliverables? What are the learning/performance outcomes?” 5.60
10	“You need to build trust with the client. This can be done through explaining what you are doing, why you are doing it, and how it is of value to them” 5.51
11	“Figure out who all the stakeholders are in the room. And figure out who is not in the room that is still a stakeholder” 5.49
12	“The team is critical. Involve the right people at the right time” 5.46
13	“As a designer you need to listen more than you talk” 5.43
13	“Know your learners’ prerequisite knowledge” 5.43
13	“You need to manage the client’s expectations” 5.43
16	“When verifying information, you often will learn more information” 5.41
16	“Consider utilizing scaffolding in your instructional experience Give the learner the tools they need to succeed” 5.41
18	“You may have to mock up something to show the client to make sure that you get all of the desired outcomes right” 5.40
18	“Determine what will keep the learner motivated during the instructional experience” 5.40
18	“Ask yourself, ‘Is instruction the solution to this problem?’’ 5.40
21	“Verify all the information you receive from the client to prevent miscommunication” 5.31
22	“Sometimes the client will not tell you all there is to know about a problem” 5.29
23	“The client thinks it is much easier to move from the conceptualization to the implementation than it actually is” 5.24
24	“Ensure that design speaks to a value chain of learning, i.e., that learning contributes to behaviors and that behaviors contribute to organizational or business results” 5.23
25	“You have to determine if the client really knows what they want” 5.19
26	“When communicating with the client, use visuals and documents in order to prevent miscommunication” 5.17
26	“You need to understand and speak the language of your client” 5.17
28	“When possible, have a subject matter expert AND a non-subject matter expert review the final product” 5.16
29	“When faced with something complex, look for previous examples that have characteristics you can draw upon, that can give you ideas on how to solve the problem” 5.14
29	“Understand the learning associated with the technology” 5.14
31	“Be prepared to think abstractly” 5.11
32	“Constraints are a key to design. Look for constraints that have been placed on a project” 5.10
33	“Needs analysis is the foundation for evaluation” 5.03
33	“Subject matter expert’s documentation often fails to provide the necessary critical thinking. The SME forgets to tell you basic steps and concepts he forgot he once learned” 5.03
33	“Don’t let technology drive the design” 5.03
33	“Resist the technical expert’s propensity to focus on the most complex or innovative aspects of a product. Remember the novice learner who needs to build basic skills” 5.03
33	“It is the instructional designer’s job to press for quality in the design” 5.03
33	“Use previous experiences, if possible, as a starting point for new projects” 5.03
39	“Be sure the instruction gives learners the opportunity to make choices” 4.97
40	“Don’t use technical instructional design terminology with the client unless you have to” 4.94

40	“You are rarely going to collect all the desired outcomes with just one interview with the client” 4.94
42	“Always conduct a pilot” 4.90
42	“When multiple stakeholders are involved, ask your client to identify your ‘‘single point of contact’’—make sure that person understands what is expected—gathering feedback on your design for you, getting approvals, etc.” 4.90
44	“Technology can get in your way, and if you don’t deal with it you can get yourself into trouble” 4.88
45	“You need to know the theories. You need to know the models. You need to have that foundation” 4.84
45	“Understand that every design situation is unique” 4.84
47	“You often don’t get to do the best instructional design you want due to constraints, resources, time, budget, etc.” 4.74
47	“Design is a people process” 4.74
47	“Resist the SME’s (subject matter expert’s) desire to teach the solution to the hot problem of the day… unless it is a common problem seen by the average learner” 4.74
50	“Allow the content to guide how users interact with the training (linear, user-driven, etc.)—not the tools used to develop the training” 4.73
51	“Bring together the client and other stakeholders for synchronous meetings at each ‘‘gate’’ in a phased process” 4.71
52	“When designing instruction, think about Elaboration Theory. Ask yourself, ‘What’s the ‘big picture’ to which the components are attached?’’ 4.70
53	“Prepare to do a lot of work that is never going to show up in the final product” 4.68
54	“The instructional designer should take prodigious notes during meetings. Do not rely purely on documentation or the SME” 4.61
55	“Invest as much time as you can in your audience analysis” 4.55
56	“Never look at the problem at face value. You have to get to the core of the problem and solve all of the subproblems” 4.52
57	“Generate multiple possible solutions that will solve the problem” 4.50
58	“Acknowledge your limitations. Don’t accept a job that is outside of your expertise” 4.48
59	“Make every effort to be part of the production process” 4.45
60	“Design continues through the delivery or implementation phase” 4.40
61	“Ask all possible relevant questions throughout the entire design process” 4.26

Of the 61 principles, 10 were identified as related to tasks of analysis. The principles centered around five main ideas: (1) determining if instruction is the solution to the problem, (2) examining the project constraints, (3) understanding the learner/audience and their prerequisite knowledge, (4) determining the objectives or goals of the project, and (5) understanding the scope and establishing consensus on a statement of work (York & Ertmer, 2011; 2016). 17 principles identified by the panel related to the design stage of the instructional design process. The design principles centered around three main ideas: (1) solving the problem, (2) identifying potential learner activities, and (3) considering the technology. Experts identified far fewer

principles for development, implementation, and evaluation. In fact, there were no principles directly aligned with implementation, which is likely a result of designers handing off the project to a trainer or client to execute the training. In the development stage, three principles were identified related to the production process and ensuring that technology is offered to support, not drive the learning. Finally, evaluation principles included a need to conduct pilot tests, and to gather feedback from subject-matter experts, as well as non-subject-matter experts throughout the process (York & Ertmer, 2011; 2016).

The remaining principles from York and Ertmer's (2011; 2016) study that fell outside of the model were clustered into three components of design: (1) communication, (2) working with a client, and (3) project management. Communication is considered a critical component of the instructional design process. Experts report that interpersonal skills, transparency among stakeholders, and limited use of technical jargon are crucial to the overall success of instructional design projects (Silber, 2007). Client relationships were also reported as important to the process. Instructional designers are responsible for gaining the client's trust and must do so by communicating often, setting clear expectations, gaining empathy for stakeholders and their processes, determining the root causes of problems, offering visual documentation, and seeking feedback throughout the process (Perez & Emery, 1995; Liang & Schwen, 1997; Visscher-Voerman, 1999; Rowland & DiVasto, 2001). Finally, project management is discussed as a critical component of the team process (Williams van Rooij, 1993). Instructional designers must ensure that the right people are involved at the right times. Instructional design is a collaborative process that involves clear identification of stakeholders and their roles and responsibilities throughout the process. Additionally, there were several principles identified that fell beyond the ADDIE framework, communication, client relationships, and project management. These

principles addressed needs for designers to recognize each experience as unique, to place people at the center of their processes, think abstractly, and to identify barriers and constraints early in the process in order to establish realistic goals and timelines (York & Ertmer, 2011; 2016).

Origins of design thinking

This section of literature briefly explores the origins of the term design thinking, and the descriptions commonly referenced among scholars. Design thinking's foundational concepts emerged from European industrial designers working in the context of industrialization (Orthel, 2015). Their research was grounded in ideas about ways of knowing and defined methods for identifying, defining, and solving problems (Alexander, 1966; Archer, 1984; Buchanan, 1992; Cross, Introduction, 1984; Rowe, 1986). In The Sciences of the Artificial (1996), Herbert Simon identified design as the knowledge that is in the domain of professions such as engineering, management, or medicine. He explained that these fields concerned *what ought to be*, in contrast to *what is* in science. Simon (1973) perceived design as "a rational set of procedures that respond to a well-defined problem" (p. 183). He further explained that solving a problem included steps to deconstruct the problem, followed by a process to brainstorm or search for new solutions or alternatives. Simon believed that this approach was also appropriate for ill-defined problems (Simon, 1973).

Peter Rowe (1986) provided one of the earliest discussions of the concept of the term, design thinking. In his book, *Design thinking*, (1986) he offers case studies and discussions about the procedural aspects of design thinking. He outlines the process and introduces general principles of design where two main ideas emerge: 1) designers have an episodic approach to decision making that relies on hunches and presuppositions, not just facts; and 2) the nature of the problem-solving process shapes the solution (Rowe, 1986). Simply explained, designers

implement strategic methods and techniques to identify and define problems that ultimately present clear opportunities for solutions. A sound process for evaluating potential outcomes of solutions yields conclusions for next steps.

One of the most known contributors to the study of how designers think and approach problem solving is Nigel Cross. Cross (1982; 2001) is renowned for the way he sees problem solving as a solution-focused mode to tackling ill-defined problems. Cross (1982; 2001) situates this idea in a larger argument about design as a discipline of study, distinct from sciences and humanities. Cross (2001) further developed the idea that problems and solutions co-evolved, and suggested that all designers approach problems as ill-defined regardless of whether they are. Approaching problems in this manner will ensure that designers take the time to articulate the causes and effects of a problem versus jumping to conclusions about ways to solve a problem.

Design thinking as a general theory of design reflects Buchanan's (1992) research on wicked problems. The focus is on design as a field or discipline where the primary purpose is to tame wicked problems. Buchanan suggests that design has no special subject matter of its own. Buchanan (1992) explains that wicked problems have no definitive conditions, which is evident in the ten properties of wicked problems that Rittel identified in his 1972 studies. Rittel's (1972) properties are outlined in Table 2. Through the years, there has been much debate among scholars about what constitutes a wicked problem, and whether "wicked" is an appropriate term to use in explanations of complex situational and societal problems. Recent studies associate the reference of "wicked" as a means to explain problems where there is a lack of certainty and understanding of the problem, and a lack of consensus to solutions for the problem, with "wickedness" being a matter of degree (Xiang, 2013; Head & Alford, 2015).

Table 2

*Rittel's **(1972)** properties of wicked problems.*

Wicked problems have no definitive formulation, but every formulation of a wicked problem corresponds to the formulation of a solution.
Wicked problems have no stopping rules.
Solutions to wicked problems cannot be true or false, only good or bad.
In solving wicked problems, there is no exhaustive list of admissible operations.
For every wicked problem, there is always more than one possible explanation, with explanations depending on the Weltanschauung of the designer.
Every wicked problem is a symptom of another, "higher level," problem.
No formulation and solution of a wicked problem has a definitive test.
Solving a wicked problem is a "one shot" operation, with no room for trial and error.
Every wicked problem is unique.
The wicked problem solver has no right to be wrong-they are fully responsible for their actions.

Since its inception, the term design thinking has been broadly represented, but the common denominator among researchers is its process to identify, define, and solve problems. Most researchers agree that in its simplest definition, design thinking represents a process used by people to solve problems of a complex nature (Alexander, 1966; Archer, 1984; Buchanan, 1992; Cross, Introduction, 1984; Rowe, 1986).

Characteristics of Design Thinking

The following review of design thinking literature looks at more than twenty years of research documenting the characteristics of design thinking. Liu (1996) stated that design

thinking, at its core, refers to how designers *see* and, consequently, how they *think*. Design thinking is described as an iterative and interactive process where designers visualize representations of problem-solving concepts and ideas, develop relationships between ideas to create solutions, and view insights that inform future designs (Do & Gross, 2001; Lloyd & Scott, 1995). Here the characteristics of design thinking are linked to the visual nature of design, with multiple references to the role of diagrams and graphic representations, which are stated as common vehicles in design practice (Do & Gross, 2001; Nagai & Noguchi, 2003).

Braha and Reich (2003) described the design process as iterative, exploratory, and sometimes chaotic. They viewed design thinking as a generic process, which is informed by new information at varying stages of the process. As new information becomes available, modifications to the design are made, and this iterative approach is replicated until a suitable solution is achieved (Braha & Reich, 2003).

The exploratory and iterative nature of the design process is echoed by many researchers. Suwa, Gero, and Purcell (2000) placed an emphasis on the process for which designers 'invent' design issues and requirements within the context of a situation. They stated that through the process of exploring issues within a current situation or solution, designers unveil new, and unexpected discoveries. Through the process of visualization and rapid alternation between issues and discoveries, they ultimately arrive at new solutions, which consequently points to the opportunistic nature of the design process (Suwa, Gero, & Purcell, 2000). Similarly, Hatchuel and Weil (2009) suggest that design is a reasoning activity that starts with a concept about a partially unknown object, and attempts to expand it into other concepts, and/or new knowledge.

Dorner (1999) described the design process as 'cloudy' in the beginning. Dorner (1999) explains that there are three forms of thinking present in the design process. The first begins with

a cloudy, abstract idea of what the designer perceives, and ultimately evolves into clearer ideas as new information is gathered. The second form of thinking is more visual and represented in an evolution of sketches produced by the designer as the designer iterates through the process. The third form involves putting pictures into words, which are used to clarify or elaborate the details of an idea (Dorner, 1999).

Goldschmidt and Weil (1998) were among the early adopters of the term 'design thinking.' They stated that the process of design thinking is non-linear. Designers move forward, breaking down problems, and backward, validating findings as a reasoning strategy (1998). Stempfle and Badke-Schaube (2002) offer four stages of the design thinking process: generation, exploration, comparison, and selection. In the first two stages, generation and exploration, the focus is on widening the problem, which is often referred to as divergence. In the third and fourth stages, comparison and selection, the focus is on narrowing the problem space, which is often referred to as convergence (Stempfle & Badke-Schaube, 2002). Each of these ideas reiterates the nature of the design process as iterative, non-linear, exploratory, and evolving.

Razzouke and Shute (2012) furthered many of these ideas and concepts in their design thinking competency model, which was adapted from an earlier version depicted by Shute and Torres (2012). The design thinking competency model is intended to advance learner-centered activities that encourage learners to design and create prototypes, experiment with different ideas and solutions, collaborate with others, reflect on learning, and repeat the cycle by revising and improving solutions each time. Their primary goal in developing the model was to offer a framework for educators to use in evaluating learners' abilities to demonstrate design thinking skills at varying times and stages of the design thinking process (Razzouk & Shute, 2012). The idea being that educators could present learners with ill-structured problems and use the

incremental steps and skills defined within the model to evaluate the learners' processes for solving the problem.

Kolodner and Wills (1996) emphasized the cognitive processes that occur in design thinking. They specified three processes: preparation, assimilation, and strategic control. In the preparation process, designers need to determine their focus and the relevance of information. In this stage, designers identify specifications and constraints of a problem, explore new ideas, draft visualizations of the problem, and reformulate the problem as new ideas and themes emerge. In the assimilation process, designers make sense of the information from the preparation process (data, environment observations, proposed solutions, etc.). This may involve prototyping and experimenting with new ideas and solutions. The strategic control process involves decision-making and setting priorities for next steps. Kolodner and Wills (1996) state that although the processes may be perceived as linear, they are actually flexible and highly opportunistic; designers move through various processes as tasks, themes, and sub-problems emerge.

Like that of its origins, the characteristics of design thinking are diversely represented by scholars and researchers. Some of the common terms used to describe design thinking characteristics are exploratory, discovery, divergent, convergent, visual, iterative, non-linear, opportunistic, collaborative, reflective, and experimental. Much of what was written about design thinking prior to the twenty-first century refers to a need to solve problems within the context of the field of design (architecture, engineering, etc.). Recently, there has been an insurgence of people using design thinking as a process to solve a variety of problems within diverse situations that extend well beyond traditional fields of design. The next section of literature further explains the evolving role of design thinking and its process for solving twenty-first century problems.

Contemporary References of Design Thinking

In recent years, the term design thinking has been positioned as an exciting paradigm for dealing with complex issues (Brown, 2009; Dorst, 2011). Although some researchers have criticized the nascent popularity of the term 'design thinking,' (Kimbell, 2011; Johansson-Sköldberg, Woodilla, & Çetinkaya, 2013), Tim Brown and David Kelley, former CEO and founder of IDEO, are largely credited for the recent emergence of design thinking and its processes for solving problems outside of the traditional design environment (Brown, 2009; Johansson-Sköldberg, Woodilla, & Çetinkaya, 2013; Hoolohan & Browne, 2020; Liedtka, 2014; Kimbell, 2011). In the early 2000's, IDEO, one of the world's largest design companies, cited a need to be more creative (Brown, 2009). They chose to reposition themselves as an innovation company, rather than a design company (Brown, 2009). During this time, IDEO's founder, David Kelley, began using the term 'design thinking' to explain to non-designers what it is that designers do. Kelley (2001) defines design thinking as a human-centered process for solving complex problems. Brown (2009) suggests that design thinking relies on our ability to be intuitive, recognize themes and patterns, construct new ideas with emotional and functional meaning, and to express ourselves visually with symbols and words. He further states that design thinking is best thought of as a "system of overlapping spaces rather than a sequence of orderly steps" (Brown, 2009, p. 16). Brown (2009) describes three spaces at the core of IDEO's culture for problem solving: inspiration, ideation, and implementation. They define inspiration as the problem that motivates the search for solutions; ideation involves generating, developing, and testing ideas; and implementation is the path that brings ideas and solutions to fruition (Brown, 2009).

Since its insurgence as a process for solving problems in any context, design thinking

research has expanded, which is evidenced by its prevalence in scholarly articles and research studies. Hoolohan and Browne (2020) define design thinking as “a human-centered approach to problem-solving that emulates the ways in which designers think and work” (p. 5). Hassi and Laakso (2011) stated that design thinking, in the context of management, consists of three elements: a set of practices, cognitive approaches, and mindsets. Similar to Hassi and Laakso (2011), Rylander (2009) compares two discourses of design thinking and knowledge work, and describes design thinking as practical knowledge, open-ended problems, a social identity of celebrating creativity, and visual forms of dominant sense making modes. Kimbell (2011) offered three unique ways of describing design thinking: 1) as a cognitive style of individual designers engaged in problem solving, 2) as a general theory of design as a field or discipline focused on taming wicked problems, and 3) as an organizational resource for businesses and other organizations in need of innovation. Kimbell (2011) suggests reframing design thinking as a means to embody the routine approaches implemented by designers, in lieu of proposing that organizations outside of design fields can readily adopt the knowledge, and skills embedded in design practice.

Another notable name in the practice of design thinking is Roger Martin, former Dean of the Rotman School of Business at the University of Toronto (Johansson-Sköldberg, Woodilla, & Çetinkaya, 2013). In addition to his role in academia, Martin is well known for his work as a strategy consultant with long-term interests in the cognitive processes of successful business executives (Martin, 2007). In collaboration with IDEO, Martin used design thinking to re-conceptualize his earlier management models and promoted teaching design thinking to management students (Dunne & Martin, 2006; Martin, 2009). He perceives design thinking as an ongoing cycle of generating ideas (abduction), predicting consequences (deduction), testing, and

generalizing (induction). He views design thinking as a way to approach indeterminate organizational problems, and a necessary skill for practicing managers (Dunne & Martin, 2006; Martin, 2009). Martin's scholarly research and influence in the areas of strategy and organizational change inspired the creation of Liedtka and Ogilvie's (2011) *Design thinking toolkit for managers*, a collection of design thinking methods selected to advance business management processes (Liedtka & Ogilvie, 2011).

Lawson and Dorst (2009) use a formal logic to describe reasoning patterns in design, which offers a basis for understanding how design thinking is used in solving open, complex problems. They explore ways in which organizations might adopt design practices as a means to frame practices or problems, identify themes, and frame new questions (Lawson & Dorst, 2009). Dorst (2011) describes the basic reasoning patterns that humans use in problem solving as a starting point to establish relationships between designer practices, and the way everyday people approach solving problems. In simple processes of *Deduction*, we know *what* is needed, and *how* we will do it, which equates to predictable results. Induction suggests that we know *what* the situation is, and we know the perceived result, but we do not know *how*, which is typically offered as a hypothesis, and then deduced to dispel or conclude the *how*. These forms of analytical reasoning are used every day in scientific research and discovery to predict and explain phenomena (Dorst, 2011).

The problems explored by design thinkers are typically more complex, and do not fit the mold of scientific reasoning. Dorst (2011) further explains the reasoning pattern in productive thinking, *Abduction*. *Abduction* is a different way of thinking about problem solving; there are no known or perceived results, instead there is an aspired *value*. There are two forms of *Abduction*: *Abduction-1* and *Abduction-2*. In *Abduction-1*, we know the aspired value, and we know how we

will get to the value, but we do not know the ‘what.’ This is a common problem space for designers, where the goal is to develop a solution (the what) that will ultimately add value. *Abduction-2* is more complex because we only know the aspired value; we do not know *what* or *how* we will achieve the value (Dorst, 2011). In *Abduction-2*, designers are more likely to employ unconventional design practices to further ideas for *what* and *how*. Dorst (2011) suggests that these unconventional design practices used in *Abduction-2* closely align with the needs to solve complex problems in professional organizations, which extend beyond the field of design.

Contemporary references of design thinking suggest a framework of steps and stages of a process that closely align with those applied by traditional designers. The major differences involve the setting and types of problems for which the process is implemented. The popularized term of ‘design thinking’ represents an idea that design, as a process, can be applied as a problem-solving technique to solve problems in any setting. Although people and organizations may not possess the background and knowledge of skilled designers, strategic methods and techniques can be defined to identify, explore, and develop solutions to solve complex problems in diverse situations.

Design thinking models and methods

As design thinking in practice and research has evolved and grown in popularity, so too have a variety of proposed frameworks and models for design thinking. Frameworks and models are typically comprised of a set of stages or phases that are common among problem solving processes. While there are no definitive frameworks or models for design thinking, most proposals include some rendition of the following stages or phases:

- Research and empathize
- Define and understand

- Ideate and brainstorm
- Prototype and test
- Seek feedback and iterate (Connell & Erin, 2013; Brown, 2009; Pacione, 2019; Liedtka, 2014)

Research and empathize involves a combination of ethnographic, participatory, and evaluative research methodologies that are applied to foster an understanding of the people and processes within a problem. Define and understand expresses a need to clearly define the causes and effects of a problem and reframe problem statements that address future steps to developing new ideas. Ideate and brainstorm represents collaborative steps to generate multiple ideas toward the development of new solutions. Prototype and test involve methods that are used to generate visual representations of ideas to identify and overcome potential failures. Lastly, seek feedback and iterate involves steps to gather feedback of proposed solutions and iterate new ideas for new solutions (Connell & Erin, 2013; Brown, 2009; Pacione, 2019; Liedtka, 2014).

In traditional settings, designers develop methods to advance the aforementioned stages of problem solving. Methods comprise a set of steps, prompts, and visual templates that designers use to engage with clients and stakeholders of a problem. In recent years, innovation companies and design practitioners have developed multiple resources to support the process of design thinking for non-designers in fields that extend well beyond the context of traditional design problems (IDEO, 2015; IBM Corporation, 2016; Kumar, 2013; Liedtka & Ogilvie, 2011; LUMA Institute, 2012). Toolkits, guides, books, websites, and handouts are all examples of the media developed to articulate the vast collection of methods used by design thinkers to solve problems and inspire innovation in a variety of organizations. Companies such as IDEO, the LUMA Institute, and IBM have developed popular frameworks and collections of design

thinking methodologies that are widely used among practitioners. These frameworks are offered in greater detail below, but it is important to note that these are a few of many, and none are definitively defined as the approach to design thinking; they are examples of one approach of many.

IDEO developed the *Field guide to human-centered design* (2015) as a resource for practitioners and facilitators to use to approach problem solving within their current settings and/or organizations. It is comprised of their explanation for design thinking, mindsets of design thinking processes, characteristics of design thinkers, phases of a design thinking process, and methodologies to accompany each phase of their proposed process. Their framework suggests that there are seven accompanying mindsets in the process of design thinking: 1) empathy, 2) optimism, 3) iteration, 4) creative confidence, 5) making, 6) embracing ambiguity, and 7) learning from failure. IDEO furthers these mindsets with characteristics of design thinkers which include:

- Optimists
- Makers
- Experimenters
- Learners
- Empathic
- Iterative
- Willing to seek out inspiration from unexpected places

They summarize their process into three main phases: inspiration, ideation, and implementation. In the inspiration phase, one learns how to "better understand people" by "observing their lives, hearing their hopes and desires, and getting smart on challenges" (p. 11). In the ideation phase, the focus is on "making sense of everything that you've heard, generating tons of ideas, identifying opportunities for design, and testing and refining solutions" (p. 11). The

implementation phase is "your chance to bring your solution to life. Figure out how to get your idea to market, and how to maximize impact in the world" (IDEO, 2015, p. 11). IDEO has developed a variety of methods to accompany each phase of their expressed framework. Some of the methods offered are more familiar such as interviewing, brainstorming, and role playing, while others are less familiar and uniquely developed by creators within their organization. Table 3 offers a list of IDEO's 57 human-centered design methods grouped within the three phases of inspiration, ideation, and implementation (IDEO, 2015).

Table 3

IDEO's methods for human-centered design **(IDEO, 2015)**.

IDEO methods for human-centered design					
Inspiration		**Ideation**		**Implementation**	
Frame your design challenge	Analogous inspiration	Download your learnings	Mash-ups	Live prototyping	Monitor and evaluate
Create a project plan	Card sort	Share inspiring stories	Design principles	Roadmap	Keep getting feedback
Build a team	Peers observing peers	Top five	Create a concept	Resource Assessment	
Recruiting tools	Collage	Find themes	Co-creation session	Build partnerships	
Secondary research	Guided tour 65 draw it	Create insight statements	Gut check	Ways to grow framework	
Interview	Resource flow	Explore your hunch	Determine what to prototype	Staff your project	
Group interviews		How might we	Storyboard	Funding strategy	
Expert interview		Create frameworks	Role playing	Pilot	
Define your audience		Brainstorm	Rapid prototyping	Define success	
Conversation starters		Brainstorm rules	Business model canvas	Keep iterating	
Extremes and mainstreams		Bundle ideas	Get feedback	Create a pitch	
Immersion		Get visual	Integrate feedback and iterate	Sustainable revenue	

Similarly, the LUMA Institute, a design and innovation company based out of Pittsburgh, PA, developed a unique, human-centered system for companies and organizations to use to scale

their processes for solving problems. Their initial approach to the development of their system was somewhat unique in that it focused on a set of four heuristics to guide their research in pursuit of a universal framework of design skills for practitioners (Pacione, 2019). LUMA Institute's team stated that a proper taxonomy of design skills would need to be:

- Based on extensive thorough research of all known design methods
- Organized in a way that is relevant and timeless
- Essential; a collection of methods used by a multitude of people for a multitude of design situations
- A comprehensible and accessible framework for the masses (Pacione, 2019).

The outcome of their extensive research efforts was the LUMA system of innovation; a collection of 36 methods presented as an aphorism that summarized design into three fundamental skills: looking, understanding, and making (Pacione, 2019). Looking methods are used to observe human experience in the sub-categories of ethnographic research, participatory research, and evaluative research. Understanding methods are used to analyze challenges and opportunities among people and systems, to identify patterns and priorities, and to frame problems. Making methods are used to envision future possibilities through concept ideation, modeling and prototyping, and design rationale. The LUMA Institute published *Innovating for people: Handbook of human-centered design methods* in 2012 to share the system, and support their curriculum needs for training people to apply design thinking to everyday problems within organizations. Table 4 provides a list of the LUMA Institute's thirty-six human-centered design methods, which are broken down into six categories of methods for Looking, Understanding, and Making.

Table 4

LUMA Institute's methods for human-centered design **(LUMA Institute, 2012)**.

The LUMA System of Innovation		
Looking	**Understanding**	**Making**
Ethnographic Research	**People & Systems**	**Concept Ideation**
Interviewing	Stakeholder Mapping	Thumbnail sketching
Conceptual inquiry	Persona Profiles	Creative Matrix
Walk-a-Mile Immersion	Experience Diagramming	Round Robin
Fly-on-the-wall observation	Concept Mapping	Alternative Worlds
Participatory Research	**Patterns & Priorities**	**Modeling & Prototyping**
What's on Your Radar??	Affinity clustering	Storyboarding
Build your own	Bull's-eye Diagramming	Schematic Diagramming
Buy-a-feature	Importance/Difficulty matrix	Rough & Ready Prototyping
Journaling	Visualize the Vote	Appearance modeling
Evaluative Research	**Problem Framing**	**Design Rationale**
Think aloud testing	Problem Tree Analysis	Concept Poster
Heuristic Review	Statement Starters	Video scenario
Critique	Abstraction Laddering	Cover story mock-up
System Usability Scale	Rose, Thorn, Bud	Quick reference guide

IBM was among one of the first, large-scale companies to adopt design thinking as a part of their daily culture. Their approach is different from the first two examples, because their process is not generalized for all people, but instead, specifically designed for IBM employees to use within their organization. IBM (2016) developed a process for design thinking that they refer to as The Loop. It is intended to help their employees better understand the users' needs and to deliver continual outcomes. There are three, key phases of the process: observe, reflect, and make (IBM Corporation, 2016). During the 'observe' phase, users immerse themselves in the real world to get to know their users, determine their needs, learn the landscape, and test ideas. In the 'reflect' phase, users come together and form points of views to find common ground, align the team, uncover insights, and plan ahead. In the 'make' phase, users give concrete form to abstract ideas to explore possibilities, communicate ideas, prototype concepts, and drive real

outcomes. Like others, IBM developed the *Field guide* (2016) which offers eleven design thinking methods commonly used by employees to solve problems using the Loop process. Table 5 offers a list of IBM's 11 commonly used methods of design thinking (IBM Corporation, 2016).

Table 5

IBM's process for design thinking, The Loop, and 11 commonly used design thinking methods **(IBM Corporation, 2016)**.

IBM's Process for design thinking, The Loop
Observe – Reflect – Make
• Hopes and fears • Stakeholder map • Empathy map • Scenario map • Big ideas vignettes • Prioritization grid • Needs Statements • Storyboarding • Assumptions and questions • Feedback grid • Experience-based roadmap

The previous examples of design thinking frameworks were developed by companies (IDEO, LUMA Institute, IBM) that offer a systematic approach and set of methodologies for solving complex problems and inspiring innovation and creativity throughout organizations. The last example offered within this review is a popular text created by an individual, Vijay Kumar, a professor at the IIT Institute of Design and notable consultant of human-centered design. Kumar (2013) published *101 Design methods: A structured approach for driving innovation in your organization*. Kumar's (2013) work offers 101 design thinking methods for organizations to use to drive innovation. Kumar suggests four core principles as a foundation for innovation: build innovations around experiences; think of innovations as systems; cultivate an innovation culture; and adopt a disciplined innovation process. He suggests a nonlinear, iterative process for innovation that includes four quadrants of activity: research, analysis, synthesis, and realization.

The methods proposed by Kumar are divided among seven modes of the design process: 1) sense intent; 2) know context; 3) know people; 4) frame insights; 5) explore concepts; 6) frame solutions; 7) realize offerings. Kumar's collection of methods reflects an extensive effort to showcase the vast plethora of approaches used for centuries by designers to solve problems. His intent was to offer these methods with step-by-step guides so anyone could implement innovative, problem solving methods within the context of their own situations. Table 6 offers Kumar's (2013) seven modes of design and 101 methods of design thinking.

Table 6

Kumar's seven modes of design and 101 methods of design thinking **(Kumar, 2013)**.

Mode 1: Sense Intent	Mode 2: Know Context	Mode 3: Know People
Buzz Reports	Contextual Research Plan	Research Participant Mapping
Popular Media Scan	Popular Media Search	Research Planning Survey
Key Facts	Publications Research	User Research Plan
Innovation Sourcebook	Eras Map	Five Human Factors
Trends Expert Interview	Innovation Evolution Map	POEMS
Keyword Bibliometrics	Financial Profile	Field Visit
Ten Types of Innovation Framework	Analogous Models	Video Ethnography
Innovation Landscape	Competitors-Complementors Map	Ethnographic Interview
Trends Matrix	Ten Types of Innovation Diagnostics	User Pictures Interview
Convergence Map	Industry Diagnostics	Cultural Artifacts
From…To Exploration	SWOT	Image Sorting
Initial Opportunity Map	Subject Matter Experts Interview	Experience Simulation
Offering-Activity-Culture Map	Interest Groups Discussion	Field Activity
Intent Statement		Remote User Research
		User Observations Database
Mode 4: Frame Insights	**Mode 5: Explore Concepts**	**Mode 6: Frame Solutions**
Observations to Insights	Principles to Opportunities	Morphological Synthesis
Observations Sorting	Opportunity Mind Map	Concept Evaluation
User Observation Database queries	Value Hypothesis	Prescriptive Value Web
User Response Queries	Persona Definition	Concept Linking Map
ERAF System Diagram	Ideation Session	Foresight Scenario
Descriptive Value Web	Concept Generating Matrix	Solution Diagramming
Entities Position Map	Concept Metaphors and Analogies	Solution Storyboard
Venn Diagramming	Role-play Ideation	Solution Enactment
Tree / Semilattice Diagramming	Ideation Game	Solution Prototype
Symmetric Clustering Matrix	Puppet Scenario	Solution Evaluation
Asymmetric Clustering Matrix	Behavioral Prototype	Solution Roadmap
Activity Network	Concept Prototype	Solution Database
Insights Clustering Matrix	Concept Sketch	Synthesis Workshop

Semantic Profile User Groups Definition Compelling Experience Map User Journey Map Opportunity Framework Design Principles Generation Analysis Workshop	Concept Scenarios Concept Sorting Concept Grouping Matrix Concept Catalog	
Mode 7: Realize Offerings		
Strategy Roadmap Platform Plan Strategy Plan Workshop Pilot Development and Testing Implementation Plan Competencies Plan Teaming Plan / Initiatives Plan Vision Statement Innovation Brief		

The examples of design thinking frameworks, models, and methods presented within this section of the literature are offered to express the commonalities and differences of approaches taken by companies, organizations, and individuals toward adopting design thinking cultures, mindsets, and methods within their daily interactions. It is evident that there are a variety of options and opportunities for which one might explore or employ processes toward approaching problems with design thinking methods. The frameworks presented here are not representative of all; they are reflective of some systematic processes and methodologies commonly used among design thinking practitioners.

Summary

Design thinking is a human-centered, process for creative problem solving, where methods and techniques are implemented to assist people with empathizing with problems, brainstorming ideas, generating a variety of solutions, gathering feedback, and evaluating performance and solutions (Brown, 2009; Liedtka, 2014; Lockwood, 2009). The process itself is non-linear and iterative in nature, but the methods are prescriptive in ways that could assist

novice instructional designers in conducting rapid analyses, idea generation, prototyping, and gathering feedback.

The literature review explored the common stages of instructional design models and frameworks, identified challenges of novice designers and heuristics of experts, and introduced the topic of design thinking research, processes, and methodologies. While the literature demonstrated that much is known about the challenges of novice instructional designers, heuristics of experts, and processes and methodologies of design thinking, little has been shared to suggest the combination of design thinking methodologies to advance novice instructional designers' processes. The review of literature in chapter two directly informed the need and development of the conceptual model that was created in this study. Chapter three further explains the design and development of the model.

CHAPTER 3

Introduction

This chapter describes the research methodology that was applied in this study. The purpose of this study was to develop a conceptual model that incorporates design thinking methods to enhance novice instructional designers' ability to overcome the challenges of implementing the instructional design process in practice. This study drew on design and development research, including model development and model revision. Through the development of the model, this research sought to answer the following questions:

1. What are the common stages of the instructional design process?
2. What are some challenges of novice instructional designers and how do they align with heuristics of expert instructional designers?
3. What is the relationship between instructional design heuristics and design thinking?
4. Which methods of design thinking align with heuristics of expert instructional designers?

Study Design

Design and development research is defined as "the systematic study of design, development, and evaluation processes with the aim of establishing an empirical basis for the creation of instructional and non-instructional products and tools, as well as new or enhanced models that govern their development" (Richey & Klein, 2007, p. 1). For this study, design and development research was selected to develop and validate a conceptual model of instructional design heuristics that incorporates design thinking methods. The primary goal of design and

development research is to inform practice by creating knowledge that is grounded in empirical data (Richey & Klein, 2007). In this study, research questions were developed from studies primarily in business and industry where practitioners commonly reported challenges on the part of novice instructional designers entering the field of instructional design (Ertmer, York, & Gedik, 2009; York & Ertmer, 2011).

The ability to identify, understand, and solve ill-structured problems is referenced as one of the most common challenges among novice designers (Jonassen, 1997; Ertmer, et al., 2008). Problem solving is at the core of design thinking, and research suggests that many of the weaknesses of novice designers may be overcome by the strengths of the process of design thinking and design thinking methodology (Brown, 2009; Liedtka, 2014; Connell & Erin, 2013). Design and development research was appropriate for this study, as there was a need to create a model of instructional design heuristics that incorporated design thinking methods for problem identification and exploration. Previously, there were no models, frameworks, or guidelines as to which design thinking methods might best support heuristics and tasks associated with the instructional design process and the framework of ADDIE. Creating a conceptual model could help designers quickly identify challenges in the context of their situations and make selections for design thinking methods to best meet the needs of their instructional design problems.

Model research

There are two types of design and development research: Type 1, product and tool research and Type 2, model research (Richey & Klein, 2007). Product and tool research focuses on the design and development of products and tools. There are three major classes of product and tool research: comprehensive design and development projects, phases of design and development, and tool development and use (Richey & Klein, 2007; Richey & Klein, 2014).

Type 2, or model research, is focused on the development and validation of models, where the focus is more geared toward process rather than the development or demonstration of a product or tool. Model research seeks to validate or determine the effectiveness of a development model, technique, or procedure (Richey & Klein, 2007). The primary outcome of Type 2 model research is new knowledge in the form of a new or revised design and development model (Richey, 2005).

This study used Type 2 design and development methodologies for model development and model validation research. There are three major classes of model research: model development or the creation of a new model; model validation, which implements processes to validate and determine the effectiveness of a model; and model use, which examines the context for which models are used (Richey, 2005; Richey & Klein, 2014). Richey and Klein (2007) suggest a variety of methodologies that one might use in model research. This research included four key phases: literature review, model development, expert review evaluation for model validation, and revision.

Phase 1: Literature Review

Phase one of the research began with an extensive review of the literature to explore common stages of instructional design processes, identify challenges of novice instructional designers and heuristics of experts in practice, explore design thinking research, and identify design thinking methods which most closely align with instructional design heuristics. The review of literature was the foundation for the development of a new conceptual model of instructional design heuristics incorporating design thinking methods. Data from the review was collected and organized using a series of synthesis matrices in Microsoft Excel.

The review began with an explanation of the instructional design process and ADDIE, a framework of instructional design commonly referenced in practice by expert instructional designers. Next, the review outlined challenges of novice instructional designers entering the field of practice, and common heuristics identified among studies of expert instructional designers. It concluded with an explanation of the origins and process of design thinking, a review of characteristics of design thinking, and identification of design thinking methodologies, which align with common heuristics of instructional designers.

The researcher used the following databases to conduct a review of instructional design processes, challenges of novice designers, and heuristics of expert instructional designers: JSTOR, EBSCOhost, ERIC, Google Scholar, and ResearchGate. Non-peer reviewed and non-empirical materials were eliminated from the search criteria. Media and medium with potentially biased views such as websites and magazines were also not considered in the review. Keywords used in the search process included: models of instructional design, ADDIE, challenges of novice instructional designers, constraints and barriers of instructional designers, principles of expert instructional designers, heuristics of expert instructional designers, and expert instructional design practitioners.

The researcher used a combination of databases, books, periodicals, and resource sites to search for design thinking and design thinking methodologies. Non-peer reviewed materials were excluded from the search. Keywords used in the search process included: design thinking process, categories of design thinking, principles of design thinking, design thinking methodology, human-centered design methods, and strategies for design thinking.

The full results of the literature review are presented in Chapter 4. References are stated at the end of this study.

Phase 2: Model Development

Following the results of the literature review in Chapter 4, a model of instructional design heuristics incorporating design thinking methods was developed. In phase 2, the areas of instructional design processes, challenges of novice designers, principles and heuristics of expert designers, design thinking processes, and methods for design thinking were analyzed to identify patterns and overlap between key concepts, challenges, principles, heuristics, and methods. Models of instructional design were compared to find common themes in activities and tasks. The ADDIE framework was selected for use in the development of the final model due to its generic design and frequently stated use among experts in practice. The researcher reviewed 15 studies addressing the common challenges of novice instructional designers and 26 studies identifying principles and heuristics of expert instructional designers in practice. York and Ertmer's (2011; 2016) 61 principles applied by experienced designers in practice were selected as the basis of development of this model for the following reasons: (1) the researchers' (York and Ertmer) extensive background, research, and knowledge of the topic, (2) detailed and qualitative nature of the findings, and (3) thorough explanations and alignment among similar studies. The researcher reviewed 12 studies outlining the processes of design thinking, and five books detailing the characteristics and methodologies of design thinking. The LUMA Institute's *Innovating for people: Handbook for human-centered design* (2012) was selected as a source for development of this model for the following reasons: (1) thorough explanation of categories of design thinking, (2) clearly defined methods with simple explanations, and (3) commonalities between terminology used in York and Ertmer's (2011; 2016) 61 principles of instructional design and the terminology used in The LUMA Institute's *Innovating for people: Handbook for human-centered design* (2012).

The model includes four sets of tables. The first table set (Table 7.1 and Table 7.2) includes a list of York and Ertmer's (2011; 2016) 61 principles of expert instructional designers that was analyzed and condensed into a subsequent list of consolidated heuristics commonly referenced in instructional design and design thinking processes. The principles and consolidated heuristics have been cross-referenced to explain relationships between the two lists.

The second table set (Table 8) was developed to define heuristics as learner – centric or designer – centric, as well as to state each heuristic's potential for application within ADDIE's generic process of instructional design: analysis, design, development, implementation, and evaluation. Learner – centric heuristics indicate a stage of the process where an action is taken to address the needs and demands of a learner (or client, user, etc.); versus designer – centric stages that primarily align with best practices and mindsets of instructional designers and their consistent processes. Most of the designer – centric heuristics should occur at each stage of the instructional design process. For example, *Communicate visually* is a best practice that instructional designers should strive for throughout the process to promote clear and transparent communications. The learner – centric methods and combinations of methods that are proposed within the model could help instructional designers become more visual communicators, but the designer – centric heuristics do not fall within specific stages of the instructional design process or ADDIE framework. Since the intent of the model was to support novice instructional designers in practice, only learner – centric heuristics were listed in the remaining tables.

The third table set (Tables 9.1 – 9.9) includes the list of 20 learner – centric heuristics and their common stages of the ADDIE model, LUMA Institute's nine categories of design thinking methods, and their corresponding methodologies for each category. In this table set, the researcher used an X at the intersections of the cells between heuristics and methods when there

was alignment between terminology of the heuristic and explanations of the design thinking methods.

The fourth table set (Table 10) presents the heuristics within each stage of the ADDIE model. Frequency of method selections from table set three informed selection of methods and method combinations in table set four. "**And**" is used to denote proposed method combinations and "**or**" is used to denote methods that can be used individually or in conjunction with one another. A glossary of terms is included to offer a simple explanation of each method identified.

Phase 3: Model Validation

Each table set of the conceptual model of instructional design heuristics incorporating design thinking methods was validated through internal validation processes in phase 3. Model validation is a critical process of Type 2 design and development research. Model validation determines the overall validity and dependability of a proposed model. It is a "carefully planned process of collecting and analyzing empirical data to demonstrate the effectiveness of a model's use in the workplace or to provide support for the various components of the model itself" (Richey, 2005, p. 736). Internal validation offers data to confirm the elements of a model, as well as the relationships and correlations between elements and procedures of a model (Tracey & Richey, ID model construction and validation: A multiple intelligences case., 2007). For this study, expert reviews were utilized to evaluate the overall accuracy and appropriateness of the model.

Expert Review Evaluation

Expert review is a procedure whereby specialists are selected to review the elements and overall structure of a model (Tracey & Richey, ID model construction and validation: A multiple

intelligences case., 2007). Expert review is an iterative process of review and critique based on pre-established standards, and succeeded by model revisions as proposed in the results (Richey, 2005). The internal validation process was fulfilled using expert reviews to evaluate the role of ADDIE within the model, confirm consolidation of heuristics, and corroborate the appropriateness of proposed design thinking methods.

Three experts were recruited to examine whether or not they agreed with the consolidated heuristics of instructional design and design thinking, their stated placement within stages of the ADDIE model, and whether or not they agreed with the proposed methods and method combinations of Tables 9.1 – 9.9 and Table 10. To achieve proper triangulation in this research, one expert was recruited from instructional design with an expertise in heuristics of instructional design and design thinking; one expert was recruited from design thinking, and one expert possessed a background in educational leadership and design thinking. They were asked to participate in reviewing the model via email. Recruited experts signed an online IRB expert review consent form before their review (see Appendix A). Expectations of the expert review, results from the literature review, the development model, and review questions (see Appendix B) were sent to reviewers via email upon consent. The researcher met individually with experts via web-conferencing software to review the model and answer any questions of experts prior to their review. Experts had two to three weeks to review all materials and complete their review of the model. Experts sent all written feedback and the results of the review to the researcher via email.

Once feedback was received from all experts, the data were examined, individually, and then synthesized to identify themes and patterns across all three responses. The synthesis of findings guided the final phase of the process, model revision.

Phase 4: Revision

In the final phase of the research, the model was revised to incorporate the recommendations and revisions of expert reviewers. According to Tracey and Richey (2007) internal validation procedures such as expert reviews, are regarded as a form of formative evaluation. Formative evaluation is a data collection procedure used to determine the effectiveness of products and resources, and offer feedback for further revisions or iterations (Dick & Carey, 1990). Thus, data collected from the results of the expert reviews were analyzed individually, and then synthesized to modify and improve the model developed in this research. Decisions to make revisions to the model were based on the following criteria: if multiple reviewers identified the same limitations and recommend the same improvement, or if only one expert recommended the revision, but it was one of his or her major concerns and weaknesses of the model. A list of revisions is presented in Chapter 6.

Chapter 4

Literature Review Results

The following section provides the results of the literature review conducted to collect data for the foundation of the model. The review sought to identify common heuristics (*generalized stages of an instructional designer's process*) of expert instructional designers and to find recommendations for design thinking methods that novice instructional designers can use to overcome common challenges when entering the field of practice. The results of the review are explained for each table set described in Chapter 3.

In recent years, numerous studies have been conducted to gain a better understanding of the challenges that exist among novice instructional designers (Liu, Gibby, Quiros, & Demps, 2002; Toker & Moseley, 2013; York & Ertmer, 2016; Chang & Kuwata, 2020; Rowland, 1992). Additionally, researchers recognize that while some expert designers reference components of a formalized instructional design process, they more commonly cite heuristics as the most important factors in the overall success of a project (York & Ertmer, 2011). Experts' stated heuristics most often come from past experiences and relate to stages of a more generalized framework of instructional design, such as ADDIE: analysis, design, development, implementation, and evaluation (York & Ertmer, 2011). Table 1 offers a detailed list of 61 principles reported among expert designers as important to their process in York and Ertmer's (2011; 2016) study. The researcher closely examined the verbiage expressed in the principles, looking for themes and patterns in purpose and terminology. The 61 principles were consolidated into a list of 28 heuristics, which were cross-referenced to ensure representation of each principle's existence among the generalized heuristics. Table 7.1 offers York and Ertmer's (2011; 2016) list of 61 principles and their alignment within the researcher's list of 28 heuristics,

while Table 7.2 offers the list of 28 heuristics and their alignment within the 61 principles. The heuristics in Table 7.2 combine terms and components of processes that are commonly referenced by experts in the literature for instructional design and design thinking. For example, the principle, "Know your learners/target audience" in Table 7.1 aligns with heuristics, *Identify problems*, *Identify stakeholders*, and *Gain empathy for people* in Table 7.2.

Table 7.1

York and Ertmer's (2011;2016) 61 principles of expert instructional designers cross-referenced with the researcher's consolidated list of 28 heuristics of instructional design and design thinking.

	Principles	Cross Reference
1	"Know your learners/target audience"	3, 10
2	"Determine what it is you want your learners to perform after the instructional experience. What is the criterion for successful performance?"	4, 11, 8
3	"There are things that need to be determined at the front end in order to make you successful at the back end."	1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13
4	"Be honest with the client"	23, 24, 25, 26, 27
5	"When designing instruction, consider the context in which the learning will be applied. Ask yourself, 'How can I put learning into context?''	12, 27
6	"Negotiate the scope of the project with the client and create a statement of work upfront"	7, 8, 24, 25, 26, 27
7	"When designing instruction, consider active learning. Ask yourself, 'How can I make learners more actively engaged?''	14, 15
8	"You have to be sensitive to the context and the culture of the client"	10, 11, 12, 13
9	"Approach the design problem with the end in mind. What are the deliverables? What are the learning/performance outcomes?"	4, 7, 8
10	"You need to build trust with the client. This can be done through explaining what you are doing, why you are doing it, and how it is of value to them."	9, 21, 22, 23, 24, 25, 26, 27
11	"Figure out who all the stakeholders are in the room. And figure out who is not in the room that is still a stakeholder."	3, 10, 11, 13
12	"The team is critical. Involve the right people at the right time."	3, 18, 28
13	"As a designer you need to listen more than you talk."	9, 10, 11, 12, 13

14	“Know your learners’ prerequisite knowledge.”	9, 10, 11
15	“You need to manage the client’s expectations.”	24, 27
16	“When verifying information, you often will learn more information.”	1, 2, 9, 10, 11, 12, 13, 18, 25, 26, 28
17	“Consider utilizing scaffolding in your instructional experience Give the learner the tools they need to succeed.”	14, 15, 17
18	“You may have to mock up something to show the client to make sure that you get all of the desired outcomes right.”	17, 18, 19
19	“Determine what will keep the learner motivated during the instructional experience.”	10, 14, 15
20	“Ask yourself, ‘Is instruction the solution to this problem?"	1, 2, 15
21	“Verify all the information you receive from the client to prevent miscommunication.”	9, 18, 24, 25, 26, 28
22	“Sometimes the client will not tell you all there is to know about a problem.”	2, 12, 13
23	“The client thinks it is much easier to move from the conceptualization to the implementation than it actually is.”	17, 24, 27
24	“Ensure that design speaks to a value chain of learning, i.e., that learning contributes to behaviors and that behaviors contribute to organizational or business results.”	4, 11, 16, 27
25	“You have to determine if the client really knows what they want.”	1, 2
26	“When communicating with the client, use visuals and documents in order to prevent miscommunication.”	26
27	“You need to understand and speak the language of your client.”	9, 10, 11, 12, 13
28	“When possible, have a subject matter expert AND a non-subject matter expert review the final product.”	18, 28
29	“When faced with something complex, look for previous examples that have characteristics you can draw upon, that can give you ideas on how to solve the problem.”	14
30	“Understand the learning associated with the technology.”	11, 12
31	“Be prepared to think abstractly.”	15, 17
32	“Constraints are a key to design. Look for constraints that have been placed on a project.”	1, 6, 13
33	“Needs analysis is the foundation for evaluation.”	1, 2, 3, 7
34	“Subject matter expert’s documentation often fails to provide the necessary critical thinking. The SME forgets to tell you basic steps and concepts he forgot he	10, 11, 12, 26

	once learned.”	
35	“Don’t let technology drive the design.”	15
36	“Resist the technical expert’s propensity to focus on the most complex or innovative aspects of a product. Remember the novice learner who needs to build basic skills.”	11, 15, 28
37	“It is the instructional designer’s job to press for quality in the design.”	15, 16, 17, 18, 19, 20
38	“Use previous experiences, if possible, as a starting point for new projects.”	14
39	“Be sure the instruction gives learners the opportunity to make choices.”	22
40	“Don’t use technical instructional design terminology with the client unless you have to.”	23
41	“You are rarely going to collect all the desired outcomes with just one interview with the client.”	9, 18, 25, 26, 28
42	“Always conduct a pilot.”	18, 20
43	“When multiple stakeholders are involved, ask your client to identify your ‘‘single point of contact’’—make sure that person understands what is expected—gathering feedback on your design for you, getting approvals, etc.”	3, 24
44	“Technology can get in your way, and if you don’t deal with it you can get yourself into trouble.”	5, 6, 15
45	“You need to know the theories. You need to know the models. You need to have that foundation.”	12
46	“Understand that every design situation is unique.”	1, 2, 10, 11, 12, 13
47	“You often don’t get to do the best instructional design you want due to constraints, resources, time, budget, etc.”	6, 15, 16, 17, 18, 19
48	“Design is a people process.”	28
49	“Resist the SME’s (subject matter expert’s) desire to teach the solution to the hot problem of the day… unless it is a common problem seen by the average learner.”	1, 2, 13
50	“Allow the content to guide how users interact with the training (linear, user-driven, etc.)—not the tools used to develop the training.”	15, 22
51	“Bring together the client and other stakeholders for synchronous meetings at each ‘‘gate’’ in a phased process.”	3, 18, 24, 25, 26, 27, 28
52	“When designing instruction, think about Elaboration Theory. Ask yourself, ‘What’s the ‘big picture’ to which the components are attached?’’	10, 11, 12, 13
53	“Prepare to do a lot of work that is never going to show up in the final product.”	17, 18, 19

54	"The instructional designer should take prodigious notes during meetings. Do not rely purely on documentation of the SME."	9, 26
55	"Invest as much time as you can in your audience analysis."	9, 10, 11, 12, 13
56	"Never look at the problem at face value. You have to get to the core of the problem and solve all of the subproblems."	1, 2, 3, 9, 10, 11, 12, 13
57	"Generate multiple possible solutions that will solve the problem."	15, 17
58	"Acknowledge your limitations. Don't accept a job that is outside of your expertise."	23, 24
59	"Make every effort to be part of the production process."	18, 19, 25, 28
60	"Design continues through the delivery or implementation phase."	18, 29, 20
61	"Ask all possible relevant questions throughout the entire design process."	2, 9, 18, 25

Table 7.2

Consolidated list of instructional design and design thinking heuristics cross-referenced with York and Ertmer's (2011) 61 principles of expert instructional designers.

From this point forward, the first letter of each heuristic is capitalized, and words are italicized.

	Heuristics	Cross Reference
1	*Identify problems*	1, 16, 20, 25, 32, 33, 46, 49, 56
2	*Question the question*	16, 20, 22, 25, 33, 46, 49, 56, 61
3	*Identify stakeholders*	1, 3, 11, 12, 33, 43, 51, 56
4	*Define outcomes*	2, 3, 9, 24
5	*Identify barriers*	3, 44
6	*Identify constraints*	3, 32, 44, 47
7	*Prioritize needs*	3, 6, 9, 33
8	*Prioritize outcomes*	2, 3, 6, 9
9	*Listen*	10, 13, 14, 16, 21, 27, 41, 54, 55, 56, 61
10	*Gain empathy for people*	1, 3, 8, 11, 13, 14, 16, 19, 27, 34, 52, 55, 56
11	*Gain empathy for processes*	2, 3, 8, 11, 13, 14, 16, 24, 27, 30, 34, 36, 46, 52, 55, 56
12	*Understand context*	3, 5, 8, 13, 16, 22, 27, 30, 34, 45, 46, 52, 55, 56
13	*Gain empathy for problems*	3, 8, 11, 13, 16, 22, 27, 32, 46, 49, 52, 55, 56
14	*Leverage past experiences*	7, 17, 19, 29, 38
15	*Explore opportunities*	7, 17, 19, 20, 31, 35, 36, 37, 44, 47, 50, 57
16	*Frame insights*	24, 37, 47

17	*Prototype*	17, 18, 23, 31, 37, 47, 53, 57
18	*Seek feedback*	12, 16, 18, 21, 28, 37, 41, 42, 47, 51, 53, 59, 60, 61
19	*Iterate designs*	18, 37, 47, 53, 59
20	*Pilot*	37, 42, 60
21	*Gain trust*	10
22	*Allow for autonomy*	10, 39, 50
23	*Be authentic/real*	4, 10, 40, 58
24	*Set clear expectations*	4, 6, 10, 15, 21, 23, 43, 51, 58
25	*Communicate often*	4, 6, 10, 16, 21, 41, 51, 59, 61
26	*Communicate visually*	4, 6, 10, 16, 21, 34, 41, 51, 54
27	*Communicate the why/how*	4, 5, 6, 10, 15, 23, 24, 51
28	*Collaborate with others*	12, 16, 21, 28, 36, 41, 48, 51, 59

Consolidated heuristics of instructional design and design thinking

Cross-referencing principles and heuristics of instructional design and design thinking informed the development of Table 8, which includes the 28 consolidated heuristics from Table 7.2, a categorization of learner – centric versus designer – centric, and identification of where the heuristic most often occurs within ADDIE. The first nine consolidated heuristics most often occur during the analysis stage of the instructional design process. The first heuristic, *Identify problems*, encompasses a need for instructional designers to ensure that they (a) identify all of the people and processes of a problem, (b) clearly understand the problem and its underlying causes, and (c) identify potential constraints or barriers toward solving the problem (Jonassen, 2008; Ertmer, et al., 2008). Similarly, the heuristic, *Question the question* involves reframing the problem statement, or asking new questions. This may also include asking whether instruction is the right solution (Isaken, Dorval, & Trefflinger, 2011; Rowland & DiVasto, 2001). *Identify stakeholders* addresses a need to identify all the people involved in the process or project (Stepich & Ertmer, 2009). This may include subject-matter experts, sponsors, managers, technology specialists, learners, etc. When instructional designers *Define outcomes*, they are establishing criteria that must be met upon completion (Rowland, 1993). Often this involves

gaining some level of consensus among stakeholders about what constitutes success among learners. *Identify constraints* references a need to identify things that might limit the project in some way, while *Identify barriers* references a need to identify things that might prevent success altogether (York & Ertmer, 2016). Constraints are most often related to time, resources, and budget; constraints may limit the project in some way, but they typically are not the deal breakers that barriers can be. Regardless, it is important to identify constraints and barriers to projects as early in the process as possible (Ertmer, York, & Gedik, 2009). *Prioritize needs* most often refers to the scope of a project. It is important for instructional designers and clients to negotiate and gain consensus on the relative importance of the needs of a project, so there is no confusion about what will or will not be included or addressed (Rowland, 1992). *Prioritize outcomes* addresses the importance of gaining consensus on what is most important among stakeholders for learners to know or do upon conclusion of instruction (Rowland, 1993). Earlier heuristics address a need to define the outcomes, but this stage establishes the priorities of those outcomes. This conversation may also contribute to conversations about the scope of a project, or the need to teach or train in smaller segments or phases.

The next three heuristics most often occur during the instructional design stages of analysis and evaluation. *Listen* references a need for instructional designers to take time and truly listen to all the stakeholders of a project, which includes listening to feedback from learners during formative and summative evaluations (Lindsey, 2007; Ertmer, York, & Gedik, 2009). *Gain empathy for people* is a heuristic for gaining the perspectives of the people involved in a process and taking the time to understand them, who they are, what they do, what they think, what they see, what they say, and how they feel. Similarly, *Gain empathy for process* involves gaining perspective for all the steps or stages of peoples' processes. This might include a

vicarious experience, such as trying the steps for one's self, or careful observation of people doing their jobs in their actual environments (Roytek, 2010; Liu, Gibby, Quiros, & Demps, 2002).

Understand context and *Gain empathy for problems* are also heuristics that most commonly occur during analysis (Rowland, 1992; Liu, Gibby, Quiros, & Demps, 2002). Studies emphasize the importance of teaching or training within the context of a situation (Merrill, 2002; Rowland, 1992); in order to introduce learning within the context, instructional designers must take steps to understand the context, which often extends to a need to gain empathy for problems. Often there are multiple causes and effects of a problem, which can be overwhelming for a designer, and make it difficult to know where to begin with the development of solutions. Gaining empathy for the problem calls on the designer to break problems apart by identifying the underlying issues that contribute to the problem (Ertmer, et al., 2008; Jonassen, 1997). As you start to look at the individual contributors to the problem, the issues become more specific and easier to approach or digest.

Leverage past experiences, *Explore opportunities*, and *Frame insights* are heuristics that most commonly exist during the design stage (Liu, Gibby, Quiros, & Demps, 2002). The simple notion of leveraging past experiences may be daunting for a novice instructional designer, but it is important to remember that anyone who is practicing in the field most likely has 15-20 years of experience being a student and learning from others, as well as life experiences, which often contribute to the development of unique ideas. *Explore opportunities* calls on the instructional designer to explore multiple ideas for solutions, quantity over quality, first. The first idea is seldom the best idea, so taking the time to explore as many ideas as possible is necessary in the design of a future solution (Rowland, 1992). Once an instructional designer has taken steps to

explore multiple opportunities, the next step is to *Frame insights* into new, vetted ideas, which most often involves gaining consensus among multiple stakeholders in the process (Liu, Gibby, Quiros, & Demps, 2002; Jonassen, 1997).

Prototype, Seek feedback, and *Iterate designs* are all iterative heuristics of the process, which most often occur throughout phases of development, implementation, and evaluation (Keppell, 2001; Wedman & Tessmer, 1993). Once ideas are vetted, they need to be prototyped, which involves some level of creation or mock-up to allow others to experience new ideas. Throughout stages of prototyping, there should be avenues for seeking feedback from multiple stakeholders. As instructional designers gain feedback, they must take steps to iterate and refine their ideas, which sometimes involves tossing out ideas and starting over with the design process. It could even shed light on a need to further gain empathy for people, processes, and problems (Keppell, 2001).

Once solutions have been prototyped and iterated, they may be ready to *Pilot*. A pilot is generally the first, real instance of delivering the instructional solution (Wedman & Tessmer, 1993). Instructional designers are not typically the ones responsible for delivering the instruction, but their role within the process is necessary to ensure proper feedback channels exist for any needed changes (Visscher-Voerman, 1999). Pilots occur during the implementation and evaluation stages of the instructional design process. Formative and summative evaluations should exist within and beyond the pilot so instructional designers know what updates or modifications may be necessary for future deliveries (Wedman & Tessmer, 1993).

The remaining eight heuristics are designer – centric, meaning that they are most often referenced as the mindsets or best practices of instructional designers. These heuristics exist within all stages of instructional designers' processes to conduct analysis, design, develop,

implement, and evaluate learning interventions. *Gain trust* is acknowledged as one of the most important heuristics of expert designers (Liu, Gibby, Quiros, & Demps, 2002). There are multiple ways in which designers take steps to gain trust; most often they involve taking the time to gain empathy for all of the people and processes of a problem, clear and transparent communication among all stakeholders, and listening and gathering feedback throughout the process (Ertmer, et al., 2008; Liu, Gibby, Quiros, & Demps, 2002). *Allow for autonomy* references a need for designers to consider opportunities for stakeholders and learners to have autonomy throughout the process (York & Ertmer, 2011; 2016). Autonomy is a key motivator for success among collaborations and learning (Jones, 2009). Stakeholders need to feel as though they have a voice in various stages of analysis, ideation, and evaluation. *Be authentic and real* refers to a need for an instructional designer to be viewed as real person; someone who can relate and empathize with the context of a situation (Jonassen, 2008). Novice instructional designers may feel a need to sound or present themselves as more experienced than they really are. It is ok for designers to be humble and ask questions when they do not know or understand something. This also includes limiting the use of technical jargon and speaking with terms that stakeholders recognize and understand (Ertmer, York, & Gedik, 2009). Stakeholders and subject-matter experts need to feel as though they have been heard and their issues acknowledged. *Being authentic and real*, taking the time to *Ask questions*, and *Visually communicating* findings from analysis are all key heuristics involved in developing trust of clients and learners (York & Ertmer, 2011; 2016). It is important for instructional designers to *Set clear expectations* throughout the process. This extends to a need for designers to be honest and transparent about what is in scope and what is not. To set clear expectations, one must *Communicate often, Communicate visually, Communicate the why and how*, and *Collaborate with others* (York &

Ertmer, 2011; 2016; Ertmer, York, & Gedik, 2009). *Communicating often* ensures that key stakeholders are familiar and involved with the process, which gives them the opportunity to share input as needed, but it can also be a helpful reference if the process goes array. *Communicating visually* and developing artifacts of communications that take place will ensure that all stakeholders have access to reference conversations and decisions that occurred throughout all stages of the instructional design process such as analysis and design. This can be particularly helpful when someone new joins the team conversations. It is also important for instructional designers to *Communicate the why and how* throughout their communications among stakeholders as well as within the development of their instructional designs (York & Ertmer, 2011; 2016; Ertmer, York, & Gedik, 2009). Finally, *Collaborate with others* references a need to involve others in every stage of the design process (Jonassen, 1997). Collaborations should be strategically designed throughout analysis, design, development, implementation, and evaluation. They should account for time for multiple people to think and work individually towards a collective goal, as well as time to work together in collaborative teams.

Table 8

Consolidated heuristics of instructional design and design thinking.

Consolidated ID & DT Heuristics	*Learner – centric vs. Designer – centric	Stages of ADDIE
Identify problems	Learner – centric	Analysis
Question the question	Learner – centric	Analysis
Identify stakeholders	Learner – centric	Analysis
Define outcomes	Learner – centric	Analysis
Identify barriers	Learner – centric	Analysis
Identify constraints	Learner – centric	Analysis
Prioritize needs	Learner – centric	Analysis
Prioritize outcomes	Learner – centric	Analysis
Listen	Learner – centric	Analysis, Evaluation
Gain empathy for people	Learner – centric	Analysis, Evaluation
Gain empathy for processes	Learner – centric	Analysis, Evaluation
Understand context	Learner – centric	Analysis

Gain empathy for problems	Learner – centric	Analysis
Leverage past experiences	Learner – centric	Design
Explore opportunities	Learner – centric	Design
Frame insights	Learner – centric	Design
Prototype	Learner – centric	Development, Implementation, Evaluation
Seek feedback	Learner – centric	Development, Implementation, Evaluation
Iterate designs	Learner – centric	Development, Implementation, Evaluation
Pilot	Learner – centric	Implementation, Evaluation
Gain trust	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Allow for autonomy	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Be authentic/real	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Set clear expectations	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Communicate often	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Communicate visually	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Communicate the why/how	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Collaborate with others	Designer – centric	Analysis, Design, Development, Implementation, Evaluation

**Refers to actionable, learner – centered stages of the ID process versus designer – centric stages, which mostly align with mindsets and best practices of instructional designers.*

Heuristics and design thinking methods

Tables 9.1 – 9.9 relate the list of 20, learner – centric heuristics identified in Table 8, The LUMA Institute's 9 categories of design thinking methodologies, the 5 stages of ADDIE (analysis, design, development, implementation, evaluation), and design thinking methods that best align with the list of heuristics. These tables were developed by reviewing the characteristics of each heuristic in conjunction with a review of design thinking methods outlined within The LUMA Institute's Handbook of Human-Centered Design Methods (2012). An X was placed at the intersection of heuristics and methods when a connection was identified between the

characteristics of the heuristic and the definitions, explanations, or benefits of the method. Appendix C includes a list of design thinking methods with citations of resources that were used to validate the characteristics of methods included in the LUMA Institute's Handbook of Human-Centered Design Methods (2012).

Within the design thinking category of ethnographic research (see **Table 9.1**), the design thinking methods included are Interviewing, Fly-on-the Wall Observations, Contextual Inquiry, and Walk-a-Mile Immersion. Themes emerged among heuristics that most commonly existed in the analysis stage. Ethnographic research methods emphasize a need for researchers to gain the perspectives of the people whom they are designing for, which directly aligns with an instructional designers' need to conduct an analysis of their learners (Pacione, 2019; LUMA Institute, 2012).

The design thinking methods included in the second category, participatory research (see **Table 9.2**), are What's on Your Radar?, Buy a Feature, Build Your Own, and Journaling. These methods call on researchers to bring the people they are designing for into the process of research and analysis. Conducting Interviews are great for gathering input of people, but they can be time consuming. Participatory research methods allow researchers to collect information from a large, diverse group of people, quickly. These methods most aligned with heuristics related to analysis and evaluation. Specifically, heuristics that addressed needs to gain empathy for people, and to establish a consensus among groups of people (Pacione, 2019; LUMA Institute, 2012).

Design thinking methods for evaluative research (see Table 9.3) include Think Aloud Testing, Heuristic Review, Critique, and Systems Usability Scale. These methods are used to conduct critiques and gather feedback about the user experience. The methods most aligned with heuristics that existed within development, implementation, and evaluation stages, but there were

a few instances where the methods could also be helpful during analysis. These methods could be helpful for an instructional designer attempting to analyze an existing learning module or training, or to gather feedback on a prototype or pilot (Pacione, 2019; LUMA Institute, 2012).

The next category of design thinking methods is understanding people and systems (see Table 9.4). The methods included are Stakeholder Mapping, Persona Profile, Experience Diagramming, and Concept Mapping. These methods are most often used to gain empathy for people and their processes within a system or organization. Instructional designers could use these methods to visually communicate with clients and develop an understanding of the people and processes for which they are designing new learning experiences. Such conversations are crucial at the beginning of a new project. They ensure that instructional designers and clients agree with what currently exists, and they support the team in developing terminology and dialogue that everyone understands. These steps are necessary in gaining trust among new teams (Pacione, 2019; LUMA Institute, 2012).

Design thinking methods for identifying patterns and priorities (see Table 9.5) include Affinity Clustering, Bull's Eye Diagramming, Importance/Difficulty Matrix, and Visualize the Vote. These methods are most often used to advance insights from prior methods, or to make decisions about next steps. Affinity Clusters help determine where patterns might exist within a system. They could be particularly useful in identifying problems, barriers, and constraints among a system or group of processes. The remaining methods are most often used to gain consensus among teams about priorities and next steps. These methods would be ideal for determining the needs of learners and prioritizing the outcomes of learning experiences (Pacione, 2019; LUMA Institute, 2012).

One of the most critical stages of the instructional design process is determining whether a problem exists, and if so, framing the right problem statements (Jonassen, 2008). The next category of design thinking methods is used for problem framing (see Table 9.6). Methods include Problem Tree Analysis, Statement Starters, Abstraction Laddering, and Rose, Thorn, Bud. The table for this category of methods revealed substantial alignment between design thinking methods and instructional design heuristics. Instructional designers could use these methods to empathize with problems, which would include identification of barriers and constraints of problems. Most often, these methods are subsequent steps to prior methods that outlined the current state of a problem such as the category of understanding people and processes, or findings from ethnographic, participatory, and evaluative research. Problem Tree Analysis and Abstraction Laddering call on a team to identify causes and effects of a problem and to broaden and narrow the focus of the problem. Rose, Thorn, Bud is used to identify positives, negatives, and opportunities for change within a problem. Statement Starters are used to reframe or advance new problems statements, which often leads a team to question new questions about a problem (Pacione, 2019; LUMA Institute, 2012).

The remaining three categories of design thinking methods are used to promote ideation develop prototypes and offer design rationale. They are identified as most useful in the design, development, and evaluation stages of the instructional design process.

The category of design thinking methods for concept ideation (see Table 9.7) includes Thumbnail Sketching, Creative Matrix, Round Robin, and Alternative Worlds. These methods each align with needs of a designer to explore opportunities in the design stage. Thumbnail Sketching involves individuals developing multiple ideas to be shared amongst a team of people. Creative Matrices are used among teams to develop large quantities of new ideas at the

intersections of categories to enable people and solutions. Round Robin is most useful among teams looking to vet ideas by developing multiple solutions to a problem, and inviting teams to identify potential failures, and ways to ultimately overcome those failures with new or evolved ideas. Finally, Alternative Worlds encourage designers to look, alternatively, at other situations or organizations and draw new ideas where commonalities might exist (Pacione, 2019; LUMA Institute, 2012).

The next category of design thinking methods is modeling and prototyping (see Table 9.8). They include Storyboarding, Schematic Diagramming, Rough and Ready Prototyping, and Appearance Modeling. These methods most aligned with heuristics that encourage instructional designers to explore opportunities for new ideas and seek feedback on the validity of multiple ideas. These methods support a need to explore a variety of possibilities, quickly, and to recognize when ideas need to be iterated or discarded. Modeling and prototyping could allow instructional designers to bring multiple ideas to light with minimal time and effort, thus reiterating the idea that it is ok for an idea to fail, but it is helpful when those failures happen early in the process (Pacione, 2019; LUMA Institute, 2012).

The final category of design thinking methods is design rationale (see Table 9.9). These methods include Concept Poster, Video Scenario, Cover Story Mock-up, and Quick Reference Guide. They most aligned with heuristics to explore, share, and gather feedback on new ideas for solutions. Instructional designers could use these methods to offer stakeholders or team members a rationale for their choices, and ultimately to gain stakeholder feedback and buy-in before advancing new solutions. Instructional designers might work together to pitch one idea or solution via these methods or offer individual ideas and request stakeholders to vote on their favorite or most promising solutions (Pacione, 2019; LUMA Institute, 2012).

Table 9.1

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Ethnographic Research

		Design Thinking Methods for Ethnographic Research			
Instructional Design Heuristics	**ADDIE**	**Interviewing**	**Fly-On-The Wall Observation**	**Contextual Inquiry**	**Walk-a-Mile Immersion**
Identify problems	Analysis	x	x	x	x
Question the question	Analysis		x		
Identify stakeholders	Analysis	x			
Define outcomes	Analysis			x	
Identify barriers	Analysis	x		x	
Identify constraints	Analysis	x		x	
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation	x	x	x	
Gain empathy for people	Analysis, Evaluation	x	x	x	x
Gain empathy for processes	Analysis, Evaluation	x	x	x	x
Understand context	Analysis	x		x	
Gain empathy for problems	Analysis	x	x	x	x
Leverage past experiences	Design				
Explore opportunities	Design				
Frame insights	Design				
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation				
Iterate designs	Development, Implementation, Evaluation				
Pilot	Implementation, Evaluation				

Table 9.2

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Participatory Research

		Design Thinking Methods for Participatory Research			
Instructional Design Heuristics	**ADDIE**	**What's on Your Radar?**	**Buy A Feature**	**Build Your Own**	**Journaling**
Identify problems	Analysis	x			x
Question the question	Analysis				
Identify stakeholders	Analysis				
Define outcomes	Analysis	x	x		
Identify barriers	Analysis	x			
Identify constraints	Analysis	x			
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation	x			x
Gain empathy for processes	Analysis, Evaluation	x			x
Understand context	Analysis				
Gain empathy for problems	Analysis				
Leverage past experiences	Design				
Explore opportunities	Design				
Frame insights	Design				
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation		x	x	x
Iterate designs	Development, Implementation, Evaluation				
Pilot	Implementation, Evaluation				

Table 9.3

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Evaluative Research

		Design Thinking Methods for Evaluative Research			
Instructional Design Heuristics	**ADDIE**	**Think-Aloud Testing**	**Heuristic Review**	**Critique**	**System Usability Scale**
Identify problems	Analysis	x	x	x	x
Question the question	Analysis				
Identify stakeholders	Analysis				
Define outcomes	Analysis		x		
Identify barriers	Analysis				
Identify constraints	Analysis				
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation	x		x	
Gain empathy for people	Analysis, Evaluation				x
Gain empathy for processes	Analysis, Evaluation	x	x		x
Understand context	Analysis				
Gain empathy for problems	Analysis				
Leverage past experiences	Design				
Explore opportunities	Design				
Frame insights	Design				
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation	x	x	x	x
Iterate designs	Development, Implementation, Evaluation				
Pilot	Implementation, Evaluation	x	x	x	x

Table 9.4

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Understanding People & Systems

		Design Thinking Methods for Understanding People & Systems			
Instructional Design Heuristics	**ADDIE**	**Stakeholder Mapping**	**Persona Profile**	**Experience Diagramming**	**Concept Mapping**
Identify problems	Analysis			x	x
Question the question	Analysis				
Identify stakeholders	Analysis	x	x		
Define outcomes	Analysis			x	x
Identify barriers	Analysis			x	x
Identify constraints	Analysis			x	x
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation	x	x		
Gain empathy for processes	Analysis, Evaluation			x	x
Understand context	Analysis	x		x	x
Gain empathy for problems	Analysis				
Leverage past experiences	Design			x	
Explore opportunities	Design				
Frame insights	Design				
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation				
Iterate designs	Development, Implementation, Evaluation				
Pilot	Implementation, Evaluation				

Table 9.5

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Identifying Patterns & Priorities

		Design Thinking Methods for Identifying Patterns & Priorities			
Instructional Design Heuristics	**ADDIE**	**Affinity Clustering**	**Bull's-eye Diagramming**	**Importance/Difficulty Matrix**	**Visualize the Vote**
Identify problems	Analysis	x			
Question the question	Analysis				
Identify stakeholders	Analysis				
Define outcomes	Analysis	x	x		
Identify barriers	Analysis	x			
Identify constraints	Analysis	x			
Prioritize needs	Analysis		x	x	x
Prioritize outcomes	Analysis		x	x	x
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation				
Gain empathy for processes	Analysis, Evaluation				
Understand context	Analysis				
Gain empathy for problems	Analysis				
Leverage past experiences	Design				
Explore opportunities	Design				
Frame insights	Design				
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation				
Iterate designs	Development, Implementation, Evaluation				
Pilot	Implementation, Evaluation				

Table 9.6

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Problem Framing

		Design Thinking Methods for Problem Framing			
Instructional Design Heuristics	**ADDIE**	**Problem Tree Analysis**	**Statement Starters**	**Abstraction Laddering**	**Rose, Thorn, Bud**
Identify problems	Analysis	x		x	x
Question the question	Analysis		x	x	
Identify stakeholders	Analysis				
Define outcomes	Analysis		x		x
Identify barriers	Analysis	x		x	x
Identify constraints	Analysis	x		x	x
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation	x		x	x
Gain empathy for processes	Analysis, Evaluation	x		x	x
Understand context	Analysis				
Gain empathy for problems	Analysis	x		x	x
Leverage past experiences	Design				x
Explore opportunities	Design		x		x
Frame insights	Design		x		x
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation				
Iterate designs	Development, Implementation, Evaluation				
Pilot	Implementation, Evaluation				

Table 9.7

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Concept Ideation

		Design Thinking Methods for Concept Ideation			
Instructional Design Heuristics	**ADDIE**	**Thumbnail Sketching**	**Creative Matrix**	**Round Robin**	**Alternative Worlds**
Identify problems	Analysis				
Question the question	Analysis				
Identify stakeholders	Analysis				
Define outcomes	Analysis				
Identify barriers	Analysis				
Identify constraints	Analysis				
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation				
Gain empathy for processes	Analysis, Evaluation				
Understand context	Analysis				
Gain empathy for problems	Analysis				
Leverage past experiences	Design				x
Explore opportunities	Design	x	x	x	x
Frame insights	Design			x	
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation			x	
Iterate designs	Development, Implementation, Evaluation			x	
Pilot	Implementation, Evaluation				

Table 9.8

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Modeling & Prototyping

		Design Thinking Methods for Modeling & Prototyping			
Instructional Design Heuristics	**ADDIE**	**Storyboarding**	**Schematic Diagramming**	**Rough & Ready Prototyping**	**Appearance Modeling**
Identify problems	Analysis				
Question the question	Analysis				
Identify stakeholders	Analysis				
Define outcomes	Analysis				
Identify barriers	Analysis				
Identify constraints	Analysis				
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation				
Gain empathy for processes	Analysis, Evaluation				
Understand context	Analysis				
Gain empathy for problems	Analysis				
Leverage past experiences	Design				
Explore opportunities	Design	x	x	x	x
Frame insights	Design	x	x	x	x
Prototype	Development, Implementation, Evaluation	x	x	x	x
Seek feedback	Development, Implementation, Evaluation	x	x	x	x
Iterate designs	Development, Implementation, Evaluation	x	x	x	x
Pilot	Implementation, Evaluation				

Table 9.9

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Design Rationale

		Design Thinking Methods for Design Rationale			
Instructional Design Heuristics	**ADDIE**	**Concept Poster**	**Video Scenario**	**Cover Story Mock-up**	**Quick Reference Guide**
Identify problems	Analysis				
Question the question	Analysis				
Identify stakeholders	Analysis				
Define outcomes	Analysis				
Identify barriers	Analysis				
Identify constraints	Analysis				
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation				
Gain empathy for processes	Analysis, Evaluation				
Understand context	Analysis				
Gain empathy for problems	Analysis				
Leverage past experiences	Design				
Explore opportunities	Design	x	x	x	x
Frame insights	Design	x	x	x	x
Prototype	Development, Implementation, Evaluation	x	x	x	x
Seek feedback	Development, Implementation, Evaluation	x	x	x	x
Iterate designs	Development, Implementation, Evaluation	x	x	x	x
Pilot	Implementation, Evaluation				

Proposed Design Thinking Methods and Combinations of Methods

Table 10 offers novice instructional designers the familiarity of the ADDIE framework and common heuristics of expert instructional designers, in conjunction with proposed design thinking methods and combinations of design thinking methods to enhance their processes among clients, teams, and project stakeholders. Table 10 is separated into the five stages of ADDIE: analysis, design, development, implementation, and evaluation. The instructional design heuristics are listed within each corresponding stage of ADDIE (previously identified in Table 8 and Tables 9.1 – 9.9), and design thinking methods and combinations of design thinking methods are proposed. Heuristics that are common among multiple stages of ADDIE are listed separately under each ADDIE heading. Design thinking methods that are proposed as sequential methods, meaning do this first then this, are stated with "and," while design thinking methods that are proposed for individual use are stated with "or." While these methods may be used in conjunction with one another, their sequence of use is irrelevant. Two additional design thinking methods, Empathy Mapping and Needs Statements, were added to the table, because of their direct alignment with the characteristics of instructional design heuristics and the stated purpose or benefit of the methods found within design thinking literature. References for design thinking method explanations are cited in Appendix C.

Analysis: *Identify problems*. Experience Diagramming is a method for mapping the current and future states of a process or experience. Instructional designers could use this tool to visually map what is currently happening, and then conduct a Rose, Thorn, Bud method to identify the positives, negatives, and opportunities of a current experience. This process would unveil what is working well, where problems currently exist, and opportunities for change or

improvements in the process. Experience Diagramming and Rose, Thorn, Bud are collaborative methods, which should be conducted with a variety of stakeholders.

Analysis: *Question the question*. Sometimes it is necessary to encourage clients and subject matter experts to question the questions that they identify to solve. Abstraction Laddering is a method that offers a process for placing a question or a problem at the center and then encourages stakeholders of the problem to think more broadly by asking why or more narrowly by asking how. It helps to frame the ‘why's’ by answering with "so that" or "so..." It helps to frame the ‘how's’ by encouraging participants to answer with "solutions that..." versus answering with specific solutions. Once participants go up and down the ladder three or four times, then the facilitator takes the responses, and guides a conversation to turn them into statements that encourage a new platform for ideation.

Analysis: *Identify stakeholders*. Stakeholder Mapping is a method used to identify all the stakeholders of a problem or a process. As an instructional designer, it is important to identify the stakeholders who will be the key decision makers; the prospective learners or clients; individuals that should be directly involved in various conversations; and individuals that may be less involved, but need to be informed at intervals of the process. Taking early steps to identify as many people directly or indirectly connected to the problem ensures that the right people are part of the process. Empathy Mapping is a method used to gain empathy for what people think, feel, hear, say, their gains, and their pains. It is not necessary to create empathy maps for every stakeholder, but it could be helpful to for instructional designers to identify key stakeholders for empathy maps. This could be a useful method for instructional designers to use while conducting an analysis of learners and their diverse needs. This process would ensure that instructional

designers are taking individual perspectives of stakeholders into account as they approach design.

Analysis: *Define outcomes*. Experience Diagramming is a method that could be used to identify current and future state of instructional processes and/or experiences. To define outcomes, the instructional designer would start by visually drawing the current state of the process of a client or learner, and then ask collaborators to identify as many outcomes of a future experience as they could think of. Each outcome would be captured in a list, which would inform a Bull's-eye Diagram. Bull's-eye Diagramming is a method for helping groups of people prioritize items in terms of importance. Members of the group would negotiate each of the stated outcomes and place each one into one of three concentric circles: primary, secondary, or tertiary with primary being the most important. These methods could be great for helping instructional designers negotiate the outcomes for learning with a variety of stakeholders. Reaching a visual consensus among multiple stakeholders at an early stage can minimize the need for scope changes later in the process.

Analysis: *Identify barriers*. Barriers are common among instructional design projects, but they can be less challenging if they're identified or anticipated early in the process. Stakeholder Mapping and Experience Diagramming could be used in conjunction with one another to help collaborators think about all the people and processes associated with an instructional design project. While looking at both diagrams, collaborators would be asked to identify as many barriers to the instructional project as they could. Thorn is in all capitals, because this method primarily asks participants to identify thorns (barriers), with less consideration around roses and buds. It is important not to confuse constraints and barriers.

Barriers will keep a project from moving forward, while constraints are limitations, but not necessarily roadblocks for a project.

Analysis: *Identify constraints*. Constraints such as time, money, and resources, are common among instructional design projects, but they can be less challenging if they are identified or anticipated early in the process. Like barriers, Stakeholder Mapping and Experience Diagramming could be used in conjunction with one another to help collaborators think about all the people and processes associated with an instructional design project. While looking at both diagrams, collaborators would be asked to identify as many constraints to the instructional project as they could. Thorn is in all capitals, because this method primarily asks participants to identify thorns (constraints) with less consideration around roses and buds.

Analysis: *Prioritize needs*. For this stage of the process, Stakeholder Mapping would be used to identify all the prospective learners or clients of an instructional design project. Once identified, collaborators would create Empathy Maps, which would outline what an individual person might think, hear, see, say, feel, their pains, and their gains. Extremes are important for this process, so it could be necessary to conduct interviews or a similar method for ethnographic research to develop the Empathy Maps. Maps should not be generalized; unique points of peoples' feelings and experiences are where the greatest insights and opportunities are often revealed. Once empathy maps were developed, collaborators of the process would be encouraged to identify three to five Needs Statements that outline what each person needs from the instructional experience.

Analysis: *Prioritize outcomes*. This stage of the process assumes that outcomes have already been identified, and the next step would be to gain consensus for which outcomes are most important. Bull's-eye Diagramming is a method for helping groups of people prioritize

items in terms of importance. Collaborators would negotiate the pre-stated outcomes and place each one into one of three concentric circles: primary, secondary, or tertiary with primary being the most important. These methods could help instructional designers negotiate the outcomes for learning with a variety of stakeholders. Reaching a visual consensus among multiple stakeholders at an early stage could minimize the need for scope changes later in the process.

Importance/Difficulty Matrix could also be a powerful method in helping instructional designers negotiate outcomes. This method calls on collaborators to first reach a consensus for which outcomes are least or most important along a horizontal axis, and then asks collaborators to rank each outcome in terms of difficulty. Starting first with importance, and then exploring difficulty ensures that the value of an outcome is not diminished because of its difficulty.

Analysis: *Listen*. Interviews and Contextual Inquiry are methods used to gather ethnographic research about people, their processes, their needs, their desires, etc. In instructional design, this is often referred to as an analysis of learners, tasks, context, etc. The instructional designer should always listen more than he/she talks (Ertmer, York, & Gedik, 2009). Interviews and Contextual Inquiry often happen in conjunction with one another. An interview could inform a need to watch and learn from a subject-matter-expert, or a Contextual Inquiry could yield additional questions for an interview. In both cases, the instructional designer would take meticulous notes, ask questions that prompt detailed responses from the client, and listen more than he/she talked.

Analysis: *Gain empathy for people – Ethnographic Research*. Each of these methods could be used individually, or collectively to gather ethnographic information about people.

Interviews could be used to compose and ask questions of prospective learners, clients, subject-matter experts, managers, and other individuals directly or indirectly related to an

instructional design project. Instructional designers should share interview questions with other collaborators prior to conducting interviews to ensure that they have thought of all the questions for which they need to gain answers. This minimizes the need for instructional designers to ask people to carve out additional time in their schedules for unanswered questions.

Fly-on-the-Wall Observations could give instructional designers an opportunity to watch, listen and absorb people in their natural settings or environments. Often people become so complacent with daily tasks that when asked about them, they forget to describe pertinent details. These observations would also be great for confirming previously developed experience diagrams.

Contextual Inquiry is a combination of interviews and Fly-on-the Wall Observations. With this method, instructional designers could go through the steps of a process with the learners, clients, SME's, etc. Along the way, they would be encouraged to ask questions and take detailed notes about the processes.

Walk-a-Mile Immersion could allow instructional designers to experience something for themselves, which could clarify the feelings associated with a novice learner or new hire. Careful and detailed documentation is an essential factor in gathering information from each of the ethnographic research methods.

Analysis: ***Gain empathy for people – Participatory Research***. These methods are used to gather participatory research from a group of people. Participatory research allows multiple people to offer feedback and input on a variety of topics at once. Gathering information from multiple people could minimize the likelihood of designing and/or developing instructional solutions that only meet the needs of a small group of users. Participatory research could allow

instructional designers to identify commonalities and unique perspectives among a group of prospective learners or clients.

What's on Your Radar?? is a method in which people plot items according to personal significance. The template looks like a radar screen that has been divided into 4-6 segments. Three concentric circles are placed on the diagram. Sub-categories are pre-determined by stakeholders. Each participant is then asked to identify items within the sub-categories and rank them in order of personal significance, with the most important in the center, and least important labeled as outliers or tertiary. This method would be a great substitution for Interviews when an instructional designer needs to gather feedback from multiple people in a limited time.

Journaling is a method that asks participants to journal their daily experiences and interactions for a period. Journals could be collected from all participants at the end of a study and analyzed to determine where there were consistencies, discrepancies, common, and unique perspectives. Participants of this method would be encouraged to offer specific details, as insights are often revealed through details.

Analysis: *Gain empathy for people* – Combined methodology. For this stage of the process, Stakeholder Mapping would first be used to identify all the prospective learners or clients of an instructional design project. Once identified, collaborators would create Empathy Maps, which would outline what an individual person might think, hear, see, say, feel, their pains, and their gains. Extremes are important for this process, so it could be necessary to conduct interviews or a similar method for ethnographic research to develop the empathy maps. Empathy Maps should not be generalized. Unique points of peoples' feelings and experiences are often where the greatest insights and opportunities exist. Once Empathy Maps were developed, instructional designers could look across the maps and identify where there are commonalities

and generalizations among individual people. These generalizations would inform the development of Persona Profiles, which could be used at various stages of an instructional design project to ensure that designers were considering a variety of characteristics and needs of people.

Analysis: *Gain empathy for processes*. Each of these methods can be used to gather ethnographic information about processes. Interviews, Fly-on-the-Wall Observations, Contextual Inquiry, and Walk-a-Mile Immersion offer the same benefit for gaining empathy for processes of a project as they do for gaining empathy for the people of a project. Experience Diagramming is a method for mapping the current and future states of a process or experience. Instructional designers could use this tool to visually map what is currently happening in a process. Collaborators would be asked to contribute, confirm, or deny experiences within a process.

Analysis: *Understand context*. Contextual Inquiry is a combination of Interviews and Fly-on-the Wall Observations. With this method, instructional designers could go through the steps of a process with the learners, clients, SME's, etc., asking questions along the way. This process could help instructional designers gain a clearer understanding of the context of a problem, which could inform the design of instructional context for which instructional problems may be introduced.

Concept Mapping is a method used to depict the relationships between various concepts in a topic. Maps offer various concepts (nouns) and their relationships (verbs) to a given subject. Exploring the concepts and relationships of a given topic could help instructional designers gain a big picture understanding or context of a situation. Concept Maps could also help subject-matter-experts in describe or portray the context of a situation and its relationships to other topics or concepts.

Analysis: ***Gain empathy for problems***. Problem Tree Analysis is a method that encourages people to collaborate around a central problem and explore the various causes and effects of the problem. Involving a diverse population of people helps collaborators explore all the possible causes and a variety of effects resulting from the problem. In instructional design, one subject matter expert may only see the causes and effects directly related to their daily tasks or roles. Involving additional stakeholders in the process, could help shed light on additional causes and/or effects that may not have been included, otherwise. Once a team feels that they have identified all the causes and effects, Affinity Clustering is a method that would allow intentional grouping of causes and effects that are similar in nature or have commonalities in characteristics. These groupings would inform needs and next steps for solving problems.

Design: ***Leverage past experiences***. Alternative Worlds is a method that uses different perspectives and/or experiences to help generate fresh ideas. Regardless of whether an instructional designer has solved the exact problem being explored, there is much to be gained from prior life experiences that might play an important role in developing unique ideas to solve complex problems.

Design: ***Explore opportunities***. Statement Starters are often generated from prior steps of a process, but they could also be a stand-alone starting place for generating new questions related to an instructional problem or need. For this method, participants generate as many "how might we..." statements as possible in a defined time period and then those questions inform the development of categories in the columns of the Creative Matrix, and the categories of the rows can be informed by enabling solutions such as technologies, environments, policies, etc. The Creative Matrix calls upon multiple collaborators to generate multiple ideas at the intersections of categories. The emphasis of this method is on quantity of ideas over quality. Additionally,

Persona Profiles are often generated during an analysis of users. Personas could also inform the development of categories in the columns of the Creative Matrix. This process would ensure that the perspectives of a variety of users or learners were considered in the development of new ideas.

Design: *Frame Insights*. As discussed, Creative Matrix is a method for sparking a variety of ideas at the intersections of distinct categories. Once participants of a Creative Matrix have exhausted their ideas, Visualize the Vote is a method that is used to allow all participants to vote on one or two top ideas. This process gives autonomy to the participants and allows them to visually see the preferences and opinions of others.

Statement Starters could be generated from prior steps in the instructional design process, or they could be a stand-alone starting place for generating new questions related to an instructional problem or need. In this method, participants generate as many "how might we..." statements as possible in a defined period. Visualize the Vote would then be used to allow all participants to vote on one or two top ideas. Once problem statements were identified, groups would place the question(s) at the top of their Round Robin templates and develop individual solutions to the question(s). Participants would pass their ideas to another person whose job it would be to identify all the reasons why the solution might fail. Lastly, ideas and potential failures would be passed to another person whose job it would be to develop a new solution that overcomes the challenges of the original idea. The final solutions would take into consideration the ideas of multiple people and have been iterated beyond potential failures.

Development: *Prototype*. Each of these prototyping methods could be used to model and/or prototype new ideas and solutions.

Storyboarding is a series of images depicting the key elements and interactions of a new scenario. Instructional designers could use ideas generated during the design phase to develop storyboards that visually depict learning scenarios and experiences. Collaboration is strongly encouraged for the development of multiple storyboards. Storyboards may be developed collectively or by multiple individuals.

Concept Posters are used to present the main points of a new idea. Instructional designers would take previously developed ideas and visually depict an evolved idea with annotations to explain the details of the instructional solution. Concept Posters could include outcomes for learning, sample personas, details of the process of a learning solution, and a tag line. Collaboration is strongly encouraged for the development of multiple Concept Posters. Concept Posters may be developed collectively or by multiple individuals.

Schematic Diagrams are detailed outlines of the structure and essential components of a system. This method could allow participants to collaborate on the development of a system for learning. Schematic Diagrams might be used to encourage autonomy of learning, based on achieved outcomes, and desired next steps. Schematic Diagrams offer enough detail to offer feedback but are simple enough to iterate to new designs.

For this stage of the process, instructional designers might also revisit the stages of *frame insights* and *prototype* to develop new solutions that overcome the challenges identified during an evaluative review of a former prototype. Examples of new prototypes might include Storyboards, Concept Posters, and Schematic Diagrams.

Implementation: *Pilot*. For this stage of the process, instructional designers would fully implement the design and development of a formerly prototyped solution. Instructional designers would gather feedback throughout the process of implementation using methods such as Critique

and Rose, Thorn, Bud to capture the positives, negatives, and opportunities for change. Feedback informs an on-going process of iteration, which may include additional prototyping, feedback, and pilots.

Evaluation: ***Seek feedback***. Each of these evaluative research methods can be used to assess the usefulness and usability of new solutions.

Think-Aloud Testing is a method where people narrate their experience while performing a task. For instructional design purposes, this method could shed light on the real experiences and interactions of a learner experiencing a new or proposed learning solution. Conducting two or three Think-Aloud Tests could unveil a substantial percent of the challenges associated with a learner's experience and inform opportunities to iterate the instruction prior to implementation.

Heuristic Review is an auditing procedure based on ten rules of thumb for good design. This type of review of new solutions could encourage instructional designers to reflect on best practices of good design and think about ways to overcome missed opportunities to align with pedagogies and theories of learning.

Critique is a forum for people to give and receive feedback. This would be an ideal environment for instructional designers and subject-matter-experts to offer feedback, concerns, and questions related to a new solution. It is paramount to establish boundaries for the type of feedback being sought within a Critique. For example, in the early stages of development, instructional designers may only be focused on the pedagogy and not the look and feel, so it would be necessary to state expectations to minimize comments and feedback on areas that are not yet of importance.

System Usability Scale is a short survey used to gather feedback about the functionality or usability of a new solution. These surveys are best when they are short and directed toward specific feedback about components of the solution design. Instructional designers could use System Usability Scales to gather feedback about specific learner interactions and experiences.

Rose, Thorn, Bud is a useful method for identifying the pros, cons, and opportunities of a new or existing solution. Instructional designers could use this method to encourage participants to independently identify the pros, cons, and challenges of their experiences, and then share among a larger group of participants to determine where there are commonalities in negatives or challenges that may need to be addressed in future iterations, as well as positives that could be acknowledged or rewarded.

Table 10

A model of expert instructional design heuristics incorporating design thinking methods introduced within the ADDIE framework.

Analysis		
Heuristic	**Method Combination**	**Glossary of terms** (LUMA Institute, 2012)
Identify problems	Experience Diagramming **and** Rose, Thorn, Bud	**Experience Diagramming**: A way of mapping a person's journey through a set of circumstances or tasks. **Rose, Thorn, Bud**: A technique for identifying things as positive, negative, or having potential.
Question the question	Abstraction Laddering **and** Statement Starters	**Abstraction Laddering**: A way of reconsidering a problem statement by broadening or narrowing its focus. **Statement Starters**: An approach to phrasing problem statements that invites broad exploration.
Identify stakeholders	Stakeholder Mapping **and** Empathy Mapping	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **Empathy Mapping**: A way of mapping an

		individual users' perspective, which includes mapping what the user thinks, says, does, feels, and their pains and gains.
Define outcomes	Experience Diagramming **and** Bull's-eye Diagramming	**Experience Diagramming**: A way of mapping a person's journey through a set of circumstances or tasks. **Bull's-eye Diagramming**: A way of ranking items in order of importance using a target diagram.
Identify barriers	Stakeholder Mapping **and** Experience Diagramming **and** Rose, Thorn, Bud	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **Experience Diagramming**: A way of mapping a person's journey through a set of circumstances or tasks. **Rose, Thorn, Bud**: A technique for identifying things as positive, negative, or having potential.
Identify constraints	Stakeholder Mapping **and** Experience Diagramming **and** Rose, Thorn, Bud	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **Experience Diagramming**: A way of mapping a person's journey through a set of circumstances or tasks. **Rose, Thorn, Bud**: A technique for identifying things as positive, negative, or having potential.
Prioritize needs	Stakeholder Mapping **and** Empathy Mapping **and** Needs Statements	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **Empathy Mapping**: A way of mapping an individual users' perspective, which includes mapping what the user thinks, says, does, feels, and their pains and gains. **Needs Statements**: A technique for identifying the needs of individual or group needs, desires, and goals. *The user needs a way to do something that addresses their need so that they benefit directly*.
Prioritize outcomes	Bull's-eye Diagramming, **or** Importance/Difficulty matrix	**Bull's eye diagramming**: A way of ranking items in order of importance using a target diagram.

		Importance/Difficulty Matrix: A quad chart for plotting items by relative importance and difficulty.
Listen	Interviews **and** Contextual Inquiry	**Interviews**: A technique for gathering information through direct dialogue. **Contextual Inquiry**: An approach to interviewing and observing people in their own environment.
Gain empathy for people	Interviews, **or** Fly-on-the-Wall Observations, **or** Contextual Inquiry, **or** Walk-a-Mile Immersion, **or** What's on Your Radar?, **or** Journaling	**Interviews**: A technique for gathering information through direct dialogue. **Fly-on-the-Wall Observations**: An approach to conducting field research in an unobtrusive manner. **Contextual Inquiry**: An approach to interviewing and observing people in their own environment. **Walk-a-Mile Immersion**: A way of building empathy for people through firsthand experience. **What's on Your Radar?**: An exercise in which people plot items according to personal significance. **Journaling**: An activity that invites people to record personal experiences in words and pictures.
Gain empathy for people	Stakeholder Mapping **and** Empathy Mapping **and** Persona Profiles	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **Empathy Mapping**: A way of mapping an individual users' perspective, which includes mapping what the user thinks, says, does, feels, and their pains and gains. **Persona Profiles**: An informed summary of the mindset, needs, and goals typically held by key stakeholders.
Gain empathy for processes	Interviewing, **or** Fly-on-the-Wall Observations, **or** Contextual Inquiry, **or** Walk-a-Mile Immersion, **or** Experience Diagramming	**Interviews**: A technique for gathering information through direct dialogue. **Fly-on-the-Wall Observations**: An approach to conducting field research in an unobtrusive manner. **Contextual Inquiry**: An approach to interviewing and observing people in their own environment.

		Walk-a-Mile Immersion: A way of building empathy for people through firsthand experience. **Experience Diagramming**: A way of mapping a person's journey through a set of circumstances or tasks.
Understand context	Contextual Inquiry, **or** Concept Mapping	**Contextual Inquiry**: An approach to interviewing and observing people in their own environment. **Concept Mapping**: A way of depicting the relationships between various concepts in a given topic area.
Gain empathy for problems	Problem Tree Analysis **and** Affinity Clusters	**Problem Tree Analysis**: A way of exploring the causes and effects of a particular issue. **Affinity Clusters**: A graphic technique for sorting items according to similarity.
Design		
Leverage past experiences	Alternative Worlds	**Alternative Worlds**: A way of using different perspectives to help generate fresh ideas.
Explore opportunities	Statement Starters **and** Creative Matrix	**Statement Starters**: An approach to phrasing problem statements that invites broad exploration. **Creative Matrix**: A format for sparking new ideas at the intersections of distinct categories.
Explore opportunities	Persona Profiles **and** Creative Matrix	**Persona Profiles**: An informed summary of the mindset, needs, and goals typically held by key stakeholders. **Creative Matrix**: A format for sparking new ideas at the intersections of distinct categories.
Frame insights	Creative Matrix **and** Visualize the Vote	**Creative Matrix**: A format for sparking new ideas at the intersections of distinct categories. **Visualize the Vote**: A quick poll of collaborators to reveal preferences and opinions.

Frame insights	Statement Starters **and** Visualize the Vote **and** Round Robin	**Statement Starters**: An approach to phrasing problem statements that invites broad exploration. **Visualize the Vote**: A quick poll of collaborators to reveal preferences and opinions. **Round Robin**: An activity in which ideas evolve as they are passed from person to person.
Development		
Prototype	Storyboarding, **or** Concept Posters, **or** Schematic Diagramming, **or** Rough & Ready Prototyping	**Storyboarding**: A series of images showing the key elements and interactions of a new scenario. **Concept Posters**: A presentation format illustrating the main points of a new idea. **Schematic Diagramming**: An outline of the structure and essential components of a system. **Rough & Ready Prototyping**: Rapidly built model(s) of new ideas or processes that approximate appearances and behaviors.
Implementation		
Pilot	Rough & Ready Prototyping **and** Rose, Thorn, Bud **and** Critique	**Rough & Ready Prototyping**: Rapidly built model(s) of new ideas or processes that approximate appearances and behaviors. **Rose, Thorn, Bud**: A technique for identifying things as positive, negative, or having potential. **Critique**: A forum for people to give and receive constructive feedback.
Evaluation		
Seek feedback	Think-Aloud Testing, **or** Heuristic Review, **or** Critique, **or** System Usability Scale, **or** Rose, Thorn, Bud	**Think-Aloud Testing**: A testing format where people narrate their experience while performing a given task. **Heuristic Review**: An auditing procedure based on ten rules of thumb for good design. **Critique**: A forum for people to give and receive constructive feedback. **System Usability Scale**: A short survey for quantifying feedback from subjective assessments of usability.

		Rose, Thorn, Bud: A technique for identifying things as positive, negative, or having potential.
Table Notes **And -** *Denotes methods that are used in combination with one another.* **Or -** *Denotes methods that can be used individually or in conjunction with one another, but in no order.*		

The design thinking methods and combinations of methods in Table 10 were selected for the following reasons (a) the alignment between the needs of the heuristic and their stated purpose (b) the frequency for which they were selected in Tables 9.1 – 9.9, and (c) their stated ease of use for novice designers. These selections are intended as a starting place for novice instructional designers; it is anticipated that instructional designers will adjust the use and order of design thinking methods to best fit their needs as they evolve their processes and further their expertise of the field. The researcher of this study recognized that these selections were subjective, which reinforced the need to include design thinking expert reviewers to determine whether the selections were corroborated.

CHAPTER 5

Expert Review Results

Expert reviews were conducted to validate the model developed and described in Chapter Four. Four experts were recruited via email and agreed to participate, utilizing a common set of evaluation questions to guide their review (see Appendix A). Prior to conducting the review, the researcher met individually with each expert via web-conferencing software to discuss the model development, and answer pertinent questions pertaining to the process of the review. Two of the experts were familiar with the LUMA Institute's methodologies; thus, no additional explanations or guidance were necessary to explain the proposed design thinking methods and combinations of methods within the model. One expert was familiar with design thinking but had little experience with LUMA Institute's methodologies. The researcher provided the expert with a copy of LUMA Institute's *Innovating for people: Handbook for human-centered design methods* to use as a resource while reviewing methods and combinations of methods proposed within the model. In addition to the questions in Appendix A, the experts were given an Excel spreadsheet with each table set and an option to add expert notes as they advanced through the tables. Although four experts were recruited, one of the experts ultimately was unable to participate when unexpected circumstances related to COVID-19 impacted that expert's ability to complete the review.

Three expert reviewers successfully completed the review of each table and offered responses to the evaluation questions. The completed expert reviews included an expert in the field of design thinking and instructional design, an expert in the field of design thinking, and an expert in the field of educational leadership with extensive knowledge of design thinking. Bruce Parsons is an Assistant Professor of Design Thinking at Radford University with an EdD in

Education Leadership and Technology and an MFA in Filmmaking. Bruce is a certified practitioner and facilitator of human-centered design and has been teaching in the MFA in Design Thinking program at Radford University for three years. Chris Pacione is the CEO and founder of the LUMA Institute headquartered in Pittsburgh, PA. Chris leads a highly skilled, multidisciplinary team of practitioners who are passionate about preparing and equipping organizations to be more innovative. He is a frequent speaker on the topic of design thinking and innovation in the United States, Europe, and Asia and is co-author of the book *Innovating for people: Handbook of human-centered design methods* (2012). Prior to co-founding the LUMA Institute, Chris was an Assistant Professor in the School of Design at Carnegie Mellon University and a guest lecturer at Harvard Business School. Reneé LeClair is the Chair of the Department of Basic Science Education at Virginia Tech Carilion Medical School. Reneé achieved a PhD in Biochemistry and Cellular Biology and completed a post-doctoral fellowship in Vascular Biology focusing on Fibrotic Remodeling. Reneé possesses two decades of experience in educational leadership and is a co-recipient and author of an interdisciplinary research study titled: *Using design thinking to effectively integrate student perspective into curricular design*. The study seeks to gather qualitative data about student perspectives of learning, which will inform the redesign of new curriculum. Each of these three expert reviewers provided responses to the questions that aligned with their level of expertise, and the two expert reviewers with extensive knowledge of LUMA's methodologies provided a copy of their Excel spreadsheet with notes and feedback where they disagreed with the model or offered suggestions for changes or additions to the model.

The results of the expert reviews were examined individually and then synthesized to identify patterns among responses. Major themes that emerged from the reviews are described

below, along with direct quotes from expert reviewers. This chapter provides the results of the reviews, which includes the reviewers' comments of support for the model and suggestions for modifications, practical applications, and future research. Each reviewer was assigned a number as illustrated in the responses to ensure anonymity. When necessary, identifiers that impact one's anonymity have been removed from quotations to avoid exposure of an individual's identity. Appendix D represents the newly adjusted model based on recommendations by expert reviewers, which are outlined and further discussed in Chapter 6.

Two of the reviewers offered responses that spoke holistically to the model and its use among novice designers entering the field of practice. One reviewer only responded to the Evaluation Questions for Expert Review, while two reviewers responded to the evaluation questions and offered comments and/or suggestions for change within the Excel spreadsheet that was provided. Of the two reviewers that offered comments within the Excel spreadsheet, one reviewer's responses were largely general comments regarding the application of the model, while the other reviewer's comments were more granular and offered specific suggestions for modifications, additions or removal of methods and method combinations in Tables 9.1 – 9.9 and Table 10.

Heuristics of Instructional Designers

Overall, Tables 7.1 and 7.2 were well received by each of the reviewers. The review suggested agreement with the consolidated instructional design heuristics, and placement of heuristics within the ADDIE framework. Reviewer 1 suggested that it might be helpful to further combine and consolidate heuristics *Gain empathy for people* and *Gain empathy for processes*, as well as *Identify constraints* and *Identify barriers*. Reviewer 2 offered comments throughout the review that implied some level of confusion with the definition of the *Frame insights* heuristic.

Instructional Design Processes: ADDIE

Reviewer 1 stated that the use of ADDIE was appropriate considering the audience of the model: novice designers entering the field of practice, and felt that keeping the model simple would aid in the novice designers' comfort and ability to implement new design thinking methods into their processes. Reviewer 1 suggested that it might be helpful to clarify or further explain the similarities and differences between design thinking's "making" methods and instructional design's process for development. Reviewer 3 responded that "the alignment with ADDIE is helpful and useful practically." Reviewer 3 posed a question about whether the use of a simple framework such as ADDIE overlooked additional functions or heuristics of the instructional design process. Reviewer 3 also asked the question, "Beyond ADDIE being very versatile and known are there any potential issues that should be presented upfront that may be limitations of the model?"

Design Thinking

Reviewer 3 did not offer any suggestions for change to the design thinking method selections or method combination proposals. Reviewer 3 did ask whether there were advantages to using one method over another when multiple methods are suggested, and why certain methods are preferred over others within the method combination proposals. Reviewer 1 and Reviewer 2 offered detailed responses to the questions pertaining to design thinking within the expert review notes section of the Excel spreadsheet for Tables 9.1 – 9.9 and Table 10. While both reviewers possessed expert knowledge in the field of design thinking, their experience working with the methodologies differed. Thus, individual responses and themes among responses where the reviewers disagreed or suggested changes are further explained for each category (e.g. Ethnographic Research) of design thinking methods in Tables 9.1 – 9.9.

Ethnographic Research

Reviewer 2 suggested that interviewing and Contextual Inquiry be identified as methods for the *Question the question* heuristic. Reviewer 2 explained that these methods were appropriate methods for investigating assumptions about problems, and further exploring whether what one says they do, aligns with what they actually do. Both reviewers suggested the addition of Contextual Inquiry to *Identify stakeholders*. Reviewer 1 stated that Contextual Inquiry could be a good option, "as some questions and comments may emerge while viewing and experiencing the daily actions - some of the fine details might be overlooked by someone who experiences those on a regular basis where the subconscious takes over performing those tasks or checks." For similar reasons, Reviewer 2 also included the observation method. For *Identify constraints* and *Identify barriers*, both reviewers suggested the addition of Fly-on-the-wall observation, and Reviewer 2 suggested the addition of Walk-a-Mile Immersion. Both reviewers suggested these methods as means for novice designers to gain insight into barriers or constraints that may be unrecognized by the client, learner, or subject matter expert. Reviewer 2 suggested adding interviewing to the *Leverage past experiences* heuristic, as it can be an effective way in capturing stories from past user experiences, and the *Seek feedback* heuristic, which can also be an effective way to gather feedback about one's experience. For the *Pilot* heuristic, Reviewer 2 further explained that each method for ethnographic research could be used "to gather feedback about the usefulness, usability and desirability of a particular design or solution during a pilot phase of work."

Participatory Research

Reviewer 1 suggested that Journaling over a period time could be an effective method for the *Identify barriers* and *Identify constraints* heuristics within the context of a situation.

Reviewer 1 posed the following question and comment for the *Gain empathy for people* and *Gain empathy for processes* heuristics, "Could Buy a Feature offer insight into areas of empathy and process? Identifying areas of development or additional components based on limited resources might paint a picture of need and conflict that doesn't come out in the interviewing or observational moments." Reviewer 2 proposed the addition of What's on Your Radar? to the following heuristics: *Prioritize needs, Prioritize outcomes, Listen, Gain empathy for people, Gain empathy for problems,* and *Seek feedback*. Reviewer 2 also offered a similar rationale for Buy A Feature to be used for the *Gain empathy for processes* heuristic and suggests that Build Your Own may also help designers empathize with an individual's reasons and/or rationale for various decisions and choices. Additionally, Reviewer 2 suggested that all participatory methods would be effective for the *Listen* and *Gain empathy for people* heuristics, and offers the following rationale, "Germaine to all of these methods is the person being studied - presenting and explaining what they built. These methods are about getting someone to build something and then listening to what they built as they explain the reasons for their various decisions and/or actions."

Evaluative Research

Reviewer 2 suggested inclusion of all evaluative methods to the *Identify barriers* heuristic. Reviewer 2 advised the inclusion of Critique to the *Gain empathy for people* and *Gain empathy for processes* heuristics and suggested that all evaluative methods could apply to the *Gain empathy for problems* heuristic. Reviewer 2 called attention to some confusion on the definition of the *Iterate designs* and *Pilot* heuristics. Reviewer 2 suggested that all evaluative methods could be appropriate if these heuristics include the full scope of analysis, design, build,

and evaluation, but stated that if they are just referencing the development component, then these methods are less applicable.

Understanding People and Processes.

Reviewers 1 and 2 identified multiple opportunities and support for uses of Experience Diagramming and Concept Mapping within the context of the following heuristics: *Identify stakeholders, Prioritize needs, Gain empathy for people,* and *Gain empathy for problems*. Specifically, Reviewer 2 commented that "creating an experience diagram or Concept Mapping can uncover previously unseen or overlooked characters who have a role within a process or ecosystem," and Reviewer 1 posed the question, "Could Concept Mapping also walk designers and participants through areas that are easy to overlook or to help connect challenges to people?" Reviewer 2 also offered an additional opportunity for the role of Personas in the *Prioritize needs* heuristic with the following comment, "A well-crafted Persona Profile will always outline that archetype's top needs or desires from a particular solution. And by highlighting these in the Profile you are, in a way prioritizing them above other secondary or tertiary needs."

Identifying Patterns and Priorities

The reviewers were largely in agreement with the methods selected for the Identifying Patterns and Priorities category. Reviewer 2 offered this comment, "Often times the problems are too numerous to take on all at once or some problems need to be resolved before others for various reasons. So prioritizing the problems to be fixed is an important step in identifying problems." Consequently, for the *Identify problems* and *Identify stakeholders* heuristics, Reviewer 2 suggested Bull's eye diagramming, Importance/difficulty matrix, and Visualize the Vote as appropriate methods for prioritizing or making determinations for next steps. Reviewer 2 also recommended Affinity clustering as an appropriate method for the Gain empathy for people,

Gain empathy for processes, Gain empathy for problems, and Understand context heuristics with the following rationale, “AC (Affinity clustering) is fundamentally about synthesizing or codifying, and often the thing you are codifying is the Voice of the Customer. You can't really empathize until you understand. It takes listening and understanding to truly empathize.”

Problem Framing

The reviewers were mostly in agreement with the method identifications in the Problem Framing category, however, Reviewer 2 offered several strong cases for inclusion of additional methods for various heuristics. As each comment differs slightly, the reviewer’s method suggestions and comments are offered below with their corresponding heuristic.

- *Identify problems* **–** “SS (Statement Starters) as an activity on top of or just after Affinity clustering is quite useful in identifying problems. Often times it's as easy as translating a cluster insight into a challenge or problem statement.”
- *Question the question* – “PTA (Problem Tree Analysis) is one of the primary ways to teach people to question the question. By exploring any question (its root cause and consequences) one can explore the problem space and identify a host of other problems or questions that may be as critical or very different than the one assumed.”
- *Listen* – “RTB (Rose, Thorn, Bud) is a very versatile method and can be used as an active listening technique for participants. For example, during a lecture or any sort of situation where knowledge and opinion is being shared, asking one to jot down R (roses), T (thorns), B (buds) throughout the dispensation is

a great way to ensure they are fully engaged and listening to what is being shared."

- *Explore opportunities* – "PTA (Problem Tree Analysis) and AL (Abstraction Laddering) are also good for this in that it exposes problem areas that were formally unseen."
- *Iterate designs* – "RTB (Rose, Thorn, Bud) is a very versatile method and can be used to get feedback on design or solution."
- *Pilot* – "RTB (Rose, Thorn, Bud) is a very versatile method and can be used to get feedback on design or solution."

Concept Ideation

Within the Concept Ideation category, Reviewer 1 offered support for method selections with the following comment, "I'm a fan of designers starting with Making elements early in the process - not to define a specific solution, but to get ideas out of the way quickly, or to connect experiences to the ideas and conceptualize how they might move forward." The reviewers were largely in agreement with the researcher's selections for this category with only three suggestions for additional methods to be included and one suggested change. Reviewer comments are outlined below for this category:

- *Question the question* – "The whole point behind AW (Alternative Worlds) is to ask the question: How would _____ do it? Although it is an ideation activity, it begins with reframing a question."
- *Prioritize needs* – "Round Robin could also be interesting here to ideate multiple possibilities and then fine tune or adjust afterward."

- *Prototype* – "Often thumbnail sketches are the first step in prototyping. Although I agree, the outcome of the sketch isn't a prototype, but a sketch of what you plan to prototype."

Reviewer 2 questioned the role that Round Robin might play in framing insights and suggested possible removal of the method for that heuristic.

Modeling and Prototyping

The Modeling and Prototyping category of methods was met with strong agreement by the reviewers who offered several comments in further support of the alignment between the heuristics and methods. Reviewer 1 commented, "The alignments and overlap make sense and I think they offer a straightforward connection. I find storyboarding to be one of the most crucial here because it allows for the linear development of the story that could not only lead to better instruction but also better storytelling and pitching to convey the right ideas and structure for the materials being created. At some point, the material will leave the hands of the designer, and Storyboarding helps make sure that content is taken forward in a purposeful and meaningful way." Reviewer 2 offered this comment to the *Seek feedback* heuristic, "What you build and how you build it should always be tied to what you want to learn. So while the methods are not what you employ in the seeking of the feedback, they are built with seeking feedback (what type, how much, on what part) in mind. Very good." Within the Modeling and Prototyping category, Reviewer 2 brought attention to inconsistencies between methods identified for *Pilot* within Table 9.8 and Table 10. Rough and ready prototyping is selected as a method for the *Pilot* heuristic within Table 10; however, it is not identified in Table 9.8.

Design Rationale

Reviewers were in strong agreement with the selections made for the Design Rationale category of methods. In response to the methods selected for the *Explore opportunities* heuristic, Reviewer 1 commented, “Great hands-on approaches for building and carrying ideas forward. Great for helping leave with a common language and understanding.” Reviewer 2 recommended the inclusion of Concept Posters for the following heuristics with these additional comments:

- *Define outcomes* – “CPs (Concept Posters) are used to outline desired outcomes of a particular concept or initiative.”
- *Identify barriers* – “Good CPs (Concept Posters) often list why the concept will fail.”
- *Identify constraints* – “Good CPs (Concept Posters) clearly define the scope of the concept, timeline, resource constraints. It presents ideas in as sober a light as possible.”

Proposed Design Thinking Methods and Combinations of Methods

Reviewer 1 and Reviewer 2 offered detailed responses within their Excel spreadsheets to Table 10: Instructional design heuristics and proposed design thinking methods and combinations of methods. The reviewers offered multiple comments in support of the method combinations for Table 10. One reviewer recurrently stated that these combinations of methods are one way to achieve the heuristic, but not the only way. Another reviewer posed the following question and comment, “It is interesting to see the heuristics and design thinking methodologies coming together. Since this is designed or built for novice instructional designers, is there also a need for more focused training on synthesizing and combining/pairing design thinking methods? Is the idea that the novice instructional designers would use the methods as proposed and

developed here - until gaining a level of mastery and choosing/implementing/developing their own further down the road?"

The remaining reviewer comments from Table 10 were consolidated into one table and are offered here within the context of the heuristic and the proposed method combinations within their aligned stage of the ADDIE framework.

Analysis		
Heuristic	**Method Combination**	**Reviewer Comments** (Agree indicates agreement with Researcher's selection)
Identify problems	Experience Diagramming **and** Rose, Thorn, Bud	**Reviewer 2**: This is an excellent way to identify problems for an instructional designer. **With the disclaimer that there are other options.*
Question the question	Abstraction Laddering **and** Statement Starters	**Reviewer 1**: Would a novice have any issue transitioning from a broadening/narrowing method and going into a broad exploration? This may require some experience or support. **Reviewer 2:** This is an excellent way to identify problems for an instructional designer. **With the disclaimer that there are other options.*
Identify stakeholders	Stakeholder Mapping **and** Empathy Mapping	**Reviewer 1:** This could be an effective exercise for the ID to go through on their own or to also involve content experts - some of this information or experience could spin-off to help content experts connect some human-centered design elements, especially empathy, to their own practice. It may not instantly affect the learning setting or ID but it would work it's way out for the "good of the order." **Reviewer 2:** I would add that just doing Stakeholder Mapping would work as well.

Define outcomes	Experience Diagramming **and** Bull's-eye Diagramming	**Reviewer 2:** This is an excellent way to identify problems for an instructional designer. **With the disclaimer that there are other options.*
Identify barriers	Stakeholder Mapping **and** Experience Diagramming **and** Rose, Thorn, Bud	**Reviewer 1:** For the sake of the novice designer, would it be helpful to combine 7 (barriers) and 8 (constraints) to include both barriers and constraints in the same thought process? It may be confusing if they feel it's too rigid of a model or that each stage needs to be acted upon or completed in a specific way. **Reviewer 2:** This is an excellent way to identify problems for an instructional designer. **With the disclaimer that there are other options.*
Identify constraints	Stakeholder Mapping **and** Experience Diagramming **and** Rose, Thorn, Bud	**Reviewer 2**: This is an excellent way to identify problems for an instructional designer. **With the disclaimer that there are other options.*
Prioritize needs	Stakeholder Mapping **and** Empathy Mapping **and** Needs Statements	**Reviewer 1:** I like the process of building to the Needs Statement. This process has a very "if this, then that" programming language structure. **Reviewer 2:** I might suggest the following alternative. Stakeholder Mapping --> What's on Your Radar?. Assuming that you are conducting the participatory exercise with key stakeholders.
Prioritize outcomes	Bull's-eye Diagramming, **or** Importance/Difficulty matrix	**Reviewer 1:** How does the model support the choice or structure here? Is the designer informed enough to make the best decision? Is there a way to emphasize that the process and human-centered thought is more of a goal than applying the perfect method? **Reviewer 2**: Agree. Would also add Visualize the Vote as another alternative.
Listen	Interviews **and** Contextual Inquiry	**Reviewer 2:** Agree. Not sure you need both. One or the other would also work.

Gain empathy for people	Interviews, **or** Fly-on-the-Wall Observations, **or** Contextual Inquiry, **or** Walk-a-Mile Immersion, **or** What's on Your Radar?, **or** Journaling	**Reviewer 2:** Agree.
Gain empathy for people	Stakeholder Mapping **and** Empathy Mapping **and** Persona Profiles	**Reviewer 2**: I think I disagree with this. For me direct interaction with the people and their context is the only way to ensure one can empathize. These methods can be performed outside that context and without direct interaction with people. I would prefer to see something like: Walk-a-Mile Immersion **and** Rose, Thorn, Bud **and** Affinity clustering.
Gain empathy for processes	Interviewing, **or** Fly-on-the-Wall Observations, **or** Contextual Inquiry, **or** Walk-a-Mile Immersion, **or** Experience Diagramming	**Reviewer 1**: It would be interesting to see which methods novice designers chose over a period of time, or through multiple projects while first starting out. Something like Walk-a-mile can be intimidating or stressful, and the time commitment and dedication needed for Journaling can feel overwhelming. From a practical side, I wonder if these stresses would sway or steer novice designers in their choices. How much of their thought process would be "what can I do quickly?" versus "what is the best way to collect this information and engage with stakeholders?" **Reviewer 2**: Agree
Understand context	Contextual Inquiry, **or** Concept Mapping	**Reviewer 2**: I would add Walk-a-Mile Immersion and Fly-on-the-wall observation.
Gain empathy for problems	Problem Tree Analysis **and** Affinity Clusters	**Reviewer 1:** It would be great to have a common language and understanding of problems, from both the ID and DT point of view. Possibly the content experts as well. While the language may be similar, motivation and action would certainly be different. **Reviewer 2:** Agree. **With the disclaimer that there are other options.*

Design		
Leverage past experiences	Alternative Worlds	**Reviewer 1:** Excellent alignment. **Reviewer 2**: Agree. I might add interviewing. Especially as a prompt for directed storytelling.
Explore opportunities	Statement Starters **and** Creative Matrix	**Reviewer 1:** Creative Matrix can be very powerful and helpful, but from my experience it really depends on effective facilitation - do you think this would be an issue and how much experience would designers need in the facilitation process to make sure the data they're generating and collecting is useful and on target? **Reviewer 2:** Agree. **With the disclaimer that there are other options*.
Explore opportunities	Persona Profiles **and** Creative Matrix	**Reviewer 2:** Agree.
Frame insights	Creative Matrix **and** Visualize the Vote	**Reviewer 2:** Disagree. Insights are not ideas and for me not about the future or what could be. Insights are about seeing and discerning what is going on now or the recent past. It's visionary for sure, but not in a futuristic way, but in a being super mindful of the present sort of way.
Frame insights	Statement Starters **and** Visualize the Vote **and** Round Robin	**Reviewer 1:** Could you follow the Round Robin with another Visualize the Vote for the new iterations and possibilities? **Reviewer 2:** Slightly Disagree. Don't think you need Round Robin to frame the insight. To me Round Robin is about generating ideas based on the insights. Again, I may be misinterpreting your definition of that heuristic here.
Development		
Prototype	Storyboarding, **or** Concept Posters, **or** Schematic Diagramming, **or** Rough & Ready Prototyping	**Reviewer 1:** I will echo some of my comments from above - the elements with pre-defined contextualization and method ordering seem more straightforward, but it

		would be interesting to track and interview designers on the methodologies where they had more choice and maneuverability - why and how are they choosing their methods? **Reviewer 2:** I might also add thumbnail sketching.
Implementation		
Pilot	Rough & Ready Prototyping **and** Rose, Thorn, Bud **and** Critique	**Reviewer 2:** This is not consistent with Table 9.8.
Evaluation		
Seek feedback	Think-Aloud Testing, **or** Heuristic Review, **or** Critique, **or** System Usability Scale, **or** Rose, Thorn, Bud	**Reviewer 1:** It would be great to develop an action plan or follow up to this step - to make sure the methods being chosen yield an actionable path forward for their work and both refinement of design and expertise for their future projects and designs. **Reviewer 2:** Agree. I might also add Interviewing to that list.

Model Usability

The final group of questions within the expert review questionnaire was model usability. The responses to the questions for model usability were positive and suggested overall approval from the reviewers. In response to the question, to what degree is the model logical and easy to understand, Reviewer 1 responded, “I find the model to be easy to understand. The advancement from table to table helps demonstrate and model how ideas and projects could be advanced. Being comfortable or having the knowledge to build and align design thinking methodologies can be difficult in the beginning, so the suggested pairings are essential to success. They are also written in a way that as designers progress and experience the process, they will be able to generate their own combinations in future projects.” In response to the question, “To what degree will this model assist novice instructional designers with processes and daily operations of being

a new designer," Reviewer 1 stated that "this is a strong starting point and scaffolding mechanism for novice designers to pair design thinking with instructional design practices." Reviewer 2 offered this response to questions of usability by novice designers, "It gives novices everything they need to go about the work involved in doing instructional design, as well as, collaborating with other designers and students in the creation, management and evaluation of instructional design projects."

In addition to the design thinking method additions and subtractions of Tables 9.1 – 9.9 and Table 10, reviewers offered two suggestions for overall improvement to the usability of the model. Reviewer 1 suggested that the model be designed for an html experience that would enable novice designers the ability to quickly look up definitions of heuristics and connect to design thinking methods, instructions, and proposed combinations of methods. Reviewer 2 recommended that the model include a featured combination of methods for each heuristic, as well as additional subsets of method combinations. The goal of this recommendation would be to remind new designers that there are multiple ways to utilize methods and combinations of methods to achieve instructional design goals.

Reviewer 3 stated that the model was very helpful and included steps that are not emphasized within instructional design frameworks such as ADDIE. Reviewer 3 offered the following comment, "For me, to visualize the process as a concept map would be very helpful with the methods linked to the heuristics. This would help me (personally) see the overlap and potentially simplify this. In a table format it is difficult to see the overlap." Reviewer 3 also suggested translating the 20 instructional design heuristics into potential questions or problem scenarios to help designers relate to the contextual situation for which each heuristic might occur. Feedback from all reviewers is discussed in Chapter 6 along with a summary of

modifications that were made to the model in Appendix D, practical implications for the model, limitations of the study, and future research.

CHAPTER 6

Discussion and Conclusion

This chapter offers a discussion of model modifications, contributions to the field of instructional design, implications for practice, study limitations and biases, proposals for future research and a summary of the study.

Model Modifications

The chapter begins with a description of model modifications made to the model in response to expert reviewers' formative suggestions to adjust and improve the model. The discussion of model modifications aligns with the expert review questions and comments presented in Chapter 5. Model modifications discussed in Chapter 6 are reflected in red font in the updated model in Appendix D.

Heuristics of Instructional Designers

Reviewer comments supported the proposed heuristics of instructional designers except for one heuristic. Reviewers offered multiple comments and posed questions about the *Frame insights* heuristic. Reviewers offered a variety of different methods to be included or removed for this heuristic and their questions suggest confusion about the role of this heuristic and its placement within the ADDIE framework. After further review of the cross-referenced principles, and the placement within the ADDIE framework, it seems appropriate to change the heuristic to *Pitch ideas*. This heuristic directly aligns with the need to collaborate with others and generate multiple ideas during the design stage of the instructional design process (Rowland, 1992). The model has been updated to reflect the new heuristic and cross-referenced to include additional principles that align with this stage of the process. This was the only heuristic that reviewers

offered any suggestions for deletions. The remainder of the modifications offered by the reviewers were additions to the original model.

Reviewer 1 suggested that it might be helpful to further combine and consolidate heuristics to *Gain empathy for people* and *Gain empathy for processes*, as well as *Identify constraints* and *Identify barriers*. There are instances within the model where the methods proposed for people versus processes, and constraints versus barriers are different. Thus, the decision was made not to combine these heuristics.

Instructional Design Processes: ADDIE

Reviewer comments support the use of ADDIE as the instructional design framework for this model. As stated by Reviewer 3, it is necessary to identify potential limitations of using ADDIE. Two notable limitations of ADDIE are its simplistic or generic nature and the tendency for people to represent ADDIE as a linear process (Branch, 1997). However, Branch and Kopcha's (2014) explanation of ADDIE as "a useful tool for measuring whether a model is inclusive of the entire instructional design process," aligns with the rationale presented by the researcher to use the ADDIE framework. They suggest ADDIE as useful in teaching novice instructional designers the design process because it is simple, generic and applicable in a variety of different contexts (Branch & Kopcha, 2014). In response to some critics who suggest ADDIE as linear, the heuristics expressed within the model and the accompanying design thinking methods should overcome this insinuation of linearity and promote a more iterative and evaluative process throughout.

Proposed Design Thinking Methods and Combinations of Methods

Each expert offered a unique perspective with varied recommendations for design thinking methods and combinations of methods that aligned with expert instructional design heuristics. Given the subjective nature of these recommendations, multiple adjustments were made to Tables 9.1 – 9.9 and Table 10 where one or more reviewers offered suggestions with concrete examples for a method's use within the context of the heuristic. Tables 9.1 – 9.9 and Table 10 have been updated in red font to reflect these adjustments in Appendix D.

Reviewer 2's comments regarding *Pilot* and *Iterate designs* heuristics unveiled potential biases of the model presented by the researcher. Although it is less common for an instructional designer to revisit the analysis stage of a project once it has started to *Pilot* and *Iterate designs*, it is quite possible that a *Prototype* or a *Pilot* could unveil a need for a designer to revisit any stage of the process, and thus utilize most categories of design thinking methods. Technically, this would involve revisiting a different heuristic (beyond *Iterate designs* or *Pilot*), so no changes have been made to the design thinking method selections for these heuristics, but instead the potential needs to revisit other heuristics as a result of *Prototype*, *Iterate designs* and *Pilot* have been acknowledged and discussed here.

Model Usability

Overall, the reviewers' responses to the model usability questions were positive. They suggest that the model is understandable and predict that it would be relatively simple for novice designers to apply the model in practical situations. Reviewers suggest that some training to introduce instructional designers to design thinking methodologies may be necessary prior to implementing the model. Reviewer 1 offered two comments regarding the need to offer training for novice designers prior to them implementing design thinking methods and/or combinations of methods. Reviewer 1 also questioned whether designers would need training on empathy, and its

role or importance within the process. The need for designers to empathize with people, processes and problems should be reviewed during designers' coursework that emphasizes the importance of analysis and needs assessments. However, if a designer expresses challenges with empathizing at any stage of the instructional design process, it may be necessary to revisit studies that reiterate the importance and role that empathy plays in everyday instructional design processes. Reviewer 1 also suggested that it might be necessary to train novice designers to use combinations of design thinking methods within the context of a problem or real-life situation. Reviewer 3 made a similar suggestion that it might be helpful to develop questions and scenarios for each heuristic to help novice designers make connections between real situations and design thinking method combinations. These suggestions are beyond the scope of this study, but they could be beneficial to consider for future iterations of the model.

Reviewer 1 suggested that the model be designed for an html experience that would enable novice designers the ability to quickly look up definitions of heuristics and connect to design thinking methods, instructions, and proposed combinations of methods. A similar product (LUMA Workplace) already exists more generally for new design thinking practitioners. Instead of starting from scratch, the researcher suggests that future efforts might involve a collaboration to expand existing websites to include a section for instructional designers that includes the heuristics stated within this model, and supports more common scenarios and collaborations of instructional designers.

Reviewer 2 recommended that the model include a featured combination of methods for each heuristic, as well as additional subsets of method combinations. The goal of this recommendation would be to remind new designers that there are multiple ways to utilize methods and combinations of methods to achieve instructional design goals. Given the stated

challenges of novice instructional designers, the researcher recommends this approach for a more advanced version of the model. Too much information can be overwhelming; the original intent and purpose of the model was to guide novices through new experiences of being an instructional designer with simple design thinking methods and combinations of methods. As designers become more comfortable with collaborations, they will become more confident in their ability to try new things. The researcher suggests a model 2.0 that might be introduced to designers who have some level of competency and proficiency with design thinking methodologies. Lastly, Reviewer 3 suggested that a concept map would be helpful in visualizing the links between design thinking methods and instructional design heuristics to determine where overlap exists. In response to this suggestion, the researcher would support the development of a concept map in future iterations of this study.

Overall, the reviewer comments were supportive of the proposed model and minor suggestions for change were included in the revised model in Appendix D. Reviewer feedback supported the use of this model by novice instructional designers and suggested that the model could be useful as they enter the field of practice and seek out opportunities to overcome common challenges.

Contributions to the Field of Instructional Design

Recent studies of novice and expert instructional designers have identified various challenges that are common among novices entering the field of practice. Specific challenges include novice instructional designers' ability to identify and solve ill-structured problems, collaborate with teams, negotiate needs, determine priorities, generate multiple ideas, identify project constraints, test solutions, gather feedback, and manage projects. The design thinking

methods and combinations of methods introduced within this model could assist novice instructional designers with their ability to overcome each of these challenges.

Novice instructional designers have limited experience working with ill-structured problems and lack the frames of reference and experience that are necessary to conceptualize problems and their underlying issues (Rowland, 1992). Novices are more likely to accept the word of clients or subject-matter experts, and consequently overlook the need to conduct a thorough analysis of learners, which includes gaining empathy for their needs and their processes (Hoard, Stefaniak, Baaki, & Draper, 2019; Roytek, 2010). Design thinking is a human-centered, process for creative problem solving where methods are implemented to assist people with empathizing with problems (Brown, 2009; Liedtka, 2014; Lockwood, 2009). The methods and combinations of methods presented within this model could help novice instructional designers ask more questions of their clients and explore causes and effects of problems that could ultimately unveil clearer perspectives of instructional problems. Specifically, the methods for conducting ethnographic and participatory research could offer strategic steps for instructional designers to conduct more thorough analyses of people and their experiences. The methods for understanding people and processes could help instructional designers identify and map stakeholders and their processes in a way that visually ensures agreement among a variety of people within a project. Finally, the methods for problem framing could help instructional designers explore broader or more specific questions and identify a variety of causes and effects of instructional problems, which could inform the design of clearer problem statements that could be used to determine objectives and outcomes for learning.

Novice instructional designers' limited experience working with teams makes it difficult for novices to plan for collaborations, anticipate outcomes, and negotiate priorities among team

members (Liu, Gibby, Quiros, & Demps, 2002). The design thinking methods presented in this model have clear steps and templates that instructional designers can use to plan for collaborations, visually communicate processes, and negotiate priorities. Specifically, the methods introduced to identify patterns and priorities could help instructional designers clearly identify the needs of people, negotiate priorities, and reveal preferences among project collaborators.

Novices are often solution-focused, and jump to solving the problem prior to fully understanding the problem making them less likely to invite others to the process of ideation and iteration (Chang & Kuwata, 2020; Tracey & Boling, 2014). Design thinking methods for concept ideation, modeling and prototyping, and design rationale, could offer strategic steps for instructional designers to use among collaborators to quickly generate a variety of new ideas, explore potential failures, and brainstorm opportunities to overcome pitfalls. Inviting more people to the process of idea generation allows project stakeholders to have autonomy in the process, which could help build trust and buy-in to new ideas and solutions.

Novice instructional designers commonly experience challenges with resource, budget, and time constraints as they near the end of projects. Limited experience working with stakeholders through these challenges makes it difficult for novices to push for additional stages of rapid prototyping and evaluation as they near the end of a project (Perez & Emery, 1995). Design thinking methods for design rationale could assist instructional designers with earlier identification of barriers and constraints, thus allowing for more time to prototype and evaluate new ideas. Evaluative research methods such as Think-Aloud Testing could be incorporated into project *Pilots* so no additional time or resources are necessary in gathering useful input about a learner or user's actual experience.

Lastly, novice instructional designers' limited experience communicating and managing instructional design projects, makes it difficult for novices to gain trust and assume leadership roles (Williams van Rooij, 1993). The artifacts of design thinking methods (physical documentation of method implementations) could help novice instructional designers kick-off projects by offering ways to visually and verbally communicate stages of the instructional design process. Many of the heuristics and methods identified within the model could assist instructional designers with conducting more thorough analyses. The artifacts from these methods could be used throughout a project to ensure clear communication and transparency among multiple stakeholders. Collaborative design thinking methods could help instructional designers invite a variety of people to map experiences, prioritize needs, generate ideas, and test solutions. Inviting more people to the process could help stakeholders gain empathy for new or unique perspectives and allow multiple collaborators to offer input. Taking steps to verbally and visually communicate and allowing stakeholders to have autonomy in the process could assist instructional designers in building stronger relationships among team members and assuming leadership roles.

Limitations and Study Biases

The efforts to simplify the principles of instructional design processes into heuristics may have oversimplified the processes. Future iterations of the model could include common scenarios to assist novice designers in developing a big picture understanding of the heuristics and common situations or scenarios when the use of methods or combinations of methods might be appropriate. There is an expressed need to further explain or define what each heuristic might entail or include. It may be helpful to reference the principles in Table 7.1, which were cross-referenced to develop the heuristics, as a starting place for developing detailed scenarios for

future iterations of the model. The expert review from a person who was less familiar with the field of instructional design unveiled some biases that the researcher had regarding instructional design and the way processes typically occur. It was helpful for the researcher to consider the reviewers' examples for which they use design thinking methods in less conventional ways. Reviews from two experts also unveiled biases the researcher subconsciously had toward the use of various methods either from poor experiences with the methods previously or from limited use or experience within a similar context of the heuristic.

One limitation of the study was the difficulty in finding experts with knowledge in instructional design and design thinking. Since the model's greatest areas of subjectivity exist within the selection of design thinking methods, the researcher chose to identify reviewers with more expertise in design thinking methodologies than instructional design.

Implications for Practice

The purpose of this study was to identify design thinking methods that aligned with heuristics of expert instructional design practitioners, and to design and develop a new model of heuristics and design thinking methods, which could assist novice instructional designers as they enter the instructional design field. If the model successfully addressed the challenges of novice designers presented in Chapter 4, it might enhance novice designers' abilities to solve ill-structured problems; conduct thorough analyses for instructional design projects; collaborate in teams; negotiate priorities; generate a variety of ideas for solutions; overcome resource, budget and time constraints; communicate and manage projects with stakeholders; and prototype, iterate and pilot new designs. The model offers novice instructional designers specific methods and combinations of methods to use for every stage of the instructional design process. As designers implement design thinking methods within the context of their daily situations, they should

become more comfortable using the methods and begin to adapt the methods to meet their individual needs for each stage of their process.

Future Research

Reviewer 1 and Reviewer 3 both posed comments and questions regarding the selections of methods and whether one method may be chosen more frequently over another in situations where multiple methods were suggested. A future study of the model's use by multiple novice instructional designers would be helpful in determining what influences designers' decisions to choose one method over another, and whether they identify positives or negatives for using various methods within different contextual situations. It would be interesting to know whether designers continue to try new methods or if they are more likely to use the same methods consistently within their processes. Future research studies of novice instructional designers applying the model in practice are needed to determine the model's usability, applicability, and success within a practical setting.

Summary

This study sought to answer the following questions:

1. What are the common stages of the instructional design process?
2. What are some challenges of novice instructional designers and how do they align with heuristics of expert instructional designers?
3. What is the relationship between instructional design heuristics and design thinking?
4. Which methods of design thinking align with heuristics of expert instructional designers?

It is evident that novice instructional designers encounter a variety of challenges when first entering the field of practice. Studies of expert instructional designers offer a plethora of information pertaining to the principles and heuristics commonly referenced as important among experts, but the challenges among novices remain largely unaddressed. Design thinking methodologies have been used among designers and practitioners in a variety of fields to overcome many of the challenges reported among novice instructional designers. This model offers novice instructional designers the familiarity of the ADDIE framework and common heuristics of expert instructional designers, in conjunction with proposed design thinking methods to enhance their processes among clients, teams, and project stakeholders. With minimal training and guidance, novice instructional designers could use the model to identify design thinking methods and combinations of methods to advance their daily needs to explore ill-structured problems and develop new instructional interventions. As instructional designers implement design thinking methods within the context of their daily situations, they could become more comfortable using the methods and begin to adapt the methods to meet their individual needs for each stage of their process.

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Appendix A: Expert Reviewer Consent Form

Title of Research:
A Model of Expert Instructional Design Heuristics Incorporating Design Thinking Methods

Principal Investigators:
Dr. Ken Potter, Virginia Tech
Kristin Machac, Doctoral student at Virginia Tech

I. Purpose
The purpose of this study was to identify design thinking methods that aligned with heuristics of expert instructional design practitioners, and to design and develop a new model of heuristics and design thinking methods, which could assist novice designers as they enter the instructional design field. The model represents a synthesis of the results of a literature review, which included identification of common stages of instructional design models, challenges among novices entering the instructional design field of practice, heuristics of expert instructional designers, and a review of design thinking origins, processes, and methodologies.

II. Procedure
If you agree to participate in this study, you will be an expert reviewer for this study. The expert review consists of questions regarding the model of expert instructional design heuristics incorporating design thinking techniques. The expert reviewer will examine the validity and feasibility of the model. The expert reviewer will provide written feedback regarding the model via email and within the designated expert reviewer comment cells within the Microsoft Excel tables.

III. Risks
The risks associated with participation in this study are minimal. Risks to participants are no greater than the risks associated with normal conversation. You have the right to withdraw from participation at any time by notifying the researcher in writing or in-person of your desire to withdraw. The researcher will work to ensure all materials collected through this study are stored securely and remain confidential.

IV. Benefits
There are no direct benefits to you for participation in this study. No guarantee of benefits has been made to encourage you to participate in this study.

V. Extent of Anonymity and Confidentiality
The results of this study will be kept strictly anonymous and confidential. Your written consent is required for the researcher to release any data identified with you as an individual to anyone other than personnel working on the study. The information you provide will have your name removed and only a pseudonym will identify you during analyses and any written reports of the research; you reserve the right to choose this pseudonym. Data will be kept for approximately one year after the conclusion of the study.

VI. Compensation
Your participation is voluntary and unpaid.

VII. Freedom to Withdraw
You may withdraw from the research project at any time and for any reason. You are free not to answer

any questions or respond to experimental situations without penalty. To withdraw please inform the researcher listed at the bottom of this form.

VIII. Subject's Responsibilities

I voluntarily agree to participate in the research. I have the following responsibilities: to review the model of expert instructional design heuristics incorporating design thinking techniques; and to respond to a set of questions to provide feedback through email including follow-up reviews if needed.

IX. Subject's Permission

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____ _____

Subject signature **Date**

Should I have any pertinent questions about this research or its conduct, I may contact:

Dr. Ken Potter	540-231-7039	kpotter@vt.edu
Kristin Machac	540-354-7650	marober5@vt.edu

Appendix B: Evaluation Questions for Expert Review

Heuristics of instructional designers

1. Do you agree with the researcher's identification of instructional design heuristics in Table 8 of the Expert Reviewer MS Excel spreadsheet?
2. Based on your expertise, are there instructional design heuristics that should be added or removed from Table 8?

Instructional design processes: ADDIE

1. Do you agree or disagree with the use of ADDIE within the model?
2. Do you agree with the alignment between the stated instructional design heuristics and their placement within the stages of the ADDIE framework identified in Table Set 8?

Design thinking

1. Given the stated heuristics, do you agree with the researcher's selection of design thinking methods in Tables 9.1 – 9.9? Please explain each selection for which you disagree.
2. Given the stated heuristics, do you agree with the researcher's recommendations for individual methods and method combinations in Table 10? Please explain each selection for which you disagree.

Model Usability:

1. To what degree was the model organized in a logical way that made it easy to understand?
2. To what degree will this model assist novice designers in their ability to design, communicate, manage, and evaluate new and existing instructional design projects?
3. In what ways do you suggest the model could be improved?
4. Please provide any additional comments or feedback you feel is appropriate and would be beneficial for this study.

Appendix C: Citations for design thinking methods

Note: The method categories, method explanations, and organization of methods presented within the model directly align with LUMA Institute's Handbook of Human-centered Design Methods: Innovating for People (2012). LUMA Institute credits the design and development of many of these methods to multiple sources. The researcher also used a variety of journals and sources in the pursuit of the design thinking literature review. LUMA Institute's citations are combined with the researcher's citations, here. Where there are no sources beyond the LUMA Institute, they have been cited as the primary source.

Methods for Ethnographic Research	
Interviewing	(Spradley, 1979)
Fly-on-the-Wall Observation	(Zeisel, 1981, 2006)
Contextual Inquiry	(Beyer & Holtzblatt, 1998; Zeisel, 1981, 2006)
Walk-a-Mile Immersion	(Spradley & McCurdy, 1972)
Methods for Participatory Research	
What's on Your Radar??	(LUMA Institute, 2012)
Buy a Feature	(Scaled Agile Inc., 2010)
Build Your Own	(Sommerich, Sanders, & Lavender, 2009; Flinn, Sanders, Yen, Sommerich, & Lavender, 2013)
Journaling	(Ohly, Sonnentag, Niessen, & Zaph, 2010; Rausch, 2013; Rausch, 2014)
Methods for Evaluative Research	
Think-Aloud Testing	(van Someren, Barnard, & Sandberg, 1994) (Cotton & Gresty, 2006)

Heuristic Review	(Nielsen J. , 1994; Nielsen J. , 1994)
Critique	(Feldman, 1973; Hokanson, 2012)
System Usability Scale	(Bangor, Kortum, & Miller, 2009; Brooke, 1996; Lewis & Sauro, 2009)
Methods for Understanding People & Systems	
Stakeholder Mapping	(Walker, Bourne, & Shelley, 2008; Freeman, 1984; Parmar, Freeman, Harrison, Purnell, & De Colle, 2010)
Persona Profile	(Grudin & Pruitt, 2002; Miaskiewicz & Kozar, 2011; Pruitt & Adlin, 2006)
Experience Diagramming	(Fox, McCormick, Procter, & Carmichael, 2007; Bagnoli, 2009; Crilly, Blackwell, & Clarkson, 2006; Copeland & Agosto, 2012; Bravington & King, 2018)
Concept Mapping	(Novak, 1998; Kinchin I. , 2000; Kinchin & Alias, 2005; Hughes & Hay, 2001; Hay, Kinchin, & Lygo-Baker, 2008)
Methods for Recognizing Patterns & Priorities	
Affinity Clustering	(Curtis, Heiserman, Jobusch, Notess, & Webb, 1999; Judge, Pyla, McCrickard, Harrison, & Hartson, 2008)
Bull's-eye Diagramming	(Ford, 1999; Caponio, Massaro, Mossa, & Mummolo, 2015; Rayo, Pawar, Sanders, Liston, & Patterson, 2018)
Importance/Difficulty Matrix	(McQuaid & Bishop, 2008; Gibbons, 2018; Kumar, 2013)
Visualize the Vote	(Gibbons, 2018; McKenzie, Gill, & Phaal, 2019)

Methods for Problem Framing	
Problem Tree Analysis	(Veselý, 2008)
Statement Starters	(Treffinger, 2000)
Abstraction Laddering	(Isaken, Dorval, & Trefflinger, 2011; Hayakawa, Hayakawa, & MacNeil, 1991)
Rose, Thorn, Bud	(LUMA Institute, 2012)
Methods for Concept Ideation	
Thumbnail Sketching	(Owen M. , 2016; Shedd, 2010)
Creative Matrix	(Tauber, 1972)
Round Robin	(Surowiecki, 2004; Gotthardt, 2018)
Alternative Worlds	(Gordon, 1961)
Methods for Modeling & Prototyping	
Storyboarding	(Krause, 2018)
Schematic Diagramming	(Matsubayashi & Watanabe, 2016)
Rough & Ready Prototyping	(Wong, 1992; Camburn, et al., 2017)
Appearance Modeling	(Mugge & Schoormans, 2012; Banks, 2011)
Methods for Design Rationale	
Concept Poster	(Woods, Cummings, Duff, & Walker, 2018)
Video Scenario	(Carroll J. , 2000)
Cover Story Mock-up	(LUMA Institute, 2012)

Quick Reference Guide	(Goodwin, 1994)

Appendix D: Revised Model

Table D1.1

York and Ertmer's (2011;2016) 61 principles of expert instructional designers cross-referenced with the researcher's consolidated list of 28 heuristics of instructional design and design thinking.

	Principles	Cross Reference
1	"Know your learners/target audience"	3, 10
2	"Determine what it is you want your learners to perform after the instructional experience. What is the criterion for successful performance?"	4, 11, 8
3	"There are things that need to be determined at the front end in order to make you successful at the back end."	1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13
4	"Be honest with the client"	23, 24, 25, 26, 27
5	"When designing instruction, consider the context in which the learning will be applied. Ask yourself, 'How can I put learning into context?''	12, 27
6	"Negotiate the scope of the project with the client and create a statement of work upfront"	7, 8, 24, 25, 26, 27
7	"When designing instruction, consider active learning. Ask yourself, 'How can I make learners more actively engaged?''	14, 15
8	"You have to be sensitive to the context and the culture of the client"	10, 11, 12, 13
9	"Approach the design problem with the end in mind. What are the deliverables? What are the learning/performance outcomes?"	4, 7, 8
10	"You need to build trust with the client. This can be done through explaining what you are doing, why you are doing it, and how it is of value to them."	9, 21, 22, 23, 24, 25, 26, 27
11	"Figure out who all the stakeholders are in the room. And figure out who is not in the room that is still a stakeholder."	3, 10, 11, 13
12	"The team is critical. Involve the right people at the right time."	3, 16, 18, 28
13	"As a designer you need to listen more than you talk."	9, 10, 11, 12, 13
14	"Know your learners' prerequisite knowledge."	9, 10, 11
15	"You need to manage the client's expectations."	24, 27
16	"When verifying information, you often will learn more information."	1, 2, 9, 10, 11, 12, 13, 18, 25, 26, 28
17	"Consider utilizing scaffolding in your instructional experience Give the learner the tools they need to succeed."	14, 15, 17
18	"You may have to mock up something to show the client to make sure that you get all of the desired outcomes right."	17, 18, 19

19	“Determine what will keep the learner motivated during the instructional experience.”	10, 14, 15
20	“Ask yourself, ‘Is instruction the solution to this problem?"	1, 2, 15
21	“Verify all the information you receive from the client to prevent miscommunication.”	9, 18, 24, 25, 26, 28
22	“Sometimes the client will not tell you all there is to know about a problem.”	2, 12, 13
23	“The client thinks it is much easier to move from the conceptualization to the implementation than it actually is.”	17, 24, 27
24	“Ensure that design speaks to a value chain of learning, i.e., that learning contributes to behaviors and that behaviors contribute to organizational or business results.”	4, 11, 16, 27
25	“You have to determine if the client really knows what they want.”	1, 2
26	“When communicating with the client, use visuals and documents in order to prevent miscommunication.”	26
27	“You need to understand and speak the language of your client.”	9, 10, 11, 12, 13
28	“When possible, have a subject matter expert AND a non-subject matter expert review the final product.”	18, 28
29	“When faced with something complex, look for previous examples that have characteristics you can draw upon, that can give you ideas on how to solve the problem.”	14
30	“Understand the learning associated with the technology.”	11, 12
31	“Be prepared to think abstractly.”	15, 17
32	“Constraints are a key to design. Look for constraints that have been placed on a project.”	1, 6, 13
33	“Needs analysis is the foundation for evaluation.”	1, 2, 3, 7
34	“Subject matter expert’s documentation often fails to provide the necessary critical thinking. The SME forgets to tell you basic steps and concepts he forgot he once learned.”	10, 11, 12, 26
35	“Don’t let technology drive the design.”	15
36	“Resist the technical expert’s propensity to focus on the most complex or innovative aspects of a product. Remember the novice learner who needs to build basic skills.”	11, 15, 28
37	“It is the instructional designer’s job to press for quality in the design.”	15, 16, 17, 18, 19, 20
38	“Use previous experiences, if possible, as a starting point for new projects.”	14
39	“Be sure the instruction gives learners the opportunity to make choices.”	22

40	“Don’t use technical instructional design terminology with the client unless you have to.”	23
41	“You are rarely going to collect all the desired outcomes with just one interview with the client.”	9, 18, 25, 26, 28
42	“Always conduct a pilot.”	18, 20
43	“When multiple stakeholders are involved, ask your client to identify your ‘‘single point of contact’’—make sure that person understands what is expected—gathering feedback on your design for you, getting approvals, etc.”	3, 24
44	“Technology can get in your way, and if you don’t deal with it you can get yourself into trouble.”	5, 6, 15
45	“You need to know the theories. You need to know the models. You need to have that foundation.”	12
46	“Understand that every design situation is unique.”	1, 2, 10, 11, 12, 13
47	“You often don’t get to do the best instructional design you want due to constraints, resources, time, budget, etc.”	6, 15, 16, 17, 18, 19
48	“Design is a people process.”	28
49	“Resist the SME’s (subject matter expert’s) desire to teach the solution to the hot problem of the day… unless it is a common problem seen by the average learner.”	1, 2, 13
50	“Allow the content to guide how users interact with the training (linear, user-driven, etc.)—not the tools used to develop the training.”	15, 22
51	“Bring together the client and other stakeholders for synchronous meetings at each ‘‘gate’’ in a phased process.”	3, 18, 24, 25, 26, 27, 28
52	“When designing instruction, think about Elaboration Theory. Ask yourself, ‘What’s the ‘big picture’ to which the components are attached?’’	10, 11, 12, 13
53	“Prepare to do a lot of work that is never going to show up in the final product.”	16, 17, 18, 19
54	“The instructional designer should take prodigious notes during meetings. Do not rely purely on documentation of the SME.”	9, 26
55	“Invest as much time as you can in your audience analysis.”	9, 10, 11, 12, 13
56	“Never look at the problem at face value. You have to get to the core of the problem and solve all of the subproblems.”	1, 2, 3, 9, 10, 11, 12, 13
57	“Generate multiple possible solutions that will solve the problem.”	15, 17
58	“Acknowledge your limitations. Don’t accept a job that is outside of your expertise.”	23, 24
59	“Make every effort to be part of the production process.”	18, 19, 25, 28
60	“Design continues through the delivery or implementation phase.”	18, 29, 20

61	“Ask all possible relevant questions throughout the entire design process.”	2, 9, 18, 25

Table D1.2

Consolidated list of instructional design and design thinking heuristics cross-referenced with York and Ertmer's (2011) 61 principles of expert instructional designers.

*Changes to the original model are noted in red text. The **Frame insights** heuristic was modified to **Pitch ideas** to represent more clearly what happens during the ideation stage of the instructional design process.*

	Heuristics	Cross Reference
1	*Identify problems*	1, 16, 20, 25, 32, 33, 46, 49, 56
2	*Question the question*	16, 20, 22, 25, 33, 46, 49, 56, 61
3	*Identify stakeholders*	1, 3, 11, 12, 33, 43, 51, 56
4	*Define outcomes*	2, 3, 9, 24
5	*Identify barriers*	3, 44
6	*Identify constraints*	3, 32, 44, 47
7	*Prioritize needs*	3, 6, 9, 33
8	*Prioritize outcomes*	2, 3, 6, 9
9	*Listen*	10, 13, 14, 16, 21, 27, 41, 54, 55, 56, 61
10	*Gain empathy for people*	1, 3, 8, 11, 13, 14, 16, 19, 27, 34, 52, 55, 56
11	*Gain empathy for processes*	2, 3, 8, 11, 13, 14, 16, 24, 27, 30, 34, 36, 46, 52, 55, 56
12	*Understand context*	3, 5, 8, 13, 16, 22, 27, 30, 34, 45, 46, 52, 55, 56
13	*Gain empathy for problems*	3, 8, 11, 13, 16, 22, 27, 32, 46, 49, 52, 55, 56
14	*Leverage past experiences*	7, 17, 19, 29, 38
15	*Explore opportunities*	7, 17, 19, 20, 31, 35, 36, 37, 44, 47, 50, 57
16	*Pitch ideas*	12, 24, 37, 47, 53
17	*Prototype*	17, 18, 23, 31, 37, 47, 53, 57
18	*Seek feedback*	12, 16, 18, 21, 28, 37, 41, 42, 47, 51, 53, 59, 60, 61
19	*Iterate designs*	18, 37, 47, 53, 59
20	*Pilot*	37, 42, 60
21	*Gain trust*	10
22	*Allow for autonomy*	10, 39, 50
23	*Be authentic/real*	4, 10, 40, 58
24	*Set clear expectations*	4, 6, 10, 15, 21, 23, 43, 51, 58
25	*Communicate often*	4, 6, 10, 16, 21, 41, 51, 59, 61
26	*Communicate visually*	4, 6, 10, 16, 21, 34, 41, 51, 54
27	*Communicate the why/how*	4, 5, 6, 10, 15, 23, 24, 51
28	*Collaborate with others*	12, 16, 21, 28, 36, 41, 48, 51, 59

Table D2

Consolidated heuristics of instructional design and design thinking.

Consolidated ID & DT Heuristics	*Learner – centric vs. Designer – centric	Stages of ADDIE
Identify problems	Learner – centric	Analysis
Question the question	Learner – centric	Analysis
Identify stakeholders	Learner – centric	Analysis
Define outcomes	Learner – centric	Analysis
Identify barriers	Learner – centric	Analysis
Identify constraints	Learner – centric	Analysis
Prioritize needs	Learner – centric	Analysis
Prioritize outcomes	Learner – centric	Analysis
Listen	Learner – centric	Analysis, Evaluation
Gain empathy for people	Learner – centric	Analysis, Evaluation
Gain empathy for processes	Learner – centric	Analysis, Evaluation
Understand context	Learner – centric	Analysis
Gain empathy for problems	Learner – centric	Analysis
Leverage past experiences	Learner – centric	Design
Explore opportunities	Learner – centric	Design
Pitch ideas	Learner – centric	Design
Prototype	Learner – centric	Development, Implementation, Evaluation
Seek feedback	Learner – centric	Development, Implementation, Evaluation
Iterate designs	Learner – centric	Development, Implementation, Evaluation
Pilot	Learner – centric	Implementation, Evaluation
Gain trust	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Allow for autonomy	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Be authentic/real	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Set clear expectations	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Communicate often	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Communicate visually	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Communicate the why/how	Designer – centric	Analysis, Design, Development, Implementation, Evaluation
Collaborate with others	Designer – centric	Analysis, Design, Development, Implementation, Evaluation

**Refers to actionable, learner – centered stages of the ID process versus designer – centric stages, which mostly align with mindsets and best practices of instructional designers.*

Table D3.1 *(Red X indicates an addition to the model upon expert reviews)*

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Ethnographic Research

		Design Thinking Methods for Ethnographic Research			
Instructional Design Heuristics	**ADDIE**	**Interviewing**	**Fly-On-The Wall Observation**	**Contextual Inquiry**	**Walk-a-Mile Immersion**
Identify problems	Analysis	x	x	x	x
Question the question	Analysis	x	x	x	
Identify stakeholders	Analysis	x	x	x	
Define outcomes	Analysis	x		x	
Identify barriers	Analysis	x	x	x	x
Identify constraints	Analysis	x	x	x	x
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation	x	x	x	
Gain empathy for people	Analysis, Evaluation	x	x	x	x
Gain empathy for processes	Analysis, Evaluation	x	x	x	x
Understand context	Analysis	x		x	
Gain empathy for problems	Analysis	x	x	x	x
Leverage past experiences	Design	x			
Explore opportunities	Design				
Frame insights	Design				
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation	x			
Iterate designs	Development, Implementation, Evaluation				
Pilot	Implementation, Evaluation	x	x	x	x

Table D3.2 *(Red X indicates an addition to the model upon expert reviews)*

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Participatory Research

		Design Thinking Methods for Participatory Research			
Instructional Design Heuristics	**ADDIE**	**What's on Your Radar?**	**Buy A Feature**	**Build Your Own**	**Journaling**
Identify problems	Analysis	x			x
Question the question	Analysis				
Identify stakeholders	Analysis				
Define outcomes	Analysis	x	x		
Identify barriers	Analysis	x			
Identify constraints	Analysis	x			
Prioritize needs	Analysis	x			
Prioritize outcomes	Analysis	x			
Listen	Analysis, Evaluation	x	x	x	
Gain empathy for people	Analysis, Evaluation	x	x	x	x
Gain empathy for processes	Analysis, Evaluation	x	x	x	x
Understand context	Analysis				
Gain empathy for problems	Analysis	x			x
Leverage past experiences	Design				
Explore opportunities	Design				
Frame insights	Design				
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation	x	x	x	x
Iterate designs	Development, Implementation, Evaluation				
Pilot	Implementation, Evaluation				

Table D3.3 *(Red X indicates an addition to the model upon expert reviews)*

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Evaluative Research

		Design Thinking Methods for Evaluative Research			
Instructional Design Heuristics	**ADDIE**	**Think-Aloud Testing**	**Heuristic Review**	**Critique**	**System Usability Scale**
Identify problems	Analysis	x	x	x	x
Question the question	Analysis				
Identify stakeholders	Analysis				
Define outcomes	Analysis		x		
Identify barriers	Analysis	x		x	x
Identify constraints	Analysis				
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation	x		x	
Gain empathy for people	Analysis, Evaluation			x	x
Gain empathy for processes	Analysis, Evaluation	x	x	x	x
Understand context	Analysis				
Gain empathy for problems	Analysis	x	x	x	x
Leverage past experiences	Design				
Explore opportunities	Design				
Frame insights	Design				
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation	x	x	x	x
Iterate designs	Development, Implementation, Evaluation	x	x	x	x
Pilot	Implementation, Evaluation	x	x	x	x

Table D3.4 *(Red X indicates an addition to the model upon expert reviews)*

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Understanding People & Systems

		Design Thinking Methods for Understanding People & Systems			
Instructional Design Heuristics	**ADDIE**	**Stakeholder Mapping**	**Persona Profile**	**Experience Diagramming**	**Concept Mapping**
Identify problems	Analysis			x	x
Question the question	Analysis				
Identify stakeholders	Analysis	x	x	x	x
Define outcomes	Analysis			x	x
Identify barriers	Analysis			x	x
Identify constraints	Analysis			x	x
Prioritize needs	Analysis		x		
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation	x	x	x	
Gain empathy for processes	Analysis, Evaluation			x	x
Understand context	Analysis	x		x	x
Gain empathy for problems	Analysis			x	x
Leverage past experiences	Design			x	
Explore opportunities	Design				
Frame insights	Design				
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation				
Iterate designs	Development, Implementation, Evaluation				
Pilot	Implementation, Evaluation				

Table D3.5 *(Red X indicates an addition to the model upon expert reviews)*

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Identifying Patterns & Priorities

		Design Thinking Methods for Identifying Patterns & Priorities			
Instructional Design Heuristics	**ADDIE**	**Affinity Clustering**	**Bull's-eye Diagramming**	**Importance/Difficulty Matrix**	**Visualize the Vote**
Identify problems	Analysis	x	x	x	x
Question the question	Analysis				
Identify stakeholders	Analysis				x
Define outcomes	Analysis	x	x		
Identify barriers	Analysis	x			
Identify constraints	Analysis	x			
Prioritize needs	Analysis		x	x	x
Prioritize outcomes	Analysis		x	x	x
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation	x			
Gain empathy for processes	Analysis, Evaluation	x			
Understand context	Analysis	x			
Gain empathy for problems	Analysis	x			
Leverage past experiences	Design				
Explore opportunities	Design				
Frame insights	Design				
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation				
Iterate designs	Development, Implementation, Evaluation				
Pilot	Implementation, Evaluation				

Table D3.6 *(Red X indicates an addition to the model upon expert reviews)*

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Problem Framing

		Design Thinking Methods for Problem Framing			
Instructional Design Heuristics	**ADDIE**	**Problem Tree Analysis**	**Statement Starters**	**Abstraction Laddering**	**Rose, Thorn, Bud**
Identify problems	Analysis	x	x	x	x
Question the question	Analysis	x	x	x	
Identify stakeholders	Analysis				
Define outcomes	Analysis		x		x
Identify barriers	Analysis	x		x	x
Identify constraints	Analysis	x		x	x
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				x
Gain empathy for people	Analysis, Evaluation	x		x	x
Gain empathy for processes	Analysis, Evaluation	x		x	x
Understand context	Analysis				
Gain empathy for problems	Analysis	x		x	x
Leverage past experiences	Design				x
Explore opportunities	Design	x	x	x	x
Frame insights	Design		x		x
Prototype	Development, Implementation, Evaluation				
Seek feedback	Development, Implementation, Evaluation				
Iterate designs	Development, Implementation, Evaluation				x
Pilot	Implementation, Evaluation				x

Table D3.7 *(Red X indicates an addition to the model upon expert reviews)*

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Concept Ideation

		Design Thinking Methods for Concept Ideation			
Instructional Design Heuristics	**ADDIE**	**Thumbnail Sketching**	**Creative Matrix**	**Round Robin**	**Alternative Worlds**
Identify problems	Analysis				
Question the question	Analysis				x
Identify stakeholders	Analysis				
Define outcomes	Analysis				
Identify barriers	Analysis				
Identify constraints	Analysis				
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation				
Gain empathy for processes	Analysis, Evaluation				
Understand context	Analysis				
Gain empathy for problems	Analysis				
Leverage past experiences	Design				x
Explore opportunities	Design	x	x	x	x
Frame insights	Design			x	
Prototype	Development, Implementation, Evaluation	x			
Seek feedback	Development, Implementation, Evaluation			x	
Iterate designs	Development, Implementation, Evaluation			x	
Pilot	Implementation, Evaluation				

Table D3.8 *(Red X indicates an addition to the model upon expert reviews)*

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Modeling & Prototyping

		Design Thinking Methods for Modeling & Prototyping			
Instructional Design Heuristics	**ADDIE**	**Storyboarding**	**Schematic Diagramming**	**Rough & Ready Prototyping**	**Appearance Modeling**
Identify problems	Analysis				
Question the question	Analysis				
Identify stakeholders	Analysis				
Define outcomes	Analysis				
Identify barriers	Analysis				
Identify constraints	Analysis				
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation				
Gain empathy for processes	Analysis, Evaluation				
Understand context	Analysis				
Gain empathy for problems	Analysis				
Leverage past experiences	Design				
Explore opportunities	Design	x	x	x	x
Frame insights	Design	x	x	x	x
Prototype	Development, Implementation, Evaluation	x	x	x	x
Seek feedback	Development, Implementation, Evaluation	x	x	x	x
Iterate designs	Development, Implementation, Evaluation	x	x	x	x
Pilot	Implementation, Evaluation			x	

Table D3.9 *(Red X indicates an addition to the model upon expert reviews)*

The intersections of instructional design heuristics, ADDIE, and design thinking methods: Design Thinking Methods for Design Rationale

Design Thinking Methods for Design Rationale

Instructional Design Heuristics	ADDIE	Concept Poster	Video Scenario	Cover Story Mock-up	Quick Reference Guide
Identify problems	Analysis				
Question the question	Analysis				
Identify stakeholders	Analysis				
Define outcomes	Analysis	x			
Identify barriers	Analysis	x			
Identify constraints	Analysis	x			
Prioritize needs	Analysis				
Prioritize outcomes	Analysis				
Listen	Analysis, Evaluation				
Gain empathy for people	Analysis, Evaluation				
Gain empathy for processes	Analysis, Evaluation				
Understand context	Analysis				
Gain empathy for problems	Analysis				
Leverage past experiences	Design				
Explore opportunities	Design	x	x	x	x
Frame insights	Design	x	x	x	x
Prototype	Development, Implementation, Evaluation	x	x	x	x
Seek feedback	Development, Implementation, Evaluation	x	x	x	x
Iterate designs	Development, Implementation, Evaluation	x	x	x	x
Pilot	Implementation, Evaluation				

Table D4

A model of expert instructional design heuristics incorporating design thinking methods introduced within the ADDIE framework.

Changes to the original model are noted in red text. Additional explanations have been included for new methods and/or combinations of methods that were suggested for the revised model.

Analysis		
Heuristic	**Method Combination**	**Glossary of terms** (LUMA Institute, 2012)
Identify problems	Experience Diagramming **and** Rose, Thorn, Bud	**Experience Diagramming**: A way of mapping a person's journey through a set of circumstances or tasks. **Rose, Thorn, Bud**: A technique for identifying things as positive, negative, or having potential.
Question the question	Abstraction Laddering **and** Statement Starters	**Abstraction Laddering**: A way of reconsidering a problem statement by broadening or narrowing its focus. **Statement Starters**: An approach to phrasing problem statements that invites broad exploration.
Identify stakeholders	Stakeholder Mapping **and** Empathy Mapping	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **Empathy Mapping**: A way of mapping an individual users' perspective, which includes mapping what the user thinks, says, does, feels, and their pains and gains.
Define outcomes	Experience Diagramming **and** Bull’s-eye Diagramming	**Experience Diagramming**: A way of mapping a person's journey through a set of circumstances or tasks. **Bull's eye diagramming**: A way of ranking items in order of importance using a target diagram.
Identify barriers	Stakeholder Mapping **and** Experience Diagramming **and** Rose, Thorn, Bud	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **Experience Diagramming**: A way of mapping a person's journey through a set of circumstances or tasks. **Rose, Thorn, Bud**: A technique for

		identifying things as positive, negative, or having potential.
Identify constraints	Stakeholder Mapping **and** Experience Diagramming **and** Rose, Thorn, Bud	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **Experience Diagramming**: A way of mapping a person's journey through a set of circumstances or tasks. **Rose, Thorn, Bud**: A technique for identifying things as positive, negative, or having potential.
Either of the combinations listed below for *Prioritize needs* could be used. The first combination of methods proposed (Stakeholder Mapping, Empathy Mapping and Needs Statements) would be helpful in identifying specific people within a project or problem, empathizing with their individual perspectives, and identifying/prioritizing what each person needs as part of a new solution. The second combination (Stakeholder Mapping and What's on Your Radar?) would identify the stakeholders of a project or problem and employ those individuals to chart their individual needs as primary, secondary, or tertiary.		
Prioritize needs	Stakeholder Mapping **and** Empathy Mapping **and** Needs Statements	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **Empathy Mapping**: A way of mapping an individual users' perspective, which includes mapping what the user thinks, says, does, feels, and their pains and gains. **Needs Statements**: A technique for identifying the needs of individual or group needs, desires, and goals. *The user needs a way to do something that addresses their need so that they benefit directly*.
Prioritize needs	Stakeholder Mapping **and** What's on Your Radar?	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **What's on Your Radar?**: An exercise in which people plot items according to personal significance.
Prioritize outcomes	Bull's-eye Diagramming, **or** Importance/Difficulty matrix	**Bull's eye diagramming**: A way of ranking items in order of importance using a target diagram. **Importance/Difficulty Matrix:** A quad chart for plotting items by relative importance and difficulty.

Listen	Interviews **and** Contextual Inquiry	**Interviews**: A technique for gathering information through direct dialogue. **Contextual Inquiry**: An approach to interviewing and observing people in their own environment.
The individual methods that are separated by "**or**" below could all advance an instructional designer's empathy for people in any given order. One is better than none, but in most instances, a combination of methods is preferred. The first combination proposed could help instructional designers gain empathy for stakeholders of a project or problem, empathize with specific individual by developing Empathy Maps, and leverage unique points or commonalities in the development of Persona Profiles. Persona Profiles could help instructional designers anticipate needs of learners, as well as serve as an excellent tool to continually revisit throughout the process to ensure ideas and solutions are learner centered. The second combination of methods could help instructional designers experience what it is like to walk in the steps of a learner or stakeholder and identify the pros and cons of that experience in a Rose, Thorn, Bud. The insights from this method are then clustered and categorized in an Affinity Cluster, which could help instructional designers determine objectives and outcomes for learner interventions.		
Gain empathy for people	Interviews, **or** Fly-on-the-Wall Observations, **or** Contextual Inquiry, **or** Walk-a-Mile Immersion, **or** What's on Your Radar?, **or** Journaling	**Interviews**: A technique for gathering information through direct dialogue. **Fly-on-the-Wall Observations**: An approach to conducting field research in an unobtrusive manner. **Contextual Inquiry**: An approach to interviewing and observing people in their own environment. **Walk-a-Mile Immersion**: A way of building empathy for people through firsthand experience. **What's on Your Radar?**: An exercise in which people plot items according to personal significance. **Journaling**: An activity that invites people to record personal experiences in words and pictures.
Gain empathy for people	Stakeholder Mapping **and** Empathy Mapping **and** Persona Profiles	**Stakeholder Mapping**: A way of diagramming the network of people who have a stake in a given system. **Empathy Mapping**: A way of mapping an individual users' perspective, which includes mapping what the user thinks, says, does, feels, and their pains and gains. **Persona Profiles**: An informed summary of

		the mindset, needs, and goals typically held by key stakeholders.
Gain empathy for people	Walk-a-Mile Immersion **and** Rose, Thorn, Bud **and** Affinity Clusters	**Walk-a-Mile Immersion**: A way of building empathy for people through firsthand experience. **Rose, Thorn, Bud**: A technique for identifying things as positive, negative, or having potential. **Affinity Clusters**: A graphic technique for sorting items according to similarity.
Gain empathy for processes	Interviewing, **or** Fly-on-the-Wall Observations, **or** Contextual Inquiry, **or** Walk-a-Mile Immersion, **or** Experience Diagramming	**Interviews**: A technique for gathering information through direct dialogue. **Fly-on-the-Wall Observations**: An approach to conducting field research in an unobtrusive manner. **Contextual Inquiry**: An approach to interviewing and observing people in their own environment. **Walk-a-Mile Immersion**: A way of building empathy for people through firsthand experience. **Experience Diagramming**: A way of mapping a person's journey through a set of circumstances or tasks.
Understand context	Contextual Inquiry, **or** Concept Mapping	**Contextual Inquiry**: An approach to interviewing and observing people in their own environment. **Concept Mapping**: A way of depicting the relationships between various concepts in a given topic area.
Gain empathy for problems	Problem Tree Analysis **and** Affinity Clusters	**Problem Tree Analysis**: A way of exploring the causes and effects of a particular issue. **Affinity Clusters**: A graphic technique for sorting items according to similarity.
Design		
Interviews have been added as a method to *Leverage past experiences* as it could also be a useful method to learn about a learner or stakeholder's prior experience.		

Leverage past experiences	Alternative Worlds, **or** Interviews	**Alternative Worlds**: A way of using different perspectives to help generate fresh ideas. **Interviews**: A technique for gathering information through direct dialogue.
Explore opportunities	Statement Starters **and** Creative Matrix	**Statement Starters**: An approach to phrasing problem statements that invites broad exploration. **Creative Matrix**: A format for sparking new ideas at the intersections of distinct categories.
Explore opportunities	Persona Profiles **and** Creative Matrix	**Persona Profiles**: An informed summary of the mindset, needs, and goals typically held by key stakeholders. **Creative Matrix**: A format for sparking new ideas at the intersections of distinct categories.
The wording for this heuristic was modified from *Frame insights* to *Pitch ideas*. *Pitch ideas* more clearly represents the principles of this stage of the process. For this heuristic, instructional designers encourage collaborators to pitch a variety ideas to explore as new solutions to problems.		
Pitch ideas	Creative Matrix **and** Visualize the Vote	**Creative Matrix**: A format for sparking new ideas at the intersections of distinct categories. **Visualize the Vote**: A quick poll of collaborators to reveal preferences and opinions.
Pitch ideas	Statement Starters **and** Visualize the Vote **and** Round Robin	**Statement Starters**: An approach to phrasing problem statements that invites broad exploration. **Visualize the Vote**: A quick poll of collaborators to reveal preferences and opinions. **Round Robin**: An activity in which ideas evolve as they are passed from person to person.
Development		
Prototype	Storyboarding, **or** Concept Posters, **or** Schematic	**Storyboarding**: A series of images showing the key elements and interactions of a new scenario.

	Diagramming, **or** Rough & Ready Prototyping	**Concept Posters**: A presentation format illustrating the main points of a new idea. **Schematic Diagramming**: An outline of the structure and essential components of a system. **Rough & Ready Prototyping**: Rapidly built model(s) of new ideas or processes that approximate appearances and behaviors.
Implementation		
Pilot	Rough & Ready Prototyping **and** Rose, Thorn, Bud **and** Critique	**Rough & Ready Prototyping**: Rapidly built model(s) of new ideas or processes that approximate appearances and behaviors. **Rose, Thorn, Bud**: A technique for identifying things as positive, negative, or having potential. **Critique**: A forum for people to give and receive constructive feedback.
Evaluation		
Seek feedback	Think-Aloud Testing, **or** Heuristic Review, **or** Critique, **or** System Usability Scale, **or** Rose, Thorn, Bud	**Think-Aloud Testing**: A testing format where people narrate their experience while performing a given task. **Heuristic Review**: An auditing procedure based on ten rules of thumb for good design. **Critique**: A forum for people to give and receive constructive feedback. **System Usability Scale**: A short survey for quantifying feedback from subjective assessments of usability. **Rose, Thorn, Bud**: A technique for identifying things as positive, negative, or having potential.

Table Notes

And - *Denotes methods that are used in combination with one another.*

Or - *Denotes methods that can be used individually or in conjunction with one another, but in no order.*