Development of a Framework for Guiding Interaction Design in Distance Learning

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Abstract

As one of the most critical elements in distance learning, interaction has been identified empirically as increasing learner motivation, satisfaction, participation, communication, and achievement. Fostering pedagogically effective interaction is a major challenge for educators in distance learning. In response to this challenge, the goal of this research was to develop a theoretically- and empirically- grounded framework for guiding interaction design in distance learning. It is anticipated that this framework can assist educators and instructional designers in designing quality interaction in distance learning. This study employed a design and developmental research methodology with three phases: analysis, development and evaluation, and revision. Findings from a systematic literature review of peer-reviewed interaction theory and research in distance learning as well as expert review informed the building of a three-phase framework for guiding interaction instructional design in distance learning.

Dedication

To my parents, Minghui Li and Yanbing Pi.

I cannot succeed without your guidance, love, patience, and support.

To my husband, Qifan Yuan, and my son, Leonardo Muxiu Yuan.

Thank you for your support and motivating me to never give up.

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Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction and Need for the Study

There is a long history of research regarding the role of interaction in supporting learning. Early in 1916, Dewey proposed the value of interaction in educational settings, considering interaction as a defining element of education. Sims (1999) pointed out that interaction serves a variety of functions in the education transaction including allowing learner control, promoting various types of communication and supporting the development of learning communities. Interaction refers to "reciprocal events that require at least two objects and two actions. Interactions occur when these objects and events mutually influence one another" (Wagner, 1994, p. 8). By conducting a review of conceptual and operational definitions represented in 132 studies regarding interaction, Bannan-Ritland (2002) identified interaction as functions of increasing students' participation, facilitating communication, providing feedback as well as enhancing social exchange through instructional activities and technologies.

Distance learning is an important and growing part of educational practice (McIsaac & Gunawardena, 2000; Simonson, Smaldino, Albright, & Zvacek, 2012). In recent decades, distance learning studies have placed increasing emphasis on interaction. In reviewing distance learning studies, Saba (2000) concluded that "a common theme in distance learning is interaction, which indicates its centrality in conceptualizing in the process of teaching and learning" (p. 4). Thus, interaction plays a critical role in learning, including distance learning, and instructional designers and educators need to call on interaction to support certain teaching and learning processes.

Need for the Study

Firstly, many studies have supported the relationship between interaction and effective learning and identified interaction as having the potential to increase learner satisfaction, participation, communication, and social presence (Fortin & Dholakia, 2005; Jung, Choi, Lim, & Leem, 2002; Swan, 2002; Tu, 2001). In addition, effective interaction enables learners to develop higher-order thinking skills including cognitive skills (Henri, 1992), critical thinking skills (Garrison, Anderson, & Archer, 2001; Newman, Webb, & Cochrane, 1995), cognitive presence (Garrison & Cleveland-Innes, 2005; Gunawardena & Zittle, 1997), and knowledge construction (Gunawardena et al., 1997). However, not every interaction is meaningful and, therefore, presents the best chance of leading to increased learning (Woo, 2007). Researchers claim that the lack of design guidelines hinders improvements in interaction qualities in distance learning (Bannan-Ritland, 2002; Roblyer, 2003; Wagner, 1994). In order to foster effective interaction in distance learning, research contributing to effective interaction design is in great need.

Secondly, interaction is important to the effectiveness of distance learning (Anderson, 2003b; Moore, 1989; Wagner, 1994). Based on transactional distance theory (Moore, 1993), one of the foundational theories in distance learning, the distance of importance in distance learning is not the geographical separation of learners and instructor, but rather the intellectual distance, the social distance, and the cultural distance (Kearsley & Moore, 1996; Moore, 1989). One solution to minimize psychological distance in distance learning is to adopt appropriate instructional strategies and technologies to foster interaction. However, facilitating interaction poses challenges to educators. Developing a framework for interaction design in distance learning supports the appropriate selection and use of interaction tools and strategies by distance learning instructors and instructional designers.

Thirdly, because of the geographical separation of learners and instructor contributing to greater intellectual, social, and even cultural distance (Moore, 1993, Swan, 2002), interaction in distance learning is more complex than in learning environments supporting real-time, in-person interactions because of the lack of nonverbal cues and the required use of potentially unfamiliar technologies (Kearsley, 1995). These varied aspects of distance create a need for researchers and practitioners to investigate effective ways to foster effective interaction in distance learning.

Furthermore, the lack of a clear and operational definition of interaction has prevented the interaction design in distance learning. Interaction's definition is a complex one based on many disciplines touching on communication, psychological, social, technical, and cultural dimensions (Anderson, 2003b; Muirhead & Juwah, 2004). Considering the large number of variables related to the construct of interaction, the definition of interaction is still not agreed upon (Soo & Bonk, 1998). Also, the concept of interaction has broadened from the classroom-based dialogue between students and teachers to include technology-mediated interaction in distance learning (Anderson, 2003b). The capabilities enabled by emerging technologies provide new interaction opportunities for learning and encourage distance educators to revisit the concept and use of interaction in the distance setting. An operationalized definition of interaction in distance learning that is well grounded in learning theory is needed to support the effective interaction design.

In addition, there are a considerable number of studies related to interaction in distance learning grounded in some form of theoretical basis (Anderson, 2003; Hillman & Gunawardena, 1994; Moore, 1989; Sutton, 2001; Wagner, 1994). However, fewer studies have been completed to help connect theory to practice in this area. One reason given in interaction distance learning

research is “the difficulty of designing assessment and evaluation tools that build on a solid theoretical framework” (Roblyer, 2003, p. 79).

Lastly, many researchers has viewed interaction quantitatively; for example, through counting the number of postings, length of messages, number of messages per student, frequency of messages, and learners’ average access time online (Ahern & Durrington, 1995; Arbaugh, 2000; Harasim, 1987, Howell-Richardson & Mellar, 1996, Picciano, 2002). However, the quality of interaction is difficult to interpret from these types of data. A reliable and valid framework for guiding interaction design in distance learning is needed to aid researchers, instructors, and instructional designers for future study and practice.

Purpose Statement of the Study

The goal of this research was to develop a theoretically- and empirically-grounded framework for guiding interaction design in distance learning. It is anticipated that this framework can assist educators and instructional designers to design, and evaluate for, quality interaction in distance learning. This study employed a model (formerly referred to as Type 2) design and development research approach with the following three phases: analysis, development and evaluation, and revision (Richey & Klein, 2007).

Research Questions

The research question for this study was: What features would a framework for designing interaction in distance learning have? An underlying assumption is that interaction, in this instance, is meant to support what is known about effective teaching and learning.

Benefits of the Study

The benefits of this study include providing guidance and support for educators to design interaction in distance learning. The study will help practitioners transfer theory into practice

regarding interaction in distance learning. The implementation of the resulting framework should have the positive impact of promoting quality teaching and learning practices in distance learning. Findings will also advance research in interaction in distance learning in that the framework can identify key variables of interest for future inquiry.

Organization of the Proposed Study

Chapter 1 has provided background information and the need for the study, the purpose statement, research questions and anticipated benefits. Chapter 2 presents a critical review of literature related to this study. It includes three sections. The first section focuses on an overview of interaction in teaching and learning, including definitions and theoretical underpinnings. The second section describes the findings of interaction research in education, especially in distance learning, and discusses implications for both researchers and practitioners. The third section investigates measures and instruments used for evaluating interaction in education and particularly in distance learning. Chapter 3 presents the methodological approach that was employed in this study. It includes the research design; the study procedure; sample and sampling procedures, research instruments, and data collection and analysis techniques. Chapter 4 presents the findings from a systematic literature review during the analysis phase, along with the development process of the original interaction design guidance framework. Chapter 5 analyzes the feedback obtained from expert reviewers, along with the discussion of how the feedback was incorporated into to a revised interaction framework. Chapter 6 presents the limitations of the study, and the contributions of the study, as well as the recommendations for future research and practice.

Chapter 2

Review of Literature

The purpose of this study was to develop a theoretically- and empirically-grounded framework for guiding interaction design in distance learning. This chapter includes three sections: the theoretical background of interaction in learning, research regarding interaction in distance learning, and the major methods, measures, and instruments for evaluating interaction quality in distance learning.

Specifically, this review of the literature addressed the following questions:

- How is interaction in learning defined? What are the theoretical underpinnings of interaction? What is the role of interaction in education and, specifically, distance learning?
- What does empirical research have to tell us regarding interaction in education, and especially distance learning; for example, the desired outcomes of interaction, factors affecting interaction, strategies supporting interaction, etc.?
- What are the major methods, measures, and instruments for evaluating interaction quality in distance learning?

Interaction

Challenges for defining interaction. A challenge facing many educators and researchers is how to derive a common functional definition of interaction (Anderson, 2003a; Bannan-Ritland, 2002; Hirumi, 2002; Wagner, 1994). The lack of a definition has challenged the application of relevant theory to instructional design practices, limited research efforts, and hindered teaching and learning improvements in interaction qualities (Bannan-Ritland, 2002; Roblyer, 2003; Wagner, 1994).

For the past several decades, the definition of interaction has been revisited and refined. However, the term is still not well defined. In 1994, Wagner raised the issue of defining interaction and stated "one of the major difficulties surrounding the discussion of interaction and interactivity is that these terms while widely used, have not been clearly or functionally defined" (p. 6). Moore (1989) also expressed concern about the definition of interaction and claimed that the term interaction "carries so many meanings as to be almost useless unless specific sub-meanings can be defined and generally agreed upon" (p. 1).

One reason for the lack of a clear definition is the complex nature and multifaceted construct of interaction (Soo & Bonk, 1998). Interaction is connected to many disciplines, touching on communication, psychological, social, technical, and cultural dimensions (Anderson, 2003b; Muirhead & Juwah, 2004). Considering its complexity, it is not surprising that interaction has been defined in many ways.

Another reason is that the concept of interaction has been broadened in light of the development of technologies. The rapid growth of technologies has promoted unique opportunities to foster interaction and enabled interaction to evolve from face-to-face unmediated dialogue between students and the teacher to technology-mediated interactions such as computer-based and web-based interaction (Anderson, 2003b; Beldarrain, 2006; Rafaeli, 1988). The nature of interaction in technology-mediated environments is more complex than in traditional education (Kearsely, 1995).

Further, some closely allied terms such as interactivity, social presence, and transaction cause further confusion about the understanding of interaction. Researchers have difficulty distinguishing the concept of interaction from these terms. So, interaction, interactivity, social presence, and transaction are often used interchangeably (Anderson, 2003a; Roblyer, 2003).

In addition, researchers claim that the lack of a sound theoretical basis hinders promoting a common definition (Roblyer & Wiencke, 2003; Wagner, 1994). An examination of interaction grounded in relevant instructional design, instructional theory, learning theory, and instructional delivery is necessary (Sargeant, Curran, Allen, Jarvis-Selinger & Ho, 2006; Wagner, 1994).

Face-to-face & Technology-mediated interaction. Historically, interaction mainly focused on learner-instructor interaction in the face-to-face classroom (Anderson, 2003b). With technology developments, there is wide recognition that interaction can be supported by the use of technologies. Therefore, interaction can take diverse forms such as synchronous interaction and asynchronous interaction (Kearsley, 1995). The concept of interaction has evolved from the dialogue between students and instructors in traditional classroom-based setting and has been broadened to include technology-mediated interaction in distance learning (Anderson, 2003a).

Face-to-face interaction is different from technology-mediated interaction. Firstly, face-to-face interaction is primarily based on the use of oral discourse (Bretz & Schmidbauer, 1983; Farahani, 2003; Restauri, 2006; Vrasidas, 1999; Vrasidas, & Zembylas,2003). However, technology-mediated interaction is mainly constructed in the form of written communication (McIsaac & Gunawardena, 2000). The nature of written communication supports the possibility of greater levels of interaction effectiveness in terms of reflection, critical thinking, and group problem solving (Chou, 2002; Gilbert & Moore, 1998; Jonassen, 2001; Markus, 1994).

Secondly, communication in face-to-face interaction typically employs the turn-taking system (Bretz & Schmidbauer, 1983; Kendon, 1990; Sacks, Schegloff, & Jefferson, 1974; Winiecki, 2003). Learners usually take turns in communication, which presents a linear sequence. However, multiple interactions can process simultaneously in technology-mediated environments (Picciano, 2002; Walther, 1996). For example, learners can post comments on the

discussion forum at the same time in a computer-mediated communication. Accordingly, more equitable participation and greater group member contributions are encouraged in technology-mediated interaction (Lally, 1999; Lapadat, 2002; Luppicini, 2007; Walther, 1996).

Control is considered as another major distinction between face-to-face interaction and technology-mediated interaction (Gilbert & Moore, 1998; Hannafin, 1989; Livengood, 1987; McMillan & Hwang, 2002; Wagner, 1994). Control refers to "having choices and making decisions as well as having the necessary contextual support and capability to successfully achieve the intended learning outcome" (Anderson & Garrison, 1998, p. 99). The level of interaction greatly depends on the amount and variety of available control (Sims, 1997). In face-to-face settings, the instructor usually takes the role of controlling the pace and complexities of interaction (Berge, 1999; Gilbert, 1998). With the emergence of new technologies, more content and navigational tools allow learners to exercise more choices over the depth of study, sequence of instruction, control of pacing, and style of presentation (Gilbert, 1998; Wagner, 1994; Sims, 1997).

Further, greater flexibility is allowed in technology-mediated interaction (Chou, 2002; Kiousis, 2002; Vrasidas, & Zembylas, 2003; Walther, 1996). With the help of technologies, the instructor and learners are not necessary to be simultaneously in the same physical place at the same time. Technology makes it possible to extend interaction beyond class time. Learners cannot only interact at school, but can also interact outside the formal educational setting on their own schedules. Learners can contribute and participate as much as they wish to the discussion without the limited amount of time in face-to-face interaction (Lapadat, 2002). Therefore, more interaction opportunities are provided because learners can access and process interaction no matter where they are or what time it is (Walther, 1996).

Other than these potential advantages, technology-mediated interaction also has disadvantages. Firstly, nonverbal cues in face-to-face interaction are absent in technology-mediated interaction (Swan, 2002). Nonverbal cues such as facial expression, gestures, eye contact, intonations are not only important in conveying information but also maintaining students' engagement (Rezabek & Cochenour, 1998). Mehrabian (1971) found that more intensive and immediate interactions could be promoted by nonverbal cues, through which sensory stimulation is increased. Nonverbal cues are also critical in developing a sense of community among students since they support more cohesive interaction (Duemer et al., 2002; Jonassen, 2001). The lack of nonverbal cues hinders or complicates interaction in technology-mediated environments to some extent (Sutton, 2001).

Additionally, technology-mediated interaction adds complexities and challenges to students' learning experiences because certain skills and abilities are required for learners in order to be competent users of technology. Mahesh and McIsaac (1999) found that students with more computer experience interacted more than less experienced students. Hillman et al. (1994) addressed this issue by adding learner-interface interaction as a fourth types of interaction, which emphasizes that successful technology-mediated interaction largely depends on "how comfortable the learner feels in working with the delivery medium" (Hillman et al., 1994, p. 32). Facilitating effective technology-mediated interactions is heavily based on the effective use of technologies.

In sum, there are substantial differences between face-to-face interaction and technology-mediated interaction due to the dimension of physical presence. With the help of technologies, the level and amount of interaction, the degree of learner control, and flexibilities in time and space can potentially influence teaching and learning. On the other hand, technology-mediated

interaction can be more complex and challenging than face-to-face interaction due to the lack of nonverbal cues and the required use of potentially unfamiliar technologies. A framework for guiding interaction design in distance learning should take these attributes into account.

Categorizing definitions of interaction. Interaction has been defined in many ways. Overall, interaction definitions can be broadly divided into three categories: definitions that focus on communication, definitions that focus on learning entities, and definitions that focus on purposes and functions.

Definitions that focus on communication. Interaction fundamentally involves communication between the teacher and learners, and among learners (Berge, 1999; Wagner, 1994). Some researchers have defined interaction as two-way communication among two or more persons (Chou, 2004; Northrup, 2002; Wagner, 1994). For example, according to Daniel and Marquis (1988), interaction refers to "activities where the student is in two-way contact with another person" (p. 339).

In addition to two-way communication, reciprocity is another important element in defining interaction that cannot be ignored (Simpson, 1986; Vrasidas, & McIsaac,1999). Wagner's (1994) description is one of the most representative definitions of interaction in the literature. He explicitly defined interaction as "reciprocal events that require at least two objects and two actions. Interaction occurs when these objects and events mutually influence one another" (p. 8). Reciprocity is the essential component and the nature of interaction (Anderson, 2003b).

Some researchers characterize key features of interaction in light of communication models initially developed by Shannon (1949). Given such a model, the process of communication is viewed as a system with the sender, the receiver, signal transmission, noise and feedback. In most educational settings, information is delivered from an instructor through

signals such as video, audio or text to students. The feedback between the sender and the receiver forms a complete interactive loop (Wagner, 1994). This model is very helpful for researchers to conceptualize the mechanics of interactive process (Roblyer & Wiencke, 2003; Wagner, 1994; Yacci, 2000). From this perspective, Yacci (2000) defined interaction as "completed message loops between two entities" (p. 3). Further, Yacci (2000) emphasized that feedback is a defining characteristic of interaction. Many researchers have supported the importance of feedback in defining interaction (Simonson, Smaldino, Albright, & Zvacek, 2000; Swan, 2002; Vrasidas, & McIsaac,1999; Wagner, 1994).

Definitions that focus on learning entities. Interaction defined as an instructional exchange between entities is the predominate framework in distance learning. The concept of interaction is conceptualized by addressing key learning agents affected by interaction in the learning cycle (Wagner, 1997).

Moore's three types of interaction. Moore (1989) expressed concerns about the definition of interaction and went a step further to identify three types of interaction that impact learning: learner-content interaction, learner-instructor interaction, and learner-learner interaction. It is the most widely known model of interaction in distance learning. This definition emphasizes with whom or with what interaction occurs in distance learning (Wagner, 1997). According to Moore (1989), "learner-content interaction is a basis for all types of education" (p. 2). Learning occurs when learners interact with content, which can take various forms such as reading texts, watching videos, etc. The second type is learner-instructor interaction, the purpose of which is to "motivate, stimulate, and facilitate educational activities and strategies" (Moore, 1989, p. 3). In traditional classroom-based environments, learner-instructor interaction mainly refers to dialogue between students and instructor. In distance learning, technologies enable learners to interact

with the instructor by email, telephone, videoconferencing, etc. The third type refers to "interaction between one learner and other learners" (Moore, 1989, p.4). It has been viewed as a missing ingredient in correspondence study, the first generation of distance learning. As technologies developed, learners became able to exchange and share information with each other. Moore (1989) stated that learner-learner interaction is an essential element for learning. The three types of interaction identified by Moore (1989) provide a general way to categorize the "transactions that are typically involved in a distance learning endeavor" (Wagner, 1997, p. 21). Most interaction studies in distance learning have been based on these three types of interaction.

Learner-interface interaction. Hillman and Gunawardena (1994) argued that Moore (1989) failed to consider interaction that occurred when a learner uses technology to interact with the content, instructors, and other learners. They suggested that emerging technologies in distance learning necessitate a fourth type of interaction, learner-interface interaction. Learner-interface interaction refers to "the access, skills, and attitudes necessary for successful online interaction" (Hillman & Gunawardena, p. 33). However, Anderson (2003b) argued that learner-interface interaction is a component of the other types of interaction rather than a unique type of interaction.

Vicarious interaction. Sutton (2001) defined a fifth interaction type as vicarious interaction in computer-mediated communication setting. Sutton (2001) observed that not all students can benefit from direct interaction. Instead, "certain students who are reluctant to participate in overt interaction may benefit from interacting vicariously" through observing and cognitively processing the interaction of other participants (p. 8). Sutton (2001) defined this form of interaction as vicarious interaction. It refers to "student activity [that] processes both sides of a direct interaction between two other students or between another student and the instructor" (p.

4). Vicarious interaction seems to serve as a supplemental type of interaction. Anderson (2003b) argued that vicarious interaction can only occur on the premise of combination with other types of interaction. Therefore, it is a variation on all types of interaction rather than a distinct type of interaction.

Others. Besides the most influential modes of interactions discussed previously, there are some other interaction types that cannot be ignored. Northrup and Rasmussen (2000) classified interaction as four types: student to student, student to instructor, student to instructional materials, and student to management interaction. From the instructor's perspective, Mortera-Gutierrez and Murphy (2000) defined interaction as instructor-facilitator interaction, instructor-peers interation, interaction betweeen instructor-support staff and technical personnel, and instructor-organization interaction.

Various taxonomies have been developed for classifying interactions in classroom-based and distance learning; however, little attention has been paid to synthesize a comprehensive set of interactions. Hirumi (2002) recognized this issue by proposing a three-level framework, which effectively details the relationship among the existing taxonomies. The framework consists of three basic and interrelated interactions: learner-self interactions, learner-human and non-human interactions, and learner-instruction interactions. Level one, labeled learner-self interaction, occurs within each individual learner. Level two refers to the interaction that "occurs between the learner and other human and non-human interactions" (Hirumi, 2002, p. 144). There are six types of interaction in level two: learner-instructor interaction, learner-learner interaction, learner-other human interaction, learner-content interaction, learner-interface interaction, and learner-environment interaction. Different from the level one and level two, the third level is

learner-instruction interactions aimed to help distance educators design and sequence level one and level two interactions with theoretical strategies.

Definitions that focus on purposes and functions. Although focusing on learning entities of interaction can help practitioners, educators and researchers define interaction in terms of the "who" and "what" involved in a transaction, the nature of interaction in educational settings is still not interpreted explicitly. Wagner (1997) advocated that the concept of interaction should shift from learning agents to learning outcomes, especially in the information age, since such a shift could aid in employing instructional methods to improve learning performance. Therefore, instead of focusing on learning entities involved in the interaction process, some researchers define interaction in terms of purposes and functions.

Interaction and interactivity. In 1987, Herring suggested distinguishing two categories of interaction: the property of learning events and the property of the media. Wagner (1994) supported Herring's (1987) view by stating that this focus on a functional perspective, rather than a philosophical perspective, would be more beneficial to improve learning outcomes. Therefore, Wagner (1989) used the term interaction and the term of interactivity to make a distinction. Wagner (1989) stated, "Interaction functions as an attribute of effective instruction" (p. 6). It is defined in terms of the learning process, focusing on instructional interaction that was intended to "change the learner's behavior toward an educational goal" (p. 8). Interactivity, on the other hand, "functions as an attribute of the instructional delivery system or technology" (p. 7). The distinction between interaction and interactivity was important for researchers who investigated technological attributes to increase instructional interaction (Roblyer & Wiencke, 2003). Despite researchers' attempts to clarify the differences between interaction and

interactivity, the use of this distinction in the literature is very limited. The terms of interaction and interactivity are often used interchangeable (Anderson, 2003a; Roblyer & Wiencke, 2003).

Social interaction and instructional interaction. Some researchers categorized interaction in two dimensions: social interaction and instructional interaction (Berge, 1999; Gilbert, 1998). Social interaction refers to social exchanges between students and the teacher, or among students such as body language, exchanging personal information, greetings, etc. Social interaction may not directly contribute to the learning goals of instruction; however, they help to build a more positive learning atmosphere (Berge, 1999). Other types of social interaction such as facial expressions and gestures serve to convey information and provide feedback to students. On the other hand, instructional interaction concerns "both teacher control of content delivery and learner control of processes that related to the presentation of and response to instructional content" (Gilbert & Moore, 1998, p. 31). Some elements of instructional interaction include questioning, answering, pacing, sequencing, and branching. Gilbert (1998) claimed that both social interaction and instructional interaction are necessary for learning.

Others. Other researchers demonstrate a similar view in defining interaction through functions and purposes, but from different perspectives and contexts. For example, Wagner (1997) suggested twelve types of interaction focused on learning outcomes: interaction for participation, communication, feedback, elaboration and retention, self-regulation, motivation, negotiation of understanding, team building, discovery, exploration, clarification of understanding and closure. Hannafin (1989) listed five functions for computer-based interaction that include confirmation, pacing, inquiry, navigation and elaboration. Some researchers view interaction from the instructional designer's perspective. For example, Sims (1997) identified types of interaction such as object interaction, linear interaction, support interaction, update

interaction, construct interaction, reflective interaction, simulation interaction, hyperlinked interaction, non-immersive contextual interaction, and immersive virtual interaction. Researchers who emphasize the contexts for interaction categorize interaction into individual interaction and social interaction (Bates, 1990) or synchronous and asynchronous interaction (Kearsley, 1995). In computer-mediated communication contexts, Gunawardena, Lowe, and Anderson (1997) considered interaction as "the vehicle of the co-construction of knowledge" (p. 428).

The conceptualization of interaction is the basis for evaluating observable and measurable interaction qualities in distance learning. A clear and functional definition of interaction can better guide the development of a framework for designing interaction.

Conceptualizing interaction based on learning theories. In order to provide a thorough understanding of interaction, a review of theoretical underpinnings of interaction is necessary. In 1994, Wagner issued a call for examination of the definition of interaction based on "learning theory, instructional theory, instructional design and instructional delivery" (p. 25). Conceptualizing interaction based on learning theories, as Woo (2007) suggested, may yield the interaction content most meaningful to learning and greatly improve the quality of interaction in learning.

Socio-constructivist theory. One perspective on the meaning of interaction comes from socio-constructivist theory. Socio-constructivist theory is based on Piaget's (1937, 1959) work. An assumption of socio-constructivist theory is that "knowledge is invented and reinvented as the child develops and interacts with the world surrounding her" (Driscoll, 2005, p. 171). According to socio-constructivist theory, interaction with peers is an important source for cognitive development (Driscoll, 2005). Piaget (1959) identified three mechanisms that explained how conceptual understanding changed when students interacted with the environment

and integrated these experiences into their understanding. These three processes are assimilation, accommodation and equilibration. Assimilation occurs when learners receive new knowledge and use the existing cognitive structure, whereas accommodation occurs when learners modify existing schemes in order to accommodate new knowledge. Equilibration is a process for dealing with conflicting understandings through engagement in assimilation and accommodation. Socio-constructivist theory implies the importance of social interactions in cognitive development.

Socio-cultural theory. Socio-cultural theory was greatly influenced by the work of Vygotsky (1978). The fundamental assumption of socio-cultural theory is that knowledge is constructed through social interaction and cannot be separated from cultural contexts (Vygotsky, 1978). As Vygotsky (1978) stated, "all the higher functions originate as actual relations between individuals" (p. 57).

There are three concepts fundamental to social-cultural theory: mediation, internalization and the zone of proximal development. The learner internalizes social relations into psychological functions through mediation, which means an individual actively modifies a stimulus as part of responding to it. Higher mental processes are created when mediation becomes increasingly internal. According to socio-cultural theory, the zone of proximal development is defined as the gap between the learner's capacity to solve problems independently and capacity to solve them with others' guidance and collaboration (Vygotsky, 1978). Scaffolding and intersubjectivity are critical to the zone of proximal development. Scaffolding is meant to help learners through support from the instructor or more advanced peers. On the other hand, intersubjectivity is another type of social interaction through which learners can share understandings of a task, co-construct the solution to a problem, or share in joint decision making. As learners construct knowledge, scaffolding from the instructor and sharing

knowledge with other learners is required for learners to bridge the gap between their current skill and a desired skill. Thus socio-cultural theory implies the importance of learner-learner interaction and leaner-instructor interaction. In addition, cognitive development is enhanced when instruction is designed in an individual's zone of proximal development.

An appreciation for the social aspects of learning theory can inform the selection and design of interaction in learning experiences.

Major theoretical developments of interaction in distance learning. Interaction is fundamental to the effectiveness of learning, including distance learning. One important design challenge revealed through distance learning research is supporting important connections across learners and teachers that are more easily fostered face-to-face (Dennen & Wieland, 2007). In distance learning, students are separated from the point of instruction (Swan, 2002). As a result, distance learning can benefit from interaction to minimize psychological distance (Beldarrain, 2006).

Interaction is crucial to the success or failure of distance learning through its ability to improve learners' higher order thinking skills and knowledge construction, as well as increase learners' motivation and satisfaction (Fahy, Crawford, & Ally, 2001; Garrison, Anderson, & Archer, 2001; Garrison & Cleveland-Innes, 2005; Gunawardena et al., 1997; Henri, 1992; Newman, Webb, & Cochrane, 1995). Therefore, distance learning studies have placed increasing emphasis on interaction over the past several decades. Interaction is considered as one of the most critical elements in distance learning (Sims, 1999; Wagner, 1994). In this section, the major theoretical developments and contributions that have influenced the concept of interaction in distance learning are discussed.

Guided didactic conversation. Early in 1983, Holmberg, a prominent theorist in distance learning, proposed the theory of guided didactic conversation. This theory has shifted the emphasis from the directional transmission model to a mediated relationship between the instructor and students in distance learning.

The concept of guided didactic conversation is central to Holmberg's (1983) theory. It refers to both real and simulated conversation. Holmberg (1983) asserted that the interaction between the instructor and students should have simulated conversational style in the written learning materials. In other words, instructors should write dialogue and comments for learners. At this stage, Holmberg (1983) emphasized the interaction for individual learning rather than social interaction. The didactic text is viewed as the oldest form of learner-content interaction (Moore, 1989).

Transactional distance theory. Another pioneering theory, transactional distance theory, (Kearsley & Moore, 1996; Moore, 1989), is one of the foundational theories in distance learning. According to transactional distance theory, the distance in distance learning is not the spatial or temporal separation of learners and instructor, but rather the pedagogical distance, the social distance and the cultural distance.

Moore (1989) posited transactional distance is determined by three elements: dialogue, structure and learner autonomy. Dialogue refers to the interaction between the instructor and learners. Structure concerns the course design elements. The success of distance learning largely depends on the degree of dialogue and the amount of structure. As dialogue and learner control increase, transactional distance decreases. Saba and Shearer (1994) conducted a research to validate transactional distance theory empirically. The findings showed that "transactional distance varies by the rate of dialogue and structure" (p. 54).

Under the influence of transactional distance theory, interactive telecommunications media has been highly developed in distance learning. With the introduction of teleconference media, learner-instructor interaction is more dialogic and less structured. Transaction theory that emphasizes the interplay among elements helps distance educators define interaction (Roblyer, 2003).

Summary: Features, defining elements of interaction. Currently, the definition of interaction still challenges educators, practitioners and researchers. From a review of literature, three approaches of defining interaction were presented: definitions that focus on communication, definitions that focus on learning entities, and definitions that focus on purposes and functions. Although the concept of interaction has been defined differently by researchers, the basic elements that comprise the concept of interaction are the same. Firstly, interaction occurs among two or more participants or objects, which can be the instructor, students, content and technologies. Secondly, interaction is reciprocal, as reflected by two-way communication. Thirdly, the purpose of interaction is to facilitate social connections and achieve instructional goals. Lastly, interaction is facilitated by instructional strategies and mediated by technologies.

To sum up, interaction can be defined as two-way communication between students and the instructor, students and the content, or among students, that is facilitated by instructional strategies and mediated by technologies with the purposes of achieving instructional goals and social connections. The definition of interaction should be based on empirical evidence as well as relevant theories such as social-constructivist theory and socio-culture theory (Wagner, 1994; Woo, 2007).

Research in Interaction

More and more studies have been conducted to examine the role of interaction in education, especially in distance learning. Current research on interaction in distance learning mainly focuses on three areas: outcomes of interaction, factors that affect interaction and instructional strategies for supporting interaction.

Outcomes of interaction. Research that investigates the relationship between interaction and satisfaction is considerable. Fulford and Zhang's (1993) study is considered as the most representative one among these studies. They examined the relationship between learners' perception of interaction and satisfaction in a course delivered by interactive television. The results showed that students' perception of interaction played an important role in satisfaction in distance learning. Learners were more satisfied with instruction when they perceived the level of interaction to be high. Fulford and Zhang (1993) also found that the perception of interaction was as important as actual interaction. These findings emphasize the importance of providing strategies to increase learners' perception of interaction in distance learning if high learner satisfaction is the desired outcome.

Some researchers focus their studies on the effects of different types and amount of interaction on learners' satisfaction, achievement, participation and attitudes (Jung, Choi, Lim, & Leem, 2002; Swan, 2002). These studies indicate that learners' satisfaction and participation increase as greater amounts of interaction are provided by the course. In addition, all learners showed positive attitudes towards interaction after completing online learning courses. In these studies, there was also evidence that learner-learner interaction contributed more to learner satisfaction than learner-instructor interaction.

Besides satisfaction, some researchers find that interaction is associated with students' perceived learning in distance learning. To examine the correlation between students' perceived learning and interaction, Swan (2002) collected data from 73 courses and found that there was a strong correlation between students' perceptions of interaction and students' perceived learning. That is, students who perceived interaction be higher, also reported higher levels of perceived learning.

Currently, studies have placed increasing focus on the outcomes of interaction through the analysis of higher-order thinking. These issues include cognitive skills, critical thinking, cognitive presence, and knowledge construction. (Fahy, Crawford, & Ally, 2001; Garrison, Anderson, & Archer, 2001; Garrison & Cleveland-Innes, 2005; Gunawardena et al., 1997; Henri, 1992; Newman, Webb, & Cochrane, 1995). In seeking for evidence of higher-order thinking within in a computer-mediated communication environment, Meyer (2003) analyzed online discussions based on the model developed by Garrison et al. (2001). Findings showed that 51% of the postings were coded as exploration, 22% as integration, and 7% as resolution. This study indicated that higher order thinking can and did occur in online interaction. Newman et al. (1995) reported similar findings. They investigated critical thinking in computer conferencing groups and found that online discussion groups exhibited a high level of critical thinking. Ng and Murphy (2005) also found evidence that online interaction can support cognitive and meta-cognitive dimensions such as critical thinking, reasoning skills and problem solving.

Numerous studies confirm that interaction can facilitate higher-order thinking in distance learning environments; however, other studies report conflicting findings. For example, Gunawardena and Zittle (1997) examined the relationship between social construction and interaction in an asynchronous environment. They analyzed students' online discussion

transcripts utilizing content analysis methods and concluded that most participants only shared information rather than constructed knowledge. Similarly, in Angeli's (2003) study, little evidence showed that critical thinking occurred through online interaction. Instead, most postings were exchanges of personal experiences.

In sum, the outcomes of interaction have been examined in terms of such learner variables as satisfaction, attitudes, perceived learning, and higher order thinking. Most early research in this area has focused on exploring the affective domain. Much fewer studies have examined cognition. More research concerning the cognitive outcomes of interaction is needed. In addition, identifying the desired outcomes of interaction may prove useful to including in a framework supporting the design of interaction in distance learning environments.

Factors that affect interaction. Research on factors impacting interaction is also prevalent in the literature. These factors can be organized into three areas: individual learner differences, learning context variations, and media differences. To begin, researchers find that differences in prior knowledge and gender affect learners' needs for interaction as well as the effectiveness of interaction (Comeaux, 1995; Herring, 1995; Monson, 2003, Tsui & Ki, 1996).

Individual learner differences. Learners' prior knowledge is an important factor that impacts interaction in distance learning (Anderson & Lee, 1995; Comeaux, 1995; Monson, 2003; Ritchie, 1993; Tsui & Ki, 1996; Vrasidas, & McIsaac, 1999). Vrasidas and McIsaac (1999) found that students with more online learning experience interacted with students and teachers much more frequently while less experienced students paid more attention to technologies than the content of communication. Also, learners with limited prior knowledge with computer-mediated communication preferred participating in asynchronous interactions over synchronous interactions because asynchronous communication allows more time to think and reflect on their

ideas. Another interesting finding from Tu and McIsaac's (2002) study was that, students felt more comfortable and participated more in the discussions when they were more familiar with the discussion topics.

Gender is another factor that influences the success of interaction (Chou, 2004; Farahani, 2003; Herring, 1994; Herring, 1995; Jeong & Davidson-Shivers, 2006; Monson, 2003). Herring (1994) looked at the differences regarding interaction style between male and female. She found that males perceived online interactions as opportunities for self-promoting and assertive behaviors more so than females. Monson (2003) added that females perceived feedback more important than males, while males perceived discussion more important than females. Some researchers noticed that females posted significantly more messages than males in synchronous communication and asynchronous communication (Arbaugh, 2000; Chou, 2002; Im & Lee, 2004). In addition, females tend to participate more collaboratively in discussion, whereas men engage more competitively in discussion (Arbaugh, 2000).

Learning context variances. Class size is central to the density and intensity of interaction (Fahy et al., 2001; Orellana, 2006). Vrasidas and McIsaac (1999) claimed that large class size inhibited high interaction. As the group size increased, individual interaction decreased. Similar findings were reported by Chen and Willits (1999). Orellana (2006) conducted a study to examine the relationship between class size and interaction for 131 online classes. The results showed that a class size of 16 was perceived to be the best class size for optimal interaction. However, some studies reveal that optimal class size varies with delivery modes. For example, Tu and McIsaac (2002) concluded that real-time discussions should be limited to two or three participants.

Some studies make the point that including a schedule of face-to-face meetings in distance learning environments leads to less online interaction due to the opportunities of having face-to-face discussions with peers and instructors offline (Angeli, 2003; Levin, Kim, & Riel, 1990; Vrasidas, & McIsaac, 1999). Likewise, Levin et al. (1990) even concluded that successful distance learning is based on the premise that participants cannot meet face-to-face.

Media differences. An investigation of the role of technology in interaction is an important area of interaction studies in distance learning. Some researchers focus their studies on the use of technologies to support different patterns of interaction. Meyer (2003) is the latest research reported in the peer reviewed literature in this area. She examined the patterns of interaction in asynchronous and synchronous environments. The findings showed that asynchronous settings were more effective to facilitate task-oriented interaction, whereas synchronous environments supported more social interaction. Chou(2002) reported related findings in that most postings in asynchronous discussion were found to be topic-related. These findings imply that asynchronous interaction is more effective for task-oriented activities and reflective activities. Yet, brainstorming can be appropriately facilitated by synchronous interaction, which is more effective to promote social interaction (Pena-Shaff, Martin, & Gay, 2001). Other researchers compare the patterns of interaction in face-to-face and computer-mediated environments. Their findings indicated that the interaction in computer-mediated environments was more task-oriented compared to face-to-face (Jonassen, 2001; Olaniran, Savage, & Sorenson, 1996). Thus, the choice of media and method for interaction may influence specific educational purposes.

The consensus in interaction studies focused on technologies is that instructors have difficulties integrating technologies to foster interaction. With the rapid growth of technologies,

various interaction opportunities are available to distance educators. Yet, as reported by Oliver and McLoughlin (1997), a limited range of interaction is used. Instructors largely employ distance technologies as content repositories, for classroom management, and for content delivery. Su et al. (2005) found that the lack of time and technical skills as well as traditional teaching habits were the main reasons for inappropriate technology integration for fostering interaction in distance learning. In examining the effects of availability of computer-mediated communication on interaction, Hartman et al. (1991) found that instructors would interact more with students when the technology was easily accessible. In sum, facilitating effective interaction at a distance depends heavily on the use of technologies. Instructional strategies are needed to help distance educators effectively integrate and use technologies for interaction.

Instructional strategies for interaction. Research on the use of instructional strategies that could contribute to interaction in distance learning is growing. There are many different strategies that research has shown are effective for promoting various types of interaction.

Learner-instructor interaction is considered as the most important type of interaction in distance learning (Farahani, 2003; Garrison & Cleveland-Innes, 2005; Hara, 2000; Monson, 2003; Rhode, 2008). In order to promote learner-instructor interaction, it is essential to provide adequate and immediate feedback (Berge & Muilenburg, 2000; Farahani, 2003; Swan, 2002; Tu, & McIsaac, 2002; Vrasidas, & McIsaac, 1999). McIsaac and Vrasidas (1999) stated that lack of timely feedback can discourage learner interaction in distance learning. Similar findings were reported by Tu and McIsaac (2002) as well as Swan (2002); that the frequency and immediacy of feedback was critical to online interaction, especially in asynchronous settings. Oliver and McLoughlin (1997) conducted a study to investigate interaction in courses delivered by audiographic technologies. This work demonstrated the importance of providing feedback in

meaningful interaction. Furthermore, feedback from the instructor is highly correlated with students' satisfaction and perceived learning (Swan, 2002).

Some studies examine what types of instructional tasks and activities can encourage interactions in online education. Among various types of activities, cooperative or collaborative learning activities have been commonly viewed as effective ways to facilitate learner-learner interaction (Lally, 1999). Su, Bonk, Magjuka, Liu, and Lee (2005) collected data from 27 courses and 102 students. They found that email and asynchronous discussion tools were used extensively in online programs to support interactions. Chou (2002) also suggested that constructivist-based instructional activities such as student-centered discussions and small group collaborative learning can promote interaction. In addition, teaching presence should be established to monitor the discussion process and make explicit the role of students in interaction (Pawan, Paulus, Yalcin, & Chang, 2003).

Tu and McIsaac (2002) identified five types of tasks that can provide better environments for interaction: planning, creating, intellectual decision-making, cognitive conflict, and social tasks. Interestingly, Vrasidas and McIsaac (1999) indicated that required activities or activities that directly relate to students' grades yield more interaction. Students' desire to achieve good grades can lead to frequent participations and interactions. In investigating the effects of anonymity on interaction in computer-mediated environment, Ahern and Durrington (1995) found that anonymous activities could promote increased interaction.

It is also important to develop appropriate assessment strategies for evaluating online discourse. Assessment strategies strongly impact both quantity and quality of online interaction. As Angeli (2003) found, the result of the lack of assessment was that "students primarily shared their personal experience amongst themselves" (p. 40). Students should be provided with clear

participation requirements such as content expectations, timelines, and the length of content (Jiang & Ting, 2000; Pawan et al., 2003).

Clarity and consistency of course design is a factor that impacts the effectiveness of interaction. In a recent study, Swan (2002) examined 22 independent course design features that affect the success of asynchronous online learning. The results revealed that clarity and consistency of course design was a key indicator of student satisfaction and perceived learning. The fewer number of modules in the course, the more learning students perceived. Thus, Swan (2002) claimed that a complex course structure can hinder learner-content interaction. Swan (2002) also concluded that the clarity and consistency of course design was vital to the learning community development.

Summary: Implications of research on interaction. From a practice perspective, promoting meaningful, high level thinking through interaction has challenged educators. Interaction does not, by itself, guarantee the quality of learning. As Woo (2007) argued, not every interaction is meaningful and leads to increased learning. The research demonstrates that attention must be paid to desired outcomes, individual learner, contextual, and media factors, and instructional strategies when designing for interaction. Systematic interaction design, implementation, and evaluation are required. As Garrison and Cleveland-Innes (2005) concluded, course design has "a significant impact on the nature of interaction and whether students approached learning in a deep and meaningful manner" (p. 133).

Several principles for the instructional design of online interaction emerge. Firstly, it is important to consider the value of interaction in course design. The quantity of interaction does not always reflect the quality of learning. Excessive interaction may have potentially negative effects (Northrup, 2002). An educator needs a way to determine if the interaction is a necessary

component for a learning experience in the particular context. Secondly, different types of interaction serve different purposes. A clear purpose of interaction can help instructors and designers choose the what, why, and how for the design of an interaction for a distance course. Next, research findings indicate that various variables should be considered when implementing interaction in distance learning. Interaction should match learners, context, learning objectives and activities. Finally, technology is a key element that needs to be taken into account. Current evidence indicates that technology can either promote or obstruct interaction (Oliver & McLoughlin, 1997). Further, there is a strong need of instructional and technical support for educators. Studies completed to-date provide some useful guidance for developing a framework for designing and evaluating for interaction in distance learning.

From a research perspective, interaction calls on a full range of learning and design theories to identify strategies that make the best use of interaction to support teaching and learning. However, studies on interaction in distance learning face a number of limitations. Firstly, studies concerning learner-instructor interaction are the largest category appearing in the literature. Yet, much fewer studies have been completed to understand interaction between learners and content and interaction between learners and technology. Another area that needs further research is intrapersonal interaction involving cognitive and meta-cognitive learning processes. Only a few studies address this issue. Additional studies involving intrapersonal interaction would enrich the literature by examining the impact of interaction on each learner's internal processes. Thirdly, interaction in distance learning is mainly measured at an individual level. Little attention has been paid to group dynamics and interaction in distance learning. Investigation of group dynamics regarding interaction in distance learning can improve the literature base by exploring patterns and characteristics of interaction within group context.

Fourth, studies of interaction in distance learning have primarily focused on investigating interaction in asynchronous communication. There has not been a full investigation regarding interaction in synchronous environments.

In light of the complex construct of interaction, studies of interaction in distance learning should move further than merely examining the importance of interaction or comparing the types and amount of interaction. Instead, more research should be done to investigate the design, implementation, and evaluation of meaningful interactions in distance learning.

Evaluating Interaction

This section of the literature review reports on the most prominent measures and instrumentation that have been used to-date in investigating interaction.

Considering interaction is a complex and multifaceted concept, researchers have developed and used a diversity of instruments to investigate it from different perspectives in order to obtain a comprehensive understanding. Generally, the most common ways of evaluating interaction in distance learning can be broken down into three categories, as follows: quantitative measures, instrumentation, and content analysis.

Quantitative measures. Early studies on interaction focused mainly on quantitative measures. Until recently, these quantitative measures were used widely. Interaction has been measured by the length of messages (Ahern & Durrington, 1995; Arbaugh, 2000; Howell-Richardson & Mellar, 1996), number of messages per student, frequency of messages (Picciano, 2002), and learners' average access time online (Harasim, 1987). These quantitative data, accounting for such measures as the number of postings, message length and logon time, have been commonly used to assess the level of interaction and basic patterns of interaction, but these data provide little information about the quality of interaction (Hillman, 1999).

Instrumentation. Since the mid-1990s, research has shown an increase in using questionnaires and interviews in evaluating interaction. Several historically important and contemporary questionnaires are discussed in further detail below.

Questionnaires. Questionnaires have been used widely in interaction studies in measuring such things as attitudes towards the use of technologies for interaction (Tsui & Ki, 1996); learner and instructor perceptions of learner-learner, learner-content and learner-instructor interaction (Fulford & Zhang, 1993; Jonassen, 2001; Northrup, 2002; Sherry, 1998; Swan, 2002); and perceived level of interaction (Farahani, 2003; Roblyer & Wiencke, 2003).

Fulford and Zhang (1993) developed a survey instrument using a six-point semantic-differential scale to investigate learners' perceptions of interaction in distance learning. This interaction survey was developed based on Moore's (1989) interaction framework including learner-content interaction, learner-learner interaction and learner-instructor interaction. Sample questions include: How often did you answer questions asked by the instructor?; How often did you volunteer your opinion?; How often did you ask a question?; How often did you participate in overall activities?; and What level of interaction was there between you and instructor?

Sherry (1998) later examined the accuracy and feasibility of Fulford and Zhang's (1993) interaction survey. In order to refine the focus and reduce administration time, Sherry (1998) condensed questions on Fulford and Zhang's (1993) survey and changed a 6-point semantic scale to a Likert scale ranging from strongly disagree to strongly agree. The updated survey consists of three sections: perceptions of overall interaction, perceptions of learner-instructor interaction, and perceptions of learner-learner interaction. Sherry (1998) confirmed the reliability of Fulford and Zhang's (1993) interaction survey for measuring students' perceptions of interaction.

In order to measure the quality of interaction in distance learning, Roblyer (2003) developed an instrument in rubric format. Based on a review of distance learning theories and studies related to interaction, Roblyer (2003) identified five components that contribute to quality of interaction and used them to create the RAIQ rubric. These five elements are social and rapport-building designs for interaction, instructional designs for interaction, interactive capabilities of the technologies, evidence of student engagement, and evidence of instructor engagement. Regarding social designs for interaction, this section mainly investigates class structure and strategies designed for promoting social rapport among instructors and students. The second section of RAIQ examines instructional designs such as instructional activities designed to facilitate and support learner-learner interaction and learner-instructor interaction. The third section of RAIQ, interactive capabilities of the technologies, focuses on the level of interactivity offered by technologies in the class. The fourth section is student engagement as measured by the number of messages contributed to the discussion. The last section is instructor engagement as measured by the level of detailed and timely feedback from instructors. Each component has a five-point response scale ranging from minimum interactive qualities with a rating of 1 to high interactive qualities with a rating of 5. With a cumulative result from the five sections, 1 to 9 points indicate low interactive qualities, 10 to 17 points indicate moderate interactive qualities, and 18 to 25 points indicate high interactive qualities. The validity and reliability of the RAIQ instrument has been verified though expert evaluation and review from sample distance courses.

Northrup's (2002) Online Learning Interaction Inventory (OLLI) questionnaire was developed according to four interaction attributes: content interaction, conversation and collaboration, intrapersonal/metacognitive, and support. Northrup (2002) identified 23 indicators

for these four variables. For example, indicators of content interaction are levels of structure, levels of pacing, multiple mediums, and interactive strategies. Support attributes include indicators such as the timeliness of responses, mentoring, tutorials, peer tips, and correspondence with the instructor. Given these 23 indicators, OLLI consists of 6 sections with 50 items in total. The first section is designed to ask demographic information of participants. The second section to the sixth section includes items with a 5-point Likert-scale ranging from strongly agree to strongly disagree to address the four interaction attributes. OLLI validity was established by pilot testing with 26 students and reports a reliability coefficient of 0.95.

Interview. The use of interview in interaction studies is primarily concerned with student and instructor perceptions about interaction. The typical interview protocol consists of four kinds of questions. The first category of interview questions focuses on exploring the nature of interaction. Researchers tend to ask: What kinds and types of interaction occur in an distance learning (Su et al., 2005)? The second category of interview questions is concerned with participant perceptions of interaction; for example, How do students and instructors perceive interaction in online courses?, or What does interaction mean to the students and instructors (McIsaac, Blocher, Mahes, & Vrasidas, 1999)? The third category of interview questions aims to understand issues related to the learner and instructor preferences for interaction. Representative questions include: What do instructors and learners value as the most important interaction types in the distance learning?; Can that type of interaction be replaced by other types of interaction (Rhode, 2008)?; and, How would instructors/students rank the types of interaction (Rhode, 2008; Soo & Bonk, 1998)?. The fourth category of interview questions is in regards to the interaction experience of learners and instructors. For example, in the Rhode (2008) study, interviewers

asked participants: What was the value of instructor feedback in the course?; and, How important is the class size to the overall interaction experience?

Content analysis. Content analysis has been widely used to analyze interaction in distance learning since the mid-1990s. According to Schwandt (1997), content analysis is a systematic technique for comparing and categorizing information based on explicit coding schemes. The capacity of computer conferencing allows researchers easy access to text-based archives for analyzing transcripts. Content analysis provides additional insights into latent variables of interaction. There are various forms of content analysis methods focused on assessing different dimensions of interaction.

Henri's cognitive model. Henri (1992) is considered the most prominent pioneer of interaction content analysis. Based on cognitive dimensions, she proposed a five level analytic framework, which consists of participation (e.g., number of messages), social cues (e.g., expression of feeling, greeting, or closure), interaction patterns (e.g., direct response, indirect response, or independent response), cognitive skills, and meta-cognitive skills. Many subsequent studies have employed this model to investigate interaction in a computer mediated communication environment (Hara, 2000; Lally, 1999; McDonald & Gibson, 1998; Ng & Murphy, 2005). Henri (1992) offered an initial interaction analytical framework for coding transcripts, but her model was questioned due to the lack of defined criteria for each category, which may cause subjective and inconsistent issues of interpretation (Hara, 2000; Rourke et al., 2001). Further, this model emphasizes cognitive aspects but neglects the social dimension of the learning process (Romiszowski & Mason, 1996).

Critical thinking and interaction. In light of Henri's (1992) interaction analysis model and Garrison's (1992) critical thinking model, Newman et al. (1995) focused on examining

evidence of critical thinking and interaction in computer supported collaborative learning environments. They developed a set of indicators of critical and uncritical thinking in the following categories: problem definition skills (elementary clarification); problem definition skills (in-depth clarification), problem exploration skills, problem application skills, and problem integration skills. In this way, ratios of critical thinking can be calculated and a low ratio would indicate low critical thinking occurrences.

Interaction analysis model. From a social constructivist perspective, Gunawardena et al. (1997) argued that existing analytical models that ignore the social construction of knowledge were not appropriate for analyzing interaction in a computer-mediated communication context. Therefore, Gunawardena et al. (1997) aimed to develop a new interaction analysis model to measure the process of knowledge construction in collaborative learning environments. The model stages are sharing and comparing information; discovering and exploring inconsistent ideas or statements; negotiating meaning and co-constructing of knowledge; texting and modification of proposed synthesis; agreement of newly constructed meaning.

Practical inquiry model. The practical inquiry model, derived from social constructivist theory, is another content analysis method proposed by Garrison et al. (2001). It is used to assess the quality of critical discourse and thinking. Consistent with the interaction analysis model (Gunawardena et al.,1997), Garrison et al. (2001) focused on evaluating critical thinking processes within a group dynamic. There are four model phases, which reflect essential phases of critical thinking processes: recognition and clarification the problem, exploration of ideas, integration (synthesis of knowledge), and resolution (application to real world).

Transcript Analysis Tool (TAT). In order to analyze the patterns of interaction in online learning, Fahy et al. (2001) presented a new tool derived from social network theory for

transcript analysis, which they named TAT (Transcript Analysis Tool). This tool was designed to evaluate the types as well as the purposes of interactive content exchange in computer-mediated communication. Fahy et al. (2001) categorized interactions into different categories that include questions, statements, reflections, scaffolding, and references.

To sum up, based on different theoretical orientations, various content analysis frameworks have been developed for measuring related variables of interaction including participation level (Hara, 2000), cognitive dimensions (Henri, 1992), critical thinking (Garrison et al., 2001; Newman et al., 1995), social knowledge construction (Gunawardena et al., 1997), patterns of interaction (Fahy et al., 2001; Hillman, 1999), and social interaction (McDonald & Gibson, 1998).

Summary: Criticisms of the major methods in investigating interaction. Interaction was measured quantitatively, such as through counting the total number and frequency of student messages posted in a discussion, in an extensive amount of studies. More and more researchers realized that quantitative measures may result in a lack of rich insight concerning the quality of interaction during the learning process (Hillman, 1999; Schrire, 2006). In 1992, Henri urged researchers to go beyond examining simple quantitative measures. As Cleveland-Innes (2005) stated, "…interaction directed to cognitive outcomes is characterized more by the qualitative nature of interaction and less by quantitative measures" (p. 135). The nature of interaction is difficult to interpret from only quantitative data. Also, the validity of such quantitative measures has been questioned (Hillman, 1999). For example, the length of the message may not reflect the level of participation. Instead, it may just indicate language usage. Long messages may be due to lengthy and unnecessary words (Henri, 1992).

Questionnaires are not time-consuming and can be an easy manner of data collection. However, it is difficult to capture the comprehensive and complex process of interaction (Romiszowski & Mason, 1996). Other issues regarding the validity and reliability of survey questionnaires may arise. Questionnaires largely rely on learners subjectively responding to a series of items.

Early on, researchers employed content analysis to analyze surface interaction content such as participation level. More recently, content analysis has been used to examine latent content related to social and cognitive variables (Monson, 2003; Rourke et al., 2001). Content analysis is inevitably time consuming. Furthermore, issues of subjectivity and inconsistency can arise through the process of coding transcripts into different categories (Rourke et al., 2001). The selection of the unit of analysis is another challenge for researchers. Different units of analysis have been attempted in content analysis models including sentences (Hillman, 1999), paragraphs (Hara, 2000), messages (Gunawardena et al., 1997), and meaning (Henri, 1992). However, the use of an ambiguously identified unit such as meaning can certainly increase the possibility of inconsistency and subjectivity among coders.

The need for a new approach for designing effective interaction. Lack of a clear and operational definition (Anderson, 2003a; Bannan-Ritland, 2002; Hirumi, 2002; Wagner, 1994) and a large amount of variables (Anderson, 2003b; Soo & Bonk, 1998) have challenged researchers when it comes to designing and studying interaction. There is a lack of a sound and systematic framework for helping educators to guide interaction design in distance learning which can lead to misinformed and incomplete research designs and findings. Most instruments guide educators to only focus on designing single aspects of interaction. The complex construct of interaction calls for a more rigorous framework for designing interaction that addresses

instructional design, learning theory, instructional theory, and instructional delivery (Sargeant, Curran, Allen, Jarvis-Selinger & Ho, 2006; Wagner, 1994). Such a framework could not only guide instructional design but also inform research design aimed to produce knowledge regarding interaction in distance learning.

Summary of Literature Review

Interaction is the most discussed topic in distance learning. There is a considerable body of research regarding interaction and this area will continue to grow. In this chapter, three parts of the literature were examined: the nature of interaction, interaction studies in distance learning, and the major measures and instruments for examining interaction quality.

A review of the nature of interaction discussed features, defining elements, and theoretical underpinnings of interaction, as well as interaction's role in learning. Currently, the definition of interaction is still ambiguous as the construct has been defined in varied ways. The lack of a commonly accepted definition has hindered the understanding and design of interaction.

A review of interaction studies in distance learning indicates that interaction can promote positive attitudes and facilitate higher order thinking. But, not all interaction is effective. Implementing interaction is a complex and challenging process for educators. The framework within which effective interaction occurs consists of various factors. Interaction should be carefully designed by considering characteristics of the learners, selecting the appropriate technologies, and employing suitable instructional strategies.

A review regarding evaluating interaction detailed the major measures and instruments including: quantitative measures, questionnaires, interview, and content analysis. The review indicates that current instrumentation is insufficient and fails to guide interaction design and research comprehensively. There is a need for a new, more comprehensive and systematic

approach to designing, and subsequently studying, interaction in order to enhance instructional designs in distance learning.

Chapter 3

Research Methodology

The purpose of this study was to develop a theoretically- and empirically-grounded framework for guiding interaction design in distance learning. It is anticipated that this framework can assist educators and instructional designers to design, and evaluate for, quality interaction in distance learning. The framework may help educators transfer theory and research to practice regarding interaction in distance learning. The implementation of the resulting framework may have the positive impact of increasing quality interaction in distance learning.

Introduction to Study Design

This research employed a design and development research methodology, a pragmatic type of research, which is particularly relevant to the field of instructional design and technology (Richey & Klein, 2007). According to Richey and Klein (2007), design and development research refers to "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 and new or enhanced models that govern their development" (p. 1).

This study was classified as Type 2, now known as model research, in that it addressed the design and development of a new framework with a generic focus (Richey & Klein, 2007). The following three phases were employed to develop a framework for guiding interaction design in distance learning: analysis, development and evaluation, and revision (Richey & Klein, 2007). An overview of study design is shown in Table 1.

Table 1

Overview of Study Phases

Model Phases	Evaluation Framework for Interaction in Distance Learning
Analysis	Literature Review
Development and Evaluation	Develop Framework Based on Analysis
	Develop Rubric for Expert Review
Revision	Revise Framework Based on Feedback from Expert Review

Research Participants

In this study, the interaction framework was validated by a purposefully selected group of expert reviewers (Patton, 2001). Three experts were selected based on their expertise and contributions related to distance learning, learning theory, and instructional design.

The decision for selecting experts in these three domains was made for two reasons. Firstly, the framework was developed based on a review of the literature in these three areas. Secondly, experts from these three areas can provide comprehensive review of the framework from all related perspectives. Prior to identifying participants, the researcher obtained approval for the study from the Institutional Review Board (IRB) at Virginia Tech (see Appendix A).

Instrumentation

The rubric for the expert review was developed by the researcher and formatted in Qualtrics. The rubric (Appendix B) contains 19 questions divided into five sections asking the participants to provide their feedback on the overall framework, each of its three phases, as well as the application of the framework. Each rubric section contained several close-ended questions with values ranging from strongly agree to strongly disagree and at least one open-ended

question for experts to provide more specific feedback for framework revision. The rubric requested usability feedback on a number of framework elements including: relevance, guidance, detail, clarity, organization, structure, and format.

Study Procedure

Phase one: Analysis. The first study phase was an analysis phase during which data from a systematic literature review were used to identify relevant elements of a distance learning interaction design framework. Systematic review is different from the traditional review. As Cronin, Ryan, and Coughlan (2008) stated, "while traditional reviews attempt to summarize results of a number of studies, systematic reviews use explicit and rigorous criteria to identify, critically evaluate and synthesize all the literature on a particular topic" (p. 39). In order to establish the reliability and validity of the review, Cronin et al. (2008) suggested that researchers should identify the time frame within which the literature will be reviewed. Also, the researcher should develop and define the criteria to be used to select the literature.

The focus of this systematic review included the concept of interaction, theoretical underpinnings of interaction, desired outcomes of interaction, related factors that affect interaction, and instructional strategies and technology attributes that support interaction. The researcher also considered the existing tools, measures, instruments and frameworks that evaluate interaction design in distance learning. The main sources of literature included academic journals, academic databases, online journals, books, and doctoral dissertations published from 1995 to 2015. Keyword searches are the method that used to identify literature (Levy, 2006). The researcher used such search terms as interaction, interactivity, synchronous communication, asynchronous communication, distance learning, eLearning, computer-supported collaboration learning, etc. The researcher consulted with a Virginia Tech research

librarian for additional recommendations regarding search strategies. The selected literature met three inclusion criteria: (1) peer-reviewed content, (2) conceptual /theoretical works or empirical research, and (3) within the context of education.

During Phase I of this study, the data collected from a literature review were analyzed through a content analysis of theories and research (Weber, 1990). Content analysis is commonly used to analyze qualitative data in an inductive or deductive way (Erickson, 1986). In this study, the researcher followed inductive content analysis procedures. First, the research reviewed qualifying theories and studies through open coding. The researcher coded the literature using symbols and key terms. The emerging categories or themes were developed in line with research questions. In order to reduce overlap and redundancy among categories, the researcher continued to revise and refine categories through repeated analysis and examination. Finally, the essential categories were identified and incorporated into the framework.

Phase two: Development and evaluation. In the second phase, development and evaluation, the findings from the analysis phase were used to develop the framework. Conceptually, the framework covered the features and characteristics of interaction in distance learning derived from the literature and included factors that impact interaction qualities in distance learning. The framework also indicated how to apply it to make interaction design decisions in distance learning.

The developed interaction framework was reviewed by three experts to determine its validity. To invite expert participation, a formal request to take part in expert review was sent via email (see Appendix C). Once permission was received, the researcher sent an additional email with an expert review packet to each of the expert reviewers. The expert review packet (see Appendix D) contained the original interaction framework, a letter explaining the review process,

informed consent information (see Appendix E) and an evaluation rubric. The experts were given two weeks to complete a review and provide their feedback via the rubric administered through Qualtrics. A reminder email was also sent to experts after two weeks (see Appendix F).

Phase three: Revision. Revision was the third phase of the study. During Phase III, the evaluation phase of this study, data collected from the three experts were coded and analyzed for improvements to the framework through a constant comparative analytic method (Glaser & Strauss, 1967; Rossman & Rallis, 2003). According to Merriam (1998), comparison is the core technique of this method, meaning each piece of data must be compared with every other piece of relevant data. Using this approach, the first level of analysis was completed by reading through each of the three responses individually. Then, each response was coded for themes. At the second level of analysis, the comparison was conducted between expert responses. The aim of comparing differences and similarities of expert responses was to gain a comprehensive and in-depth understanding of expert feedback. Comparison was begun immediately after receiving more than one expert response.

The next chapter details the original framework resulting from the analysis of the literature. Chapter 5 describes the feedback received from the expert review process and the resulting revisions to the framework. Chapter 6 discusses study conclusions and recommendations.

Chapter 4

Developing A Framework for Guiding Interaction Design in Distance Learning

The purpose of this study was to develop a theoretically- and empirically-grounded framework for guiding interaction design in distance learning. It is anticipated that this framework can assist educators and instructional designers to design, and evaluate for, quality interaction in distance learning. In order to accomplish this purpose, the study employed a Type 2 design and development research design with the following stages: analysis, development and evaluation, and revision (Richey & Klein, 2007). Chapter 4 presents the findings from a systematic literature review during the analysis phase, along with the development process of the original interaction design framework.

Operationalization of Components in the Framework

The components in the framework were carefully identified based on the desired outcomes of interaction, preconditions of effective interaction, and the theoretical underpinnings of interaction.

The initial steps in the framework development process were determining the desired outcomes of effective interaction. As has been discussed in Chapter 2, effective interaction enables learners to develop higher-order thinking skills including cognitive skills (Henri, 1992), critical thinking skills (Garrison, Anderson, & Archer, 2001; Newman, Webb, & Cochrane, 1995), cognitive presence (Garrison & Cleveland-Innes, 2005; Gunawardena & Zittle, 1997), and knowledge construction (Gunawardena et al., 1997). In addition, interaction has great potential to increase learner satisfaction, participation, communication, and social presence (Fortin & Dholakia, 2005; Jung, Choi, Lim, & Leem, 2002; Swan, 2002; Tu, 2001). In sum,

effective interaction design has the opportunity to contribute to achieving these desired learning outcomes.

Next, the focus shifted to the preconditions of effective interaction meaning those features of interaction in distance learning that impact interaction quality in distance learning. As detailed in Chapter 2, effective interaction includes the following preconditions. Interaction must:

- align with learning objectives.
- be guided by clear interaction purposes.
- match learners and learning context.
- involve learners' cognitive engagement in the learning process.
- require adequate instructor involvement.
- occur in a highly supported and collaborative environment.
- include effective uses of technology integration.

Lastly, the theoretical underpinnings of interaction were also considered in identifying framework components. These theoretical underpinnings include socio-constructivist theory (Piaget, 1937, 1959), socio-cultural theory (Wertsch, 1991; Vygotsky, 1978), transactional distance theory (Kearsley & Moore, 1996; Moore, 1989), Moore's model of interaction (Moore, 1989), and Hillman and Gunawardena's (1994) model of interaction. Each of these theoretical underpinnings has been described in Chapter 2 and is summarized in Table 2.

Table 2

Overview of Theoretical Underpinnings of Interaction

Theoretical Underpinnings	**Key Themes**
Socio-constructivist Theory (Piaget, 1937, 1959)	• Knowledge construction is both a social and cognitive process. • Social interactions play an important role in cognitive development.
Socio-cultural Theory (Wertsch, 1991; Vygotsky, 1978)	• Knowledge is constructed through social interaction and cannot be separated from the cultural contexts. • Cognitive development is enhanced when instruction is designed in the learner's Zone of Proximal Development (ZPD). • Provide scaffolding for learners within their ZPD.
Transactional Distance Theory (Kearsley & Moore, 1996; Moore, 1989)	• Transactional distance is determined by three elements: dialogue between learners and instructor, structure of the course (the rigidity or flexibility of the instruction), and learner autonomy.
Moore's (1989) Model of Interaction	• Three types of interaction impact learning: learner-content interaction, learner-instructor interaction and learner-learner interaction.
Hillman and Gunawardena's (1994) Model of Interaction	• Learner-interface interaction should be considered when a learner uses technology to interact with the content, instructor and learners.

In sum, framework components have been identified based on three criteria; that is, all components must: (1) contribute to the desired outcomes of interaction; (2) support the preconditions of effective interaction; and (3) be informed by the theoretical underpinnings of

interaction. Figure 1 shows the concept map of the operationalization of components in the framework.

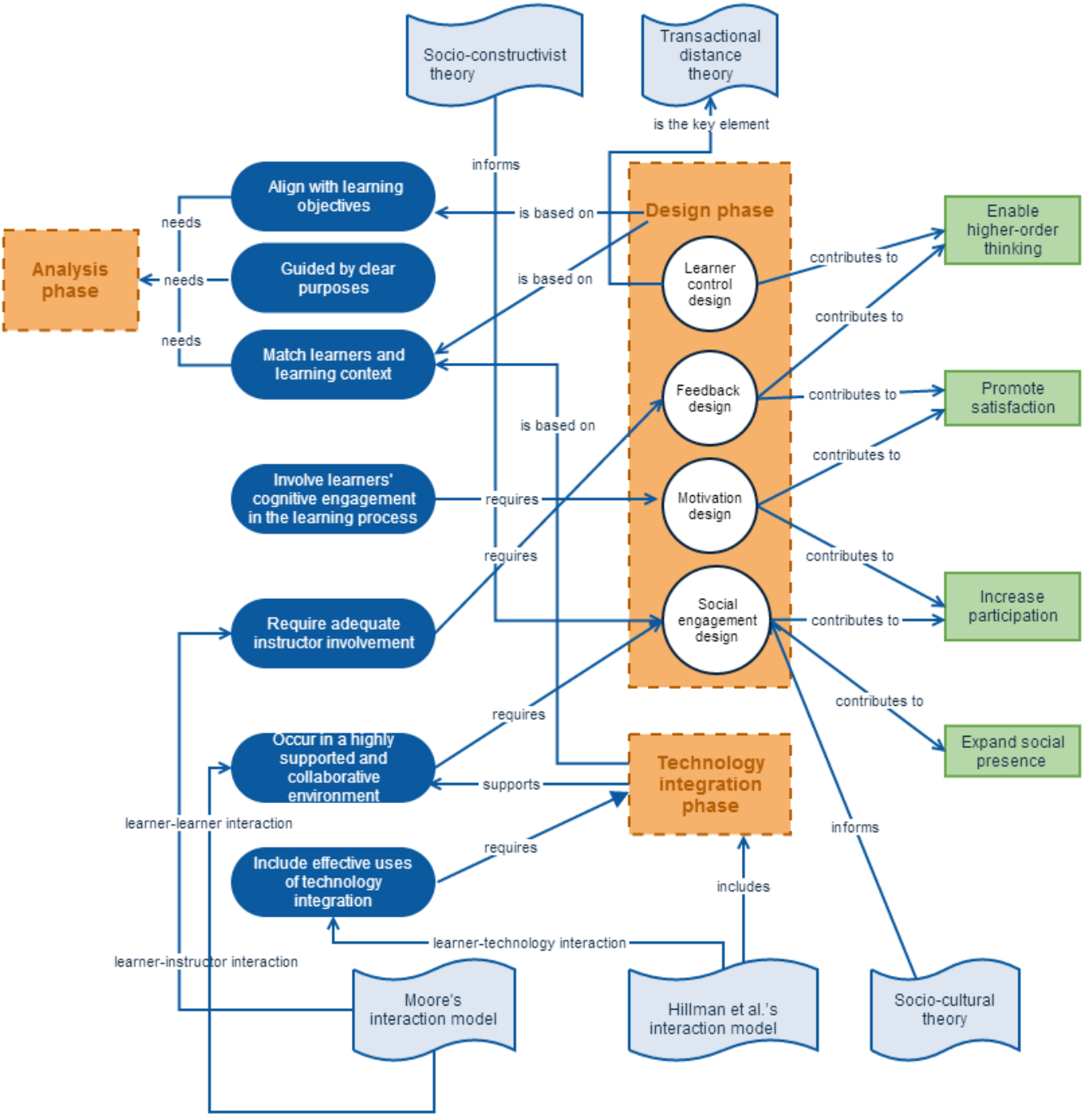

Figure 1. Concept map of the operationalization of components in the framework.

Development of the Framework

Based on the findings from a systematic literature review of interaction research in distance learning, the framework for designing and evaluating interaction was created as shown in Figure 2. The framework was built with the intention to enable instructional designers, instructors, and researchers to guide quality interaction design in distance learning.

The framework represents a systematic process for designing and evaluating the quality of interaction design in three phases: analysis, design, and technology integration. Instructional designers should complete one phase before starting the next in a linear fashion. In the framework, each phase is described and identifies key questions and components to be considered for users to design quality interaction. Guidelines, along with supporting research, for each component in each phase are also provided.

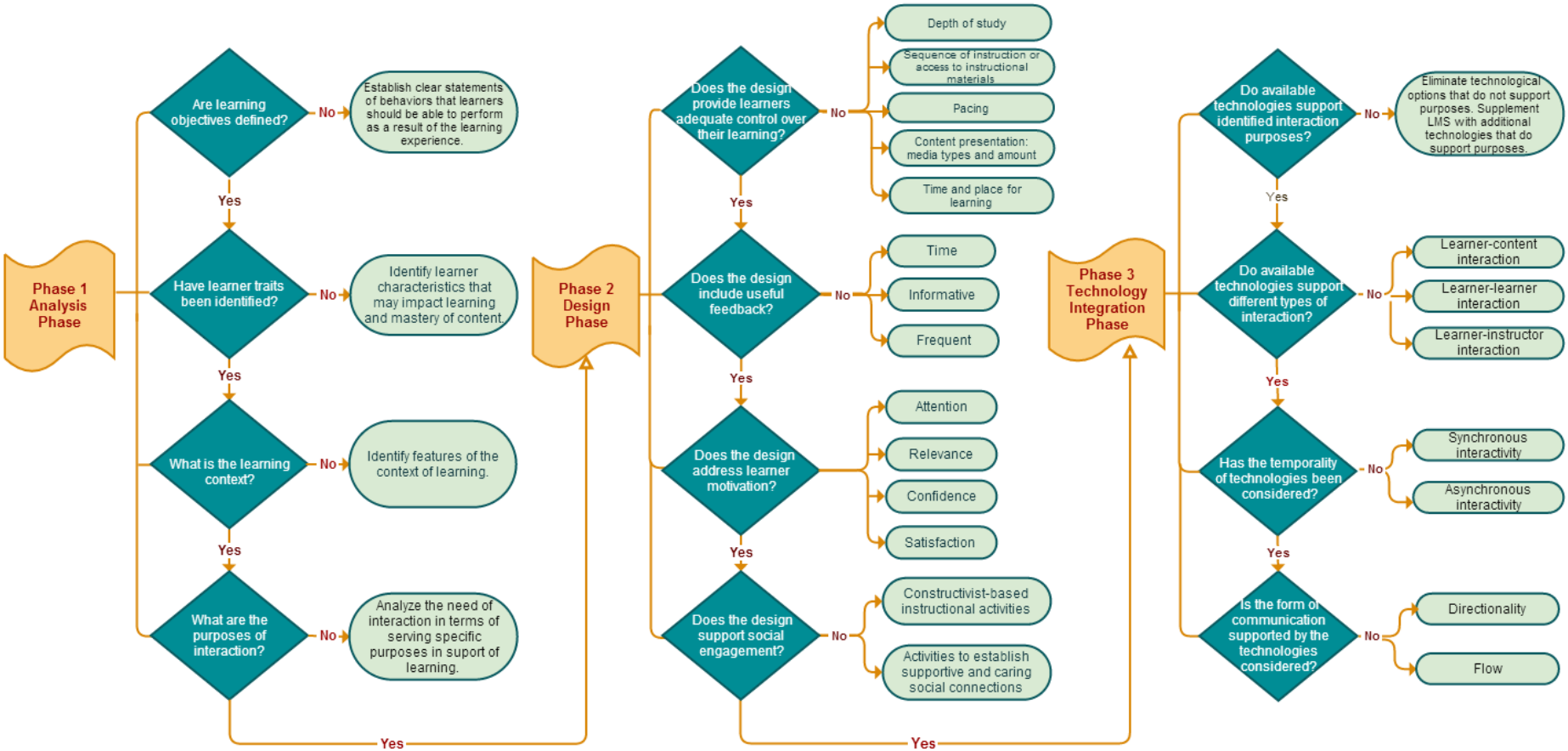

Figure 2. A framework for guiding interaction design in distance learning.
Note. ARCS motivation design elements used with permission (Appendix G). See Keller, J. M. (1987). Development and use of the ARCS model of instructional design, *Journal of instructional development, 10*(3), 2-10.

Analysis phase. According to the preconditions of effective interaction (discussed earlier in this chapter), quality interaction design should be based on the analysis of learning objectives, target learners, learning contexts, as well the purposes of interactions. Given that, in the analysis phase, four key questions are addressed. These questions include:

1. Are learning objectives defined?
2. Have learner traits been identified?
3. What is the learning context?
4. What are the purposes of interaction?

Table 3 (see Appendix H) provides a summary of guidelines for the analysis phase of the interaction design framework in distance learning.

Design phase. The focus of the design phase is to evaluate four design components that are central to the effectiveness of interaction. These components are learner control, motivation, feedback, and social engagement. Table 4 (see Appendix I) provides the summary of guidelines related to each component in the design phase of the interaction framework. The four questions in the design phase are:

1. Does the design provide learners adequate control over their learning?
2. Does the design include useful feedback?
3. Does the design address learner motivation?
4. Does the design support social engagement?

Learner Control. The Learner Control component mainly examines the degree to which learner have controls and options over the depth of study, sequence of interaction, control of pacing, types of presentation, and time spent on learning (Gilbert, 1998; Harper-Marinick & Gerlach, 1986; Kinzie, 1990; Sims, 1997; Wagner, 1994).

Learner control is central to the effectiveness of interaction in distance learning (Abrami, Bernard, Bures, Borokhovski, & Tamim, 2011; Gilbert, 1998; Hannafin, 1989; Livengood, 1987; McMillan & Hwang, 2002; Vrasidas, 1999; Wagner, 1994). In 1990, Kinzie developed a theoretical framework to address the requirements and benefits of effective interactive instruction. In her framework, learner control is defined as one of the three essential necessities for the effective design and successful utilization of interaction. As distance learning moves towards more student-centered mode, the interaction design should be well considered to accommodate more learner control (Parker, 1999).

Feedback. The Feedback component primarily focuses on examining the provision of immediate, informative, and frequent feedback, underlying factors for high levels of interaction. Feedback, a defining characteristic of interaction, is the most significant variable linked to learner-instructor interaction.

Many researchers have supported the importance of feedback in defining interaction (Simonson, Smaldino, Albright, & Zvacek, 2000; Swan, 2002; Vrasidas, & McIsaac,1999; Wagner, 1994). Feedback plays an important role in meaningful communication (Oliver & McLoughlin, 1997; Yacci, 2000). In addition, feedback is a factor that influence learner satisfaction and cognitive engagement. The absence of immediate feedback leads to anxiety among students and inhibited student engagement in the learning process (Horn, 1994). Frequent, timely, and constructive feedback to students is also the evidence of high instructor engagement (Roblyer & Wiencke, 2003). Therefore, as Wagner (1994) stated, “questions regarding amount of interaction, quality of interaction, etc. may be most effectively addressed by generalizing from the literature describing the function, types, scheduling, and timing of feedback” (p. 12).

Motivation. The Motivation component assesses motivational strategies for promoting student cognitive and active engagement. The Keller's (1984) ARCS (Attention, Relevance, Confidence, and Satisfaction) motivational-design model can be adapted for designing and evaluating the Motivation component of the design phase of the interaction framework.

The design for motivation has a strong impact on the effectiveness of interaction (Abrami et al., 2011; Driver, 2002; Fulford & Sakaguchi, 2001; Kinzie, 1990; Wagner, 1994; Zhu, 2006). Interactive distance learning environments require students to be more motivated than traditional face-to-face learning environments. The challenge for instructional designers and educators is to maximize the motivation benefits of learning theories so that students are cognitively and actively engaged (Abrami et al., 2011; Wagner, 1994). Learner engagement can be enhanced when instructional designs incorporate motivational strategies. Motivation, especially continuing motivation, is an important component that needs to be accounted for when designing interaction in distance learning courses.

Social engagement. The Social Engagement component of the framework mainly evaluates the instructional activities and strategies designed to facilitate a collaborative learning environment and support learner-learner interaction. Both social-constructivist theory and social-cultural theory, as theoretical underpinnings of interaction, emphasize the role of interaction with peers for cognitive development (Drisoll, 2005; Piaget, 1937, 1959; Vygotsky, 1978). Increased learner-learner interaction helps decrease the psychological distance and thus increase social presence by distance students. Constructivist-based instructional activities, such as small group collaborative learning and online discussion, have been commonly viewed as effective ways to increase interaction among learners (Abrami et al., 2011; C. Chou, 2003; Farahani, 2003; Fulford & Sakaguchi, 2001; C. H. Tu, & McIsaac, 2002) . Activities that promote social interactions in

order to establish social relationships among learners are also important (Abrami et al., 2011; Garrison & Cleveland-Innes, 2005).

Technology integration phase. The technology integration considers technology attributes, focusing on the level of interactivity offered by technologies. Technologies differ greatly in their potential to foster interaction in terms of level and functions (Barker, Frisbie, & Patrick, 1989; Bates, 1990; Heeter, 2000; Roblyer & Wiencke, 2003; Wagner, 1994). A review of literature indicates that capabilities of two-way communication, control, real-time interactivity and delayed-time interactivity are key attributes with respect to fostering interaction. Table 5 (see Appendix J) provides a summary of guidelines related to each component.

The technology integration phase outlines four key questions for designers to follow as they utilize technologies to enhance interaction in distance learning. These questions are:

1. Do available technologies support identified interaction purposes?
2. Do available technologies support different types of interaction?
3. Has temporality of technologies been considered?
4. Is the form of communication supported by the technologies considered?

In this chapter, the framework for interaction design was presented. The framework leads a user through three phases: analysis, design, and technology integration. In Chapter 5, expert review findings and a revised framework will be presented.

Chapter 5

Expert Review

Consistent with design and development research, an expert review was used to validate the proposed interaction design framework. Chapter 5 contains the description of the expert review process, findings from the feedback obtained from expert reviewers, along with a discussion of how the feedback was incorporated into a revised interaction framework. Appendix K documents the recommendations from expert reviewers and Appendix L summarizes the framework revisions discussed in this chapter.

Review of the Framework

The original framework was validated by a purposefully selected group of expert reviewers. To invite expert participation, a formal request to take part in expert review was sent via email. Reviewers were selected based on their expertise and contributions related to distance learning, instructional design and learning theory. The strategy of triangulating data from experts in three areas was adopted to provide a comprehensive review of the framework from all related perspectives.

Three experts agreed to participate in the evaluation of the framework. They were as follows: Dr. Ellen Wagner, Chief Research and Strategy Officer for the PAR (Predictive Analytics Reporting) Framework, Executive Director of the WICHE Cooperative for Educational Technologies (WCET), and former Senior Director of Worldwide eLearning Solutions, Adobe Systems, Inc.; Dr. Charles B. Hodges, Associate Professor of the Instructional Technology program and former Program Director at Georgia Southern University and Editor-in-Chief of TechTrends Journal; and Dr. Michael Simonson, Professor and Department Head of

Instructional Technology & Distance Education at Nova Southeastern University and Editor of The Quarterly Review of Distance Education and Distance Learning Journal.

When permission was received, the expert review packet was sent to each of the reviewers. The packet included the original interaction framework, a letter explaining the review process, informed consent information and an evaluation rubric. The experts were asked to complete a review and provide their feedback via the rubric within two weeks. One expert review completed the review and returned the feedback promptly within the two-week review period. Two of the three expert reviewers were given 10 more days to complete the review.

The feedback from the expert reviewers was collected using the predesigned rubric. Fourteen questions regarding the overall framework, the analysis phase, the design phase, the technology integration phase, and the application of the framework, were designed to guide the evaluation process. In order to encourage reviewers to provide more detail and clarification of feedback, a follow-up email was sent to two of the three experts.

Overall Expert Perspectives

Generally, the results of expert review indicated that the framework could be helpful for improving the quality of interaction design in distance learning experiences. Reviewer one stated, "I believe you have assembled a good product. The guidance is clear and sufficient for many, formally trained, instructional designers." The third reviewer also stated that, "this is a worthy early attempt to codify decision-making for designing different kinds and types of instructional interactions. I really love that you are bringing some order to the learning design chaos around interactions! Keep up the good work."

Reviewers also pointed out that a systematic literature review served as a solid foundation to develop this theoretically- and empirically- grounded framework for guiding

interaction design in distance learning. The third reviewer stated that, "I so appreciate that you build your case for your design on top of research, perspectives, opinion and evidence that already exist in the research literature to ensure that your design is predicated on reliable information." This reviewer also stated that, "this is a nice enough overview of design considerations from the educational technology literature." While the proposed framework was generally viewed to meet its intended use, experts offered several suggestions for improvement. Opportunities for improvement to the framework are discussed the below.

Recommendations from the Expert Review

Feedback collected from the three experts was coded and analyzed for improvements to the framework through a constant comparative analytic method (Glaser & Strauss, 1967; Rossman & Rallis, 2003). These recommendations were analyzed and coded and have been categorized by the following categories: the overall design, the analysis phase, the design phase, the technology integration phase as well as the application of the framework.

Overall design. Overall, the framework received positive feedback about the description of the framework's purpose, its intended use, and guidance for using the framework. Two experts agreed or strongly agreed that the organization and format of the framework were well designed to support its purpose and use. The third expert took a neutral stance. Suggestions gained from the open-ended question are discussed below.

Reviewer one suggested a clarification of the concept of interaction in distance learning. This reviewer indicated that the target users may have different understandings of the term interaction since the definition of interaction was still not agreed upon; thus some explanation of what interaction in distance learning means was needed. To address this issue, the term of interaction was defined in the introduction of the framework.

Reviewer one also suggested that journals and articles related to activity theory be added to the framework. While this suggestion may be helpful, the researcher's position is that activity theory contributed most to the field of human-computer interaction (HCI), including computer-supported cooperative work (CSCW), and was less relevant to the theoretical underpinnings of interaction in distance learning. Thus, this suggestion is not reflected in the revised framework.

Analysis phase. The feedback related to the analysis phase was positive. Two experts answered agree or strongly agree to the question of whether the analysis phase included appropriate and sufficient key questions and guidelines. One expert selected neutral. All experts agreed or strongly agreed that this phase was reflective of relevant theories and important practices in the design of learning experiences. Suggestions in the open-ended question are discussed below.

Reviewer three suggested that the analysis phase needed to include guidance for deciding what types of interaction would best enable achieving the purposes of interaction. The identification of relevant types of interaction was placed intentionally in the design and technology integration phases, rather than the analysis phase, so that users are encouraged to identify interaction purposes first. Thus no changes were made.

Design phase. Two reviewers agreed that the design phase included appropriate and sufficient key questions and provided clear and sufficient guidelines. Each reviewer selected agree or strongly agree that this phase reflected relevant interaction theories and research as well as important practices in the design of learning experiences. One reviewer selected neutral. Suggestions from the open-ended question are discussed below.

Feedback from reviewer one highlighted the issue related to the use of the ARCS model in the motivation component. This reviewer suggested that there was no need to ask users to

address all model elements (attention, relevance, confidence, and satisfaction) for the motivation component in the design phase. Instead, this component should be used to help instructional designers or instructors select the correct ARCS elements and strategies based on identified motivation problems rather than just applying them all. The researcher agreed with this suggestion. In order to address this issue, the researcher added an explanation for each element of ARCS for the motivation component. Also, a statement was added: "Based on any identified motivational deficits, select the appropriate motivation elements and strategies."

Technology integration phase. The technology integration phase was found to be acceptable by two of the expert reviewers in regards to the appropriateness of selected key questions, sufficient level of guidelines, and the reflection of relevant theories and research. The third reviewer expressed disagreement regarding these same three criteria. Suggestions in the open-ended question are discussed below.

Reviewer one suggested that social presence can be addressed more in this phase. Therefore, the researcher added a short explanation about the relationship between social presence and interaction in addition to explaining the term social presence.

The feedback from reviewer one also raised another issue regarding implementing the technology integration phase. This reviewer explained that:

> "Some instructors have very little control over the LMS and the tools they are given in it. In my case, there are many LMS options that I do not use and I want to turn them off, but Information Technology Services refuses to enable that level of instructor control over the LMS. Also, supplementing the LMS with additional technologies is a great idea, but policies on some campuses require instructors to only use the institutionally supported LMS, or to only include other technologies if they have been properly vetted by the

(usually non-academic) campus Information Technology groups. I believe your guidance in this area should recognize those issues and soften a bit."

This reviewer suggested that the statement be reworded as, "When possible, supplement LMS with additional technologies that do support interaction purposes." To address this suggestion, the text "when possible" was added in the first key questions of the technology integration phase. More discussion about this issue appears in Chapter 6.

Reviewer three suggested to include some contemporary technologies such as interactive web design, app design, app design, mobile design, and games in example technologies in this phase's guidelines. To address this issue, a statement was added after the technology integration table indicating that, since technologies will continue to change, the technology integration phase guidelines was intentionally limited to address only affordances and not specific technologies (that may or may not be current) and that the examples in the guidelines chart for this phase are not exhaustive but only representative.

The application of the framework. When reviewing the application of the framework, two experts agreed or strongly agreed that the framework will likely be effective in helping to improve the quality of interaction design in distance learning experiences. The third expert offered a neutral response and commented that the target audience for framework use has been defined too broadly. The researcher judges that this framework can be helpful for instructional designers, instructors, and researchers in distance learning and does not view this identified target audience as too broad. However, in light of the reviewer comments, it is likely that the rubric questions were phrased inappropriately in that the word "educator" was used rather than the more specific phrase "instructional designers, instructors, and researchers in distance learning". It appears that this error on the rubric likely introduced confusion among the expert

reviewers as to who the target audience actually included. This error will be corrected before the rubric is used in the future. Further, future research investigating the use of the framework by actual target users can inform and improve upon its usefulness in practice.

Two experts expressed the concern that the framework assumed certain prior knowledge of learning theories and instructional design and, therefore, it was more applicable for formally trained instructional designers. They pointed out that the framework may be difficult to implement by novice instructional designers or those distance learning practitioners who lack a background in learning theories and instructional design. In order to make the framework more accessible to novices, reviewer one and reviewer two suggested providing some examples**.** Specifically, reviewer one suggested adding examples for learning objectives, stating that: "the learning objectives need to have brief examples of good and bad objectives. Perhaps a progression from poor, good, better, and best examples on this particular one." To address this concern, some examples have been provided in the revised framework. Given the fact that some terms in the framework may be less familiar to novice instructional designers, the researcher also added explanations of key terms such as social interaction, instructional interaction, etc.

In addition to the changes made based on feedback from the expert reviewers, the researcher felt that the subtitle "Development of the Framework" could be improved. The subtitle was revised to "Purpose and Introduction" to better guide the use of the framework.

This chapter analyzed findings from the feedback obtained from expert reviewers and discussed how the feedback was incorporated into a revised interaction framework. Appendix M presents a revised interaction framework.

Chapter 6

Conclusions and Recommendations

This chapter presents a brief review of the study, the limitations of the study, and the contributions of the study, as well as the recommendations for future research and practice.

Review of the Study

For the past decade, distance learning studies have placed increasing emphasis on interaction (Bannan-Ritland, 2002; Saba, 2000). As one of the most critical elements in distance learning, interaction has been identified as a function for increasing learner motivation, satisfaction, participation, communication, and achievement (Jung, Choi, Lim, & Leem, 2002; Swan, 2002; Tu, 2001). Currently, fostering pedagogically effective interaction is a major challenge for educators in distance learning (Roblyer, 2003). In response to this challenge, the purpose of this study was to develop a theoretically- and empirically-grounded framework for guiding interaction design in distance learning.

This study employed a design and development research methodology with three phases: analysis, development and evaluation, and revision (Richey & Klein, 2007). The first study phase was an analysis phase during which data from a systematic literature review were used to identify relevant elements of a distance learning interaction evaluation framework. In the second phase, development and evaluation, the findings from the analysis phase were used to develop the framework. The resulting framework was reviewed by three experts for validation and feedback. During the revision phase, feedback from the three experts was analyzed and used to make improvements to the framework.

Study Limitations

There are three major limitations to this study. The first limitation was a timeline that

provided an inadequate amount of time for development of the framework that resulted in a compressed timeframe for the expert review phase of the study. In the future, a similar study should plan for more time to complete phases one and two of this type of design and development research. Limited time for the completion of phase three prohibited the researcher from being able to consider and introduce follow-up interviews with the experts that, in retrospect, would have offered more insight into expert perspectives regarding strengths and weaknesses of the original framework. The researcher plans on following up with at least one expert reviewer, post-study, given that this expert has already expressed interest in doing so.

The second limitation is the design of the evaluation rubric. The researcher selected strongly agree, agree, neutral, disagree and strongly disagree as the categories for the expert reviewers' response scales. The option of neutral made it more challenging to synthesize and interpret expert feedback, especially when the sample size was so small. Limited information can be gained from a response of neutral. Further, as discussed previously, the use of the word "educator" in certain questions on the rubric to identify the target user group for the framework was not specific enough and may have impacted the validity of the expert responses for these questions. The rubric should be refined prior to using it again.

Lastly, while the research strove to ensure the framework would provide guidance for any technology-mediated interaction design in distance learning, technologies will continue to evolve, necessitating adjustments to the framework. Every attempt was made to generalize the framework to account for developments in technology-mediated interaction design. Specific recommendations to address this issue are discussed later in this chapter.

Contributions of Study

This study contributes to research and practice in four significant ways. Firstly, the resulting framework provides guidance and support for educators to design new distance learning experiences and improve existing ones. Researchers have asserted that the current lack of guidance hinders improvement in the quality of interaction in distance learning (Roblyer, 2003; Wagner, 1994). The framework, grounded in current scholarship, provides three phases for designing quality interaction and identifies key questions and components to foster effective interaction. Implementing the framework should have the positive impact of promoting higher quality teaching and learning practices in regards to interaction in distance learning. In the future, a learning experiencing that used the framework to design its interactions can be evaluated for impact. A prototype of the framework was presented at the Conference on Higher Education Pedagogy in February 2014. Several educators and instructional designers at this conference session expressed enthusiasm for the prototype and interest in applying the completed framework for improving or guiding their online course design in the future.

Secondly, this study adds to the body of knowledge on interaction in distance learning. Considering the large number of variables related to the construct of interaction, scholars continue to debate interaction in learning (Anderson, 2003b; Soo & Bonk, 1998). This research project identified and reported on core characteristics of interaction, desired outcomes of effective interaction, and preconditions of effective interaction that are well-grounded in peer-reviewed theories and empirical evidence, contributing to an operationalized concept of interaction in distance learning that can be researched to advance scholarship.

Thirdly, there are a considerable number of studies related to interaction in distance learning grounded in some form of theoretical basis (Anderson, 2003; Hillman & Gunawardena,

1994; Moore, 1989; Sutton, 2001; Wagner, 1994). However, few studies have been completed that intentionally connect theory to practice. This study used a design and development methodology that enabled the construction and expert evaluation of a framework intended to meet the practical design needs of instructional designers creating distance learning experiences. As such the study addresses a need expressed in the instructional design professional community. The need for design tools grounded in rigorous scholarship (Gustavson & Branch, 2002; Richey & Klein, 2007).

Fourthly, design and development methodology is an applied research method that is best suited to providing a solution to practical problems (Richey & Klein, 2007). However, the use of this methodology is challenging. As Richey, Klein and Nelson (2004) stated, "the notion of development research is often unclear, not only to the broader community of educational researchers, but to many instructional technology researchers as well" (p. 1100). This study can serve as a model of how design and development methodology can be used in practice.

Theoretical Implications

Based on the literature review, currently, most interaction studies still only touch the surface of interaction, merely examining the importance of interaction or comparing the types and amount of interaction (Hyo-Jeong, 2010). Few studies were found that attempted to develop guidance for interaction in distance learning. While a few studies have provided certain forms of design guidance, educators are currently guided to only focus on designing single aspects of interaction (Northrup, 2002; Roblyer, 2003). Future researchers are greatly encouraged to investigate useful approaches for designing, implementing, and evaluating meaningful interaction.

The following recommendations are made to assist researchers in the field of distance learning who attempt to conduct studies regarding interaction design. Firstly, as mentioned in Chapter 3, the lack of a commonly agreed upon concept of interaction has prevented transfer from theory to instructional design practices, limited research effort, and hindered improvements in interaction quality (Bannan-Ritland, 2002; Roblyer, 2003). It is difficult for researchers to design and facilitate interaction without understanding the concept of interaction. From the perspective of an instructional designer, the researcher suggests conceptualizing interaction by Wagner's (1997) recommendation, which shifted focus from learning agents to learning outcomes. Only in this way can educators and practitioners obtain valuable insights into the range of potential interactions that can facilitate learning.

Secondly, there is a need to further examine other factors that may influence interaction in multiple contexts of distance learning. For example, most interaction studies in distance learning paid attention to asynchronous environments while ignoring the investigation of synchronous interaction. Further examination of the multiple contexts of distance learning might reveal other relations, factors, or strategies that can effect interaction, which might necessitate the need for adding more phases or components to the framework.

Recommendations for Further Research

There are three potential areas for further research. Firstly, the technology integration phase defined in this study is worth further exploration. Considering the findings, seeking additional insights into various contemporary or emerging interactive technologies, and offering specific and detailed guidelines for different types of commonly-used interactive technologies that educators may use for facilitating interaction would strengthen the application of the

technology integration phase. Currently, the framework provides technology integration guidance for fostering interaction in relatively general terms.

Secondly, in order to make the framework more accessible for those distance learning practitioners who do not have prior knowledge regarding learning theory and instructional design, one recommendation is to demonstrate the application of this framework step by step via a distance learning course. Also, to better serve its use, the framework can be in website form.

Another recommendation is to invite more theoretical experts and distance learning practitioners to review this framework further. One reason to include distance learning practitioners, the target user audience, is to judge the applicability of the framework. Further review can make the framework more robust for use in distance learning.

Recommendations for Further Practice

The first recommendation for practice, based on the researcher's reflections gained through the expert review, is to maximize the degree to which instructors and instructional designers have control over technology selection and use. Some universities require instructors to only use the institutionally supported LMS or technologies. However, with the rate at which new distance technologies, even free Web-based technologies, are made available, such a requirement can be unrealistic. Having limited control over technology selection and use may greatly reduce the effectiveness of interaction design. Giving more control to instructional designers could lead to more effective interaction design.

The second recommendation for practice is also a reflection from the expert review process. This framework sought to provide comprehensive theoretically- and empirically-grounded guidance for each component and phase. However, it is not intended nor is it necessary to ask instructional designers to apply all strategies identified in each component of the

framework. Good interaction design should be purposefully designed; that is, designers must select the correct strategies based on both defined interaction goals and instructional goals.

Thirdly, findings suggest seeking collaboration with other instructors, subject matter experts, and researchers when designing interaction. Designing interaction is a complex process that needs to consider numerous variables. Collaboration with other educators could broaden and deepen the understanding of the concept of interaction, so that more quality interaction can be designed and implemented.

The fourth recommendation for practice is to consider interaction qualitatively instead of only pursuing quantity when designing distance learning courses. As mentioned in Chapter 3, distance learning practitioners tend to think that the more interaction in distance learning, the more effective the teaching and learning. While appropriate use of interaction can be helpful, excessive interaction may even have negative effects.

Summary

In summary, designing effective interaction is challenging, particularly in distance learning. The complex nature of this construct is difficult to define. Interaction is still the most debated topic in distance learning in terms of its role, functions, and use, even though the concept has been investigated for decades. Many more issues should be explored. This design and development research effort aimed to develop a theoretically- and empirically-based framework in order to assist instructional designers to design and improve the quality of interaction, to ultimately ensure more successful distance learning experiences.

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Appendix A

IRB Approval

VirginiaTech

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120, Virginia Tech
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Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
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website http://www.irb.vt.edu

MEMORANDUM

DATE: December 11, 2014

TO: Jennifer Mary Brill, Wei Li

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)

PROTOCOL TITLE: Development of a Framework for Evaluating Interaction in Distance Education

IRB NUMBER: **14-1045**

Effective December 11, 2014, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Exempt, under 45 CFR 46.110 category(ies) 2**
Protocol Approval Date:	**December 11, 2014**
Protocol Expiration Date:	**N/A**
Continuing Review Due Date*:	**N/A**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Appendix B

Rubric for Evaluation of Distance Learning Interaction Design Framework

Reviewer Name: _____

The following questions are in reference to the framework for guiding interaction design in distance learning. Please provide as much feedback as you can and feel free to direct any questions to me (Wei Li, Virginia Tech, Ph.D. Candidate, Instructional Design and Technology; weili@vt.edu) any time throughout the review process.

Your input in this endeavor is well-appreciated.

Section 1: Overall Design

Q1: The framework packet describes in sufficient detail the framework's purpose and intended use.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Comments_____

Q2: The guidance for using the framework is clear and sufficient.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Comments_____

Q3: The organization and format of the framework are well designed to support its purpose and use.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Comments_____

Please leave any comments you have regarding the Overall Design of the framework. In particular, if you responded Disagree or Strongly Disagree to any previous item, please offer specific recommendations for improvement.

Section 2: Analysis Phase

Q4: The key questions in the ANALYSIS PHASE are appropriate and sufficient.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Comments_____

Q5: In the tables, the guidelines for each question are clear and sufficient.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree
- Don't Know/Unsure

Comments_____

Q6: The ANALYSIS PHASE reflects relevant interaction theories and research as well as important practices in the design of learning experiences.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Comments_____

Please leave any comments you have for the ANALYSIS PHASE. In particular, if you responded Disagree or Strongly Disagree to any previous item, please offer specific recommendations for improvement.

_____

Section 3: Design Phase

Q7: The key questions in the DESIGN PHASE are appropriate and sufficient.

- Strongly Agree
- Agree
- Neutral

- Disagree
- Strongly Disagree

Comments_____

Q8: In the tables, the guidelines for each question are clear and sufficient.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree
- Don't Know/Unsure

Comments_____

Q9: The DESIGN PHASE reflects relevant interaction theories and research as well as important practices in the design of learning experiences.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Comments_____

Please leave any comments you have for the DESIGN PHASE. In particular, if you responded Disagree or Strongly Disagree to any previous item, please offer specific recommendations for improvement.

_____

Section 4: Technology Integration Phase

Q10: The key questions in the TECHNOLOGY INTEGRATION PHASE are appropriate and sufficient.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Comments_____

Q11: In the tables, the guidelines for each question are clear and sufficient.

- Strongly Agree
- Agree
- Neutral

- Disagree
- Strongly Disagree
- Don't Know/Unsure

Comments_____

Q12: The TECHNOLOGY INTEGRATION PHASE reflects relevant interaction theories and research as well as important practices in the design of learning experiences.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Comments_____

Please leave any comments you have for the TECHNOLOGY INTEGRATION PHASE. In particular, if you responded Disagree or Strongly Disagree to any previous item, please offer specific recommendations for improvement.

_____

Section 5: The Application of the Framework

Q13: Overall, the framework, when used by educators, will likely be effective in helping to improve the quality of interaction design in distance learning experiences.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Comments_____

Q14: The framework will be reasonable to implement by educators, the intended user audience.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Comments_____

What additional recommendations do you have to improve this framework?

_____

Thank you for your feedback.

Appendix C

Expert Review Request

Dear Professor _____

My name is Wei Li and I am a Doctoral Candidate in the Instructional Design and Technology program at Virginia Tech. As a recognized expert in distance learning, I would like to invite you to evaluate a framework that I am designing and developing as part of my dissertation work under the supervision of my advisor, Dr. Jennifer M. Brill (jmbrill@vt.edu). Your participation in this study is voluntary.

The purpose of my study is to develop a framework for guiding interaction design in distance learning. The study employs a Type 2 development research design with the following stages: analysis, development and evaluation, and revision. The evaluation stage requires that the framework be formatively evaluated by three experts for recommendations for improvement. Additional study details can be found in the attached consent form. No signature is required. Rather, you will have the opportunity to indicate your voluntary consent to participate as an expert reviewer on the first page of the online document containing the evaluation rubric.

Should you accept this invitation, you will be provided with a rubric that can be used to guide the evaluation process of the framework. Also, you will be provided the framework itself. I estimate that your participation would take approximately 2 hours of your time over a two week review period, beginning with receipt of the framework and the rubric. You will also be given the option of being acknowledged by name for your contribution as an expert reviewer or having your identity kept confidential.

Your expertise will help me to improve the framework prior to its dissemination as a practical tool for designers of distance learning. I hope that you are able to participate! If you have any questions, please do not hesitate to contact me.

Thank you, in advance, for your valuable time and expertise.

Sincerely,

Wei Li weili@vt.edu

Virginia Tech
Ph.D. Candidate, Instructional Design & Technology

Appendix D

Expert Review Packet

Dear Professor _____ ,

I would like to thank you for evaluating the framework I am developing as part of my dissertation work under the supervision of my advisor, Dr. Jennifer M. Brill (jmbrill@vt.edu), in the Instructional Design and Technology program at Virginia Tech.

The framework I have built is attached. I have also created a rubric for your use in evaluating the framework. The rubric can be accessed and submitted through the following link: https://virginiatech.qualtrics.com/SE/?SID=SV_e3bhF1PWAPHAU4Z

I estimate that your participation would take no more than 2 hours. Please ensure your feedback is submitted by 5:00 p.m. on Aug 13th.

If you have any questions, please do not hesitate to contact me.

Thank you again,

Wei Li
Virginia Tech
Ph.D Candidate, Instructional Design & Technology
weili@vt.edu

A Framework for Guiding Interaction Design in Distance Learning

Development of the Framework

Based on the findings from a systematic literature review of interaction research in distance learning, a framework for guiding interaction design was created as shown in Figure 1. The purpose of the framework is to assist instructional designers, instructors, and researchers in designing high quality interactions in distance learning environments.

The framework represents a systematic process for designing and evaluating the quality of interaction for learning in distance education through three phases: analysis, design, and technology integration. A user of the framework should complete one phase of the framework before starting the next one. In the framework figure, each phase is detailed in decision tree form, identifying key questions and components to be considered by users to design for quality interactions. More detailed guidance, along with the supporting research, for each element in each phase of the framework is also provided through Tables 1, 2, and 3.

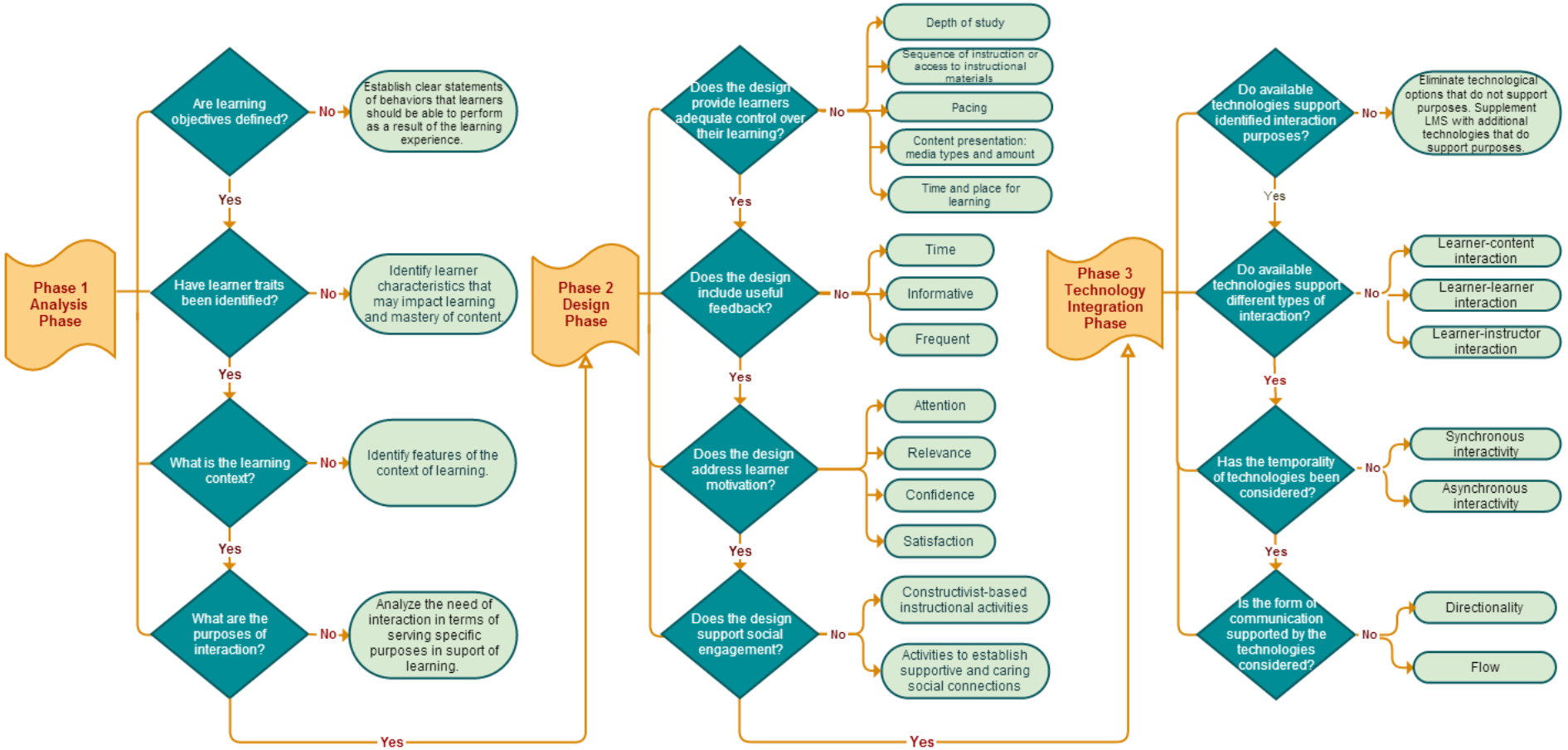

Figure 1. A framework for guiding interaction design in distance learning.

Note. ARCS motivation design elements used with permission. See Keller, J. M. (1987). Development and use of the ARCS model of instructional design, *Journal of instructional development, 10*(3), 2-10.

Table 1

Guidelines for the Analysis Phase

Key Question	**Guidance**
Are learning objectives defined?	Establish clear statements of behaviors that learners should be able to perform as a result of the learning experience (Dick, Carey, & Carey, 2005). • Three components of an effective learning objective (Dick et al., 2005): ▪ Performance: A description of the behavior that learners will be able to do; e.g. write, present, solve. ▪ Conditions: The performance context in which the behavior will be applied. ▪ Criterion: A description of the criteria for an acceptable level of performance.
Have learner traits been identified?	Identify learner characteristics that may impact learning and mastery of content, e.g.: • Prior knowledge of subject matter (Anderson & Lee, 1995; Comeaux, 1995; Jung, Choi, Lim, & Leem, 2002; Monson, 2003; Ritchie, 1993; Tsui & Ki, 1996; Vrasidas, & McIsaac, 1999). • Prior online learning experience (Comeaux, 1995; Farahani, 2003; Vrasidas & McIsaac, 1999). • Gender (Arbaugh, 2000; Chou, 2004; Farahani, 2003; Herring, 1995; Im & Lee, 2004; Jeong & Davidson-Shivers, 2006; Monson, 2003): o Males perceive online interaction more self-promoting and assertive (Herring, 1994). o Females perceive feedback more important, while males perceive discussion more important (Monson, 2003).
What is the learning context?	Identify features of the context for learning:

	• Opportunities for asynchronous or synchronous learning (Chou, 2002; Meyer, 2003; Pena-Shaff, Martin, & Gay, 2001; Swan, 2002). • Class size (Chen & Willits, 1999; Fahy, Crawford, & Ally, 2001; Orellana, 2006; Tu, & McIsaac, 2002; Vrasidas & McIsaac, 1999; Zhu, 2006). • Potential for face-to-face meeting(s) online (Angeli, 2003; Levin, Kim, & Riel, 1990; Vrasidas, & McIsaac, 1999).
What are the purposes of interaction?	Analyze the need of interaction in terms of serving specific purposes in support of learning: • Social interaction and instructional interaction (Berge, 1999; Gilbert & Moore, 1998). • Interaction for participation, communication, feedback, elaboration and retention (enhance information provision, confirmation and correction), self-regulation, motivation, negotiation of understanding, team building, discovery, exploration, clarification of understanding and closure (Wagner, 1997). • Triggering interactions (communicates expectations), exploration interactions, integration interactions (constructing meaning) and resolution interactions (application to real world) (Garrison, Anderson, & Archer, 2001).
Information gathered from Phase I should be used to inform the next phase, Phase II: Design.	

Table 2

Guidelines for the Design Phase

In light of the identified learning objectives, learner traits, features of the learning context, and purposes for interaction, plan for the learning experience…	
Key Question	**Guidance**
Does the design provide learners adequate control over their learning?	Plan for appropriate opportunities for learners to control: • Depth of study. • Sequence of instruction or access to instructional materials. • Pacing. • Content presentation: Media types and amount. • Time and place for learning. (Anderson & Garrison, 1998; Chou, 2003; Garrison & Baynton, 1987; Gilbert & Moore, 1998; Harasim, 1987; Kinzie, 1990; McIsaac & Gunawardena, 2000; Sims, 1997; Wagner, 1994)
Does the design include useful feedback?	Provide timely feedback (Bates, 1990; Chou, 2003; Farahani, 2003; Yacci, 2000). Provide informative feedback: • Provide more than yes/no feedback in regard to whether the learner's response is correct (Dennen, Aubteen Darabi, & Smith, 2007). • Provide feedback that encourages discussion or dialogue about the quality of a learner's response (Bates, 1990; Dennen & Wieland, 2007). • Provide feedback that asks for learner reflections (Fulford & Sakaguchi, 2001). • Provide feedback that ask for learner clarification or elaboration (Fulford & Sakaguchi, 2001).

	Provide frequent feedback: • Support feedback frequency by using various channels: email, face-to-face, discussion board, phone (Hartman, Neuwirth, Kiesler, Sproull, Cochran, Palmquist & Zubrow; 1991). • Maintain frequency of contact through feedback (Dennen et al., 2007).
Does the design address learner motivation?	Integrate strategies into the learning experience based on Keller's ARCS model of motivation. Selected Attention Strategies: • Encourage or praise interaction, comments or responses (Fulford & Sakaguchi, 2001; Hara, 2000). • Present opportunities for student questions, comments, or ideas (Fulford & Sakaguchi, 2001). • Use games, role plays, or simulations that require learner participation (Abrami, Bernard, Bures, Borokhovski, & Tamim, 2011; Driver, 2002; Keller, 1987). • Use highlighting to focus attention (Woo, 2007). Selected Relevance Strategies: • Ask for learner information, experience, or personal examples (Fulford & Sakaguchi, 2001). • Provide tasks, material and activities that are relevant to learners (Abrami et al., 2011). • Allow learners to exercise control over the form of and context for learning (Kinzie, 1990). Selected Confidence Strategies:

	• Set and explain goals that motivate and direct learners (Garrison & Cleveland-Innes, 2005). • Communicate rules and expectations (Dennen et al., 2007; Driver, 2002; Farahani, 2003; Garrison et al., 2001). Selected Satisfaction Strategies: • Reward interaction, e.g. through a score, grade, etc. (Dennen & Wieland, 2007; Driver, 2002). • Request or encourage real-time student contact (Fulford & Sakaguchi, 2001).Use small online group discussions to increase satisfaction (Abrami et al., 2011; Cornell & Martin, 1997; Dennen et al., 2007; Dennen & Wieland, 2007; Driver, 2002). • Use instructor feedback to increase student satisfaction (Swan, 2002).
Does the design support social engagement?	Include constructivist-based learning activities: • Cooperative or collaborative group work (Chou, 2002; Lally, 1999; Northrup, 2002). • Structured online discussions or debates (Abrami et al., 2011; Badia, Barberà, Guasch, & Espasa, 2011; Chou, 2003; Chou, 2004; Driver, 2002; Duemer et al., 2002; Farahani, 2003; Fulford & Sakaguchi, 2001; Kanuka, 2011). • Appropriate employment of the synchronous seminar enhances interpersonal connections (Abrami et al., 2011). • Asynchronous peer review provides opportunity for collaboration on building the knowledge base and sharing information (Abrami et al., 2011). • Role playing (Farahani, 2003). • Authentic tasks (Woo, 2007). • Co-construction and negotiation of meaning (Dennen & Wieland, 2007).

- Sharing of learner-created artifacts (Dennen & Wieland, 2007; Garrison et al., 2001).

Include activities that help establish supportive and caring social connections (Garrison & Cleveland-Innes, 2005).

Information from Phases I and II should be used to inform the final phase, Phase III: Technology Integration.

Table 3

Guidelines for the Technology Integration Phase

In light of the identified learning objectives, learner traits, features of the learning context, and purposes for interaction and design decisions regarding learner control, feedback, motivation, and social engagement, identify technologies providing the most effective learning support…	
Key Question	**Guidance**
Do available technologies support identified interaction purposes?	Eliminate technological options from the LMS that do not support identified interaction purposes. Supplement LMS with additional technologies that do support interaction purposes.

Do available technologies support different types of interaction?	• Learner-content interaction (Dunlap, Sobel, & Sands, 2007; Moore, 1989)
	  ○ Enriching interaction: Supports learner access to information.
	  ▪ e.g., links, forward and back buttons
	  ○ Supportive interaction: Helps learners understand and work with the material.
	  ▪ e.g., search function, zoom function
	  ○ Conveyance interaction: Provides ways to apply knowledge.
	  ▪ e.g., simulations, games
	  ○ Constructive interactions: Organizing and mapping knowledge and understanding.
	  ▪ e.g., concept map, organization charts
	• Learner-instructor interaction (Moore, 1989)
	  ○ Provides for identified feedback opportunities.

	• Learner-learner interaction (Moore, 1989) ○ Provides for learner information exchanges, shared work, collaboration.
Has temporality of technologies been considered?	Synchronous interactivity: • Supports high social presence and immediate feedback (Chou, 2003; Tu, 2001). • Supports more social interaction (Chou, 2002; Jonassen, 2001; Meyer, 2003; Pena-Shaff, Martin & Gay, 2001). • Effective in developing a sense of community among learners since it supports more cohesive interaction (Duemer, 2002; Jonassen, 2001). • Provides a higher level of immediacy than asynchronous technology (Horn, 1994). Asynchronous interactivity: • Provides flexibility in terms of time and place, which can support learner control (Chou, 2002; Kiousis, 2002; Vrasidas & Zembylas, 2003). • Can provide an extended time period for interaction and more opportunity for reflection, critical thinking, and group problem solving (Angeli, 2003; Chou, 2002; Gilbert & Moore, 1998; Jonassen, 2001; Markus, 1994; McIsaac & Gunawardena, 2000).

Is the form of communication supported by the technologies considered?	Directionality:
	• One-way communication
	• Two-way communication
	  ○ Fosters interaction (McMillan & Hwang, 2002; Northrup, 2002; Roblyer & Wiencke, 2003; Woo, 2007).
	  ○ Supports interpersonal interaction and feedback capabilities (McMillan & Hwang, 2002; Oliver, McLoughlin, 1997).
	  ○ e.g., videoconferencing, teleconferencing and computer-mediated conferencing
	Flow:
	• One-to-one communication
	  ○ e.g., instant message, email
	• One-to-many communication
	  ○ e.g., blog, listerv, bulletin board
	• Many-to-many communication
	  ○ e.g., wiki, discussion forum

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Appendix E

Informed Consent Form

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Informed Consent for Participants in Research Projects Involving Human Subjects

Title of Project: Development of a Framework for Guiding Interaction Design in Distance Education

Investigator: Wei Li, School of Education, Virginia Tech

Research Advisor: Dr. Jennifer M. Brill, School of Education, Virginia Tech

I. Purpose of this Research/Project
The purpose of this research study is to develop a framework for guiding interaction design in distance education. It is anticipated that this framework can assist instructional designers, instructors, and researchers design the quality of interaction in order to enhance instructional designs in distance education.

II. Procedures
The researcher will send an email with an expert review packet to you. The expert review packet will contain the original evaluation framework, a letter explaining the review process, consent information and an evaluation rubric. You will have two weeks to complete a review and provide your feedback via the online rubric formatted in Qualtrics.

III. Risks
There are no anticipated risks to you as a result of participating in this project.

IV. Benefits
There will be no personal benefits to you for your participation in this study. However, there are larger community benefits. The results from this study can inform other educators, researchers and other instructional designers how to evaluate the quality of interaction in distance education. Your participation in this study will contribute to research that may influence the design of a framework for interaction evaluation. You may contact the researcher at any time for a summary of the research study results once completed and available.

V. Extent of Anonymity and Confidentiality
Participation in this study is confidential and your name will only be known to the study investigators. Every effort will be made to ensure your identity in this study will be treated confidentially unless you indicate another preference in writing to the investigator.

VI. Compensation
There is no compensation to you for your participation in this study.

VII. Freedom to Withdraw

You are free to withdraw from the research project at any time and without giving a reason. To withdraw, please inform the researchers (Wei Li or Dr. Jennifer Brill) or contact Dr. David Moore, IRB chair. Contact information for these individuals is available at the end of this document.

VIII. Participants Responsibilities

I voluntarily agree to participate in this study. I acknowledge I have the following responsibilities:

- Give voluntary consent by returning a completed rubric to the investigator, Wei Li.
- Complete the online evaluation rubric.
- Submit my evaluation, once complete.
- (Optional) Indicate in writing if you would like to be acknowledged by name in the reporting of this research as an expert reviewer (otherwise, your name will be held in confidence).

IX. Contact Information

Investigator:	Wei Li	Phone: 540-315-6040 [weili@vt.edu]
Faculty Advisor:	Jennifer Brill	Phone: 540-231-8328 [jmbrill@vt.edu]
Department Reviewer:	Barbara B. Lockee	Phone: 540-231-5587 [lockeebb@vt.edu]

For questions related to the rights as a human subject research participant:
Chair, IRB: David M. Moore Phone: 540-231-4991 [moored@vt.edu]
Office of Research Compliance, Research and Graduate Studies

Appendix F

Expert Review Email – Reminder

Dear Professor _____

Recently, I contacted you to request your participation as an expert reviewer of a framework for evaluating the quality of interaction in distance education (see below for original email). If you have completed the expert review, I want to thank you for your time and participation.

If you have NOT completed the expert review yet, I eagerly await your input! Please complete the review by Aug 20th.

--
Wei Li
Virginia Polytechnic Institute and State University
Ph.D Candidate, Instructional Design & Technology
weili@vt.edu

Appendix G

Permission to Use ARCS Model

Wei Li <weili@vt.edu> Feb 10

to jkeller

Dr. Keller,

I am a doctoral student in Instructional Design and Technology at Virginia Tech. My chair is Dr. Jennifer Brill. I am currently completing my dissertation of developing a framework for guiding interaction design in distance learning. Motivation is one design consideration that I include in the framework. I would like to request your permission to use your ARCS model in that part of my framework as a means for higher education faculty to consider important elements of motivation as they make interaction design choices. Of course, you would be given explicit credit for ARCS.

Your research has been very meaningful to my work. I greatly respect your work towards motivational design.

I look forward to your reply.

Best Regards,
Wei Li

John Keller <jkellersan@gmail.com> Feb 10

to Wei

Dear Wei Li,

Thank you for your comments about my work. I appreciate it.

Certainly, you may include the ARCS model as a component of your design framework.

Best wishes,
John K.

John M. Keller, Ph.D.
Professor Emeritus
Educational Psychology and Learning Systems
Florida State University

9705 Waters Meet Drive

Appendix H

Guidelines for the Analysis Phase

Table 3

Guidelines for the Analysis Phase

Key Question	Guidance
Are learning objectives defined?	Establish clear statements of behaviors that learners should be able to perform as a result of the learning experience (Dick, Carey, & Carey, 2005). • Three components of an effective learning objective (Dick et al., 2005): ▪ Performance: A description of the behavior that learners will be able to do; e.g. write, present, solve. ▪ Conditions: The performance context in which the behavior will be applied. ▪ Criterion: A description of the criteria for an acceptable level of performance.
Have learner traits been identified?	Identify learner characteristics that may impact learning and mastery of content, e.g.: • Prior knowledge of subject matter (Anderson & Lee, 1995; Comeaux, 1995; Jung, Choi, Lim, & Leem, 2002; Monson, 2003; Ritchie, 1993; Tsui & Ki, 1996; Vrasidas, & McIsaac, 1999). • Prior online learning experience (Comeaux, 1995; Farahani, 2003; Vrasidas & McIsaac, 1999). • Gender (Arbaugh, 2000; Chou, 2004; Farahani, 2003; Herring, 1995; Im & Lee, 2004; Jeong & Davidson-Shivers, 2006; Monson, 2003): ○ Males perceive online interaction more self-promoting and assertive

	(Herring, 1994). ○ Females perceive feedback more important, while males perceive discussion more important (Monson, 2003).
What is the learning context?	Identify features of the context for learning: • Opportunities for asynchronous or synchronous learning (Chou, 2002; Meyer, 2003; Pena-Shaff, Martin, & Gay, 2001; Swan, 2002). • Class size (Chen & Willits, 1999; Fahy, Crawford, & Ally, 2001; Orellana, 2006; Tu, & McIsaac, 2002; Vrasidas & McIsaac, 1999; Zhu, 2006). • Potential for face-to-face meeting(s) online (Angeli, 2003; Levin, Kim, & Riel, 1990; Vrasidas, & McIsaac, 1999).
What are the purposes of interaction?	Analyze the need of interaction in terms of serving specific purposes in support of learning: • Social interaction and instructional interaction (Berge, 1999; Gilbert & Moore, 1998). • Interaction for participation, communication, feedback, elaboration and retention (enhance information provision, confirmation and correction), self-regulation, motivation, negotiation of understanding, team building, discovery, exploration, clarification of understanding and closure (Wagner, 1997). • Triggering interactions (communicates expectations), exploration interactions, integration interactions (constructing meaning) and resolution interactions (application to real world) (Garrison, Anderson, & Archer, 2001).
Information gathered from Phase I should be used to inform the next phase, Phase II: Design.	

Appendix I

Guidelines for the Design Phase

Table 4

Guidelines for the Design Phase

In light of the identified learning objectives, learner traits, features of the learning context, and purposes for interaction, plan for the learning experience…	
Key Question	**Guidance**
Does the design provide learners adequate control over their learning?	Plan for appropriate opportunities for learners to control: • Depth of study. • Sequence of instruction or access to instructional materials. • Pacing. • Content presentation: Media types and amount. • Time and place for learning. (Anderson & Garrison, 1998; Chou, 2003; Garrison & Baynton, 1987; Gilbert & Moore, 1998; Harasim, 1987; Kinzie, 1990; McIsaac & Gunawardena, 2000; Sims, 1997; Wagner, 1994)
Does the design include useful feedback?	Provide timely feedback (Bates, 1990; Chou, 2003; Farahani, 2003; Yacci, 2000). Provide informative feedback: • Provide more than yes/no feedback in regard to whether the learner's response is correct (Dennen, Aubteen Darabi, & Smith, 2007). • Provide feedback that encourages discussion or dialogue about the quality of a learner's response (Bates, 1990; Dennen & Wieland, 2007). • Provide feedback that asks for learner reflections (Fulford & Sakaguchi,

	2001). • Provide feedback that ask for learner clarification or elaboration (Fulford & Sakaguchi, 2001). Provide frequent feedback: • Support feedback frequency by using various channels: email, face-to-face, discussion board, phone (Hartman, Neuwirth, Kiesler, Sproull, Cochran, Palmquist & Zubrow; 1991). • Maintain frequency of contact through feedback (Dennen et al., 2007).
Does the design address learner motivation?	Integrate strategies into the learning experience based on Keller's ARCS model of motivation. Selected Attention Strategies: • Encourage or praise interaction, comments or responses (Fulford & Sakaguchi, 2001; Hara, 2000). • Present opportunities for student questions, comments, or ideas (Fulford & Sakaguchi, 2001). • Use games, role plays, or simulations that require learner participation (Abrami, Bernard, Bures, Borokhovski, & Tamim, 2011; Driver, 2002; Keller, 1987). • Use highlighting to focus attention (Woo, 2007). Selected Relevance Strategies: • Ask for learner information, experience, or personal examples (Fulford & Sakaguchi, 2001). • Provide tasks, material and activities that are relevant to learners (Abrami et al., 2011). • Allow learners to exercise control over the form of and context for learning (Kinzie, 1990).

	Selected Confidence Strategies: • Set and explain goals that motivate and direct learners (Garrison & Cleveland-Innes, 2005). • Communicate rules and expectations (Dennen et al., 2007; Driver, 2002; Farahani, 2003; Garrison et al., 2001). Selected Satisfaction Strategies: • Reward interaction, e.g. through a score, grade, etc. (Dennen & Wieland, 2007; Driver, 2002). • Request or encourage real-time student contact (Fulford & Sakaguchi, 2001). Use small online group discussions to increase satisfaction (Abrami et al., 2011; Cornell & Martin, 1997; Dennen et al., 2007; Dennen & Wieland, 2007; Driver, 2002). • Use instructor feedback to increase student satisfaction (Swan, 2002).
Does the design support social engagement?	Include constructivist-based learning activities: • Cooperative or collaborative group work (Chou, 2002; Lally, 1999; Northrup, 2002). • Structured online discussions or debates (Abrami et al., 2011; Badia, Barberà, Guasch, & Espasa, 2011; Chou, 2003; Chou, 2004; Driver, 2002; Duemer et al., 2002; Farahani, 2003; Fulford & Sakaguchi, 2001; Kanuka, 2011). • Appropriate employment of the synchronous seminar enhances interpersonal connections (Abrami et al., 2011). • Asynchronous peer review provides opportunity for collaboration on building the knowledge base and sharing information (Abrami et al., 2011). • Role playing (Farahani, 2003). • Authentic tasks (Woo, 2007). • Co-construction and negotiation of meaning (Dennen & Wieland, 2007).

- Sharing of learner-created artifacts (Dennen & Wieland, 2007; Garrison et al., 2001).

Include activities that help establish supportive and caring social connections (Garrison & Cleveland-Innes, 2005).

Information from Phases I and II should be used to inform the final phase, Phase III: Technology Integration.

Appendix J

Guidelines for the Technology Integration Phase

Table 4

Guidelines for the Technology Integration Phase

In light of the identified learning objectives, learner traits, features of the learning context, and purposes for interaction and design decisions regarding learner control, feedback, motivation, and social engagement, identify technologies providing the most effective learning support…	
Key Question	**Guidance**
Do available technologies support identified interaction purposes?	Eliminate technological options from the LMS that do not support identified interaction purposes. Supplement LMS with additional technologies that do support interaction purposes.

Do available technologies support different types of interaction?	• Learner-content interaction (Dunlap, Sobel, & Sands, 2007; Moore, 1989)
	  ○ Enriching interaction: Supports learner access to information.
	  ▪ e.g., links, forward and back buttons
	  ○ Supportive interaction: Helps learners understand and work with the material.
	  ▪ e.g., search function, zoom function
	  ○ Conveyance interaction: Provides ways to apply knowledge.
	  ▪ e.g., simulations, games
	  ○ Constructive interactions: Organizing and mapping knowledge and understanding.

	▪ e.g., concept map, organization charts • Learner-instructor interaction (Moore, 1989) o Provides for identified feedback opportunities. • Learner-learner interaction (Moore, 1989) o Provides for learner information exchanges, shared work, collaboration.
Has temporality of technologies been considered?	Synchronous interactivity: • Supports high social presence and immediate feedback (Chou, 2003; Tu, 2001). • Supports more social interaction (Chou, 2002; Jonassen, 2001; Meyer, 2003; Pena-Shaff, Martin & Gay, 2001). • Effective in developing a sense of community among learners since it supports more cohesive interaction (Duemer, 2002; Jonassen, 2001). • Provides a higher level of immediacy than asynchronous technology (Horn, 1994). Asynchronous interactivity: • Provides flexibility in terms of time and place, which can support learner control (Chou, 2002; Kiousis, 2002; Vrasidas, & Zembylas, 2003). • Can provide an extended time period for interaction and more opportunity for reflection, critical thinking, and group problem solving (Angeli, 2003; Chou, 2002; Gilbert & Moore, 1998; Jonassen, 2001; Markus, 1994; McIsaac & Gunawardena, 2000).

Is the form of communication supported by the technologies considered?	Directionality:
	• One-way communication
	• Two-way communication
	  ○ Fosters interaction (McMillan & Hwang, 2002; Northrup, 2002; Roblyer & Wiencke, 2003; Woo, 2007).
	  ○ Supports interpersonal interaction and feedback capabilities (McMillan & Hwang, 2002; Oliver, McLoughlin, 1997).
	  ○ e.g., videoconferencing, teleconferencing and computer-mediated conferencing
	Flow:
	• One-to-one communication
	  ○ e.g., instant message, email
	• One-to-many communication
	  ○ e.g., blog, listerv, bulletin board
	• Many-to-many communication
	  ○ e.g., wiki, discussion forum

Appendix K

Expert Review Feedback

Questions	Reviewer One	Reviewer Two	Review Three
1. The framework packet describes in sufficient detail the framework's purpose and intended use.	Agree	Strongly Agree	Agree
2. The guidance for using the framework is clear and sufficient.	Neutral	Agree	Neutral
3. The organization and format of the framework are well designed to support its purpose and use.	Strongly Agree	Agree	Neutral
Please leave any comments you have regarding the Overall Design of the framework. In particular, if you responded Disagree or Strongly Disagree to	* "I believe some explanation of what "interaction in distance learning" means for this context is needed" * "The guidance is clear and sufficient for many, formally	* "Guidance could be improved." * "Your directions assume too much prior knowledge by those using your model, so give examples and step by step	* "I think this is a worthy early attempt to codify decision-making for designing different kinds and types of instructional interactions." * "I really love that you are bringing some order to the learning design chaos around interactions! Keep up the good work."

any previous item, please offer specific recommendations for improvement.	trained, instructional designers, but there are many people working with that job title who have no formal training. Therefore, in at least some cases, some examples should be provided. For example, the learning objectives need to have a brief of example of good and bad objectives. Perhaps a progression from "poor", "good", "better", and "best" examples on this particular one."	direction."	* "I so appreciate that that you need to build your case for your design on top of (research, perspectives, opinion, evidence) that already exists in the research literature to ensure that YOUR design is predicated on reliable information." * "I think you are going to need to build out the technology components of interaction design more than it is here currently. I think it is going to be problematic to not have a stronger focus on contemporary interactivity in a framework focused on functional or aesthetic interaction design considerations."
4. The key questions in the ANALYSIS PHASE are appropriate and sufficient.	Agree	Strongly Agree	Neutral
5. In the tables, the guidelines for each question are clear and sufficient.	Agree	Agree	Neutral
6. The ANALYSIS PHASE reflects relevant interaction theories and research as	Agree	Strongly Agree	Agree

well as important practices in the design of learning experiences.			
Please leave any comments you have for the ANALYSIS PHASE. In particular, if you responded Disagree or Strongly Disagree to any previous item, please offer specific recommendations for improvement.			* “ I do appreciate that this is more about establishing parameters for exploring the literature around techniques of front end analysis, learner analysis, goal analysis, etc. etc. Just don't forget that your analysis is trying to determine what kinds of interactions will best enable the outcomes you hope to achieve; that's not going to be the least bit theoretical.”
7. The key questions in the DESIGN PHASE are appropriate and sufficient.	Agree	Strongly Agree	Neutral
8. In the tables, the guidelines for each question are clear and sufficient.	Agree	Agree	Neutral
9. The DESIGN PHASE reflects relevant interaction theories and research as	Agree	Strongly Agree	Neutral

well as important practices in the design of learning experiences.			
Please leave any comments you have for the DESIGN PHASE. In particular, if you responded Disagree or Strongly Disagree to any previous item, please offer specific recommendations for improvemet.	* “Keller developed ARCS to address identified motivation problems. In your analysis phase I do not see any questions that would lead to an understanding of any motivation deficits. If you probed for motivation deficits in the analysis phase, then you may be more likely to appropriately address motivation with the correct ARCS element rather than just trying them all.		* “This is a nice enough overview of design considerations from the educational technology literature, but Interactive design is such an active evolving field; I'm thinking that maybe you should think about reaching outside of the educational technology literature a bit more.” * “Given what I know is going on in the arenas of interactive web design, app designs, mobile designs, games, click stream analyses, I just wonder if you wouldn't want to open up your framework a bit more to accommodate those developments.”
10. The key questions in the TECHNOLOGY INTEGRATION PHASE are appropriate and sufficient.	Agree	Strongly Agree	Disagree
11. In the tables, the guidelines for each question are clear and sufficient.	Agree	Agree	Disagree

12. The TECHNOLOGY INTEGRATION PHASE reflects relevant interaction theories and research as well as important practices in the design of learning experiences.	Agree	Strongly Agree	Disagree
Please leave any comments you have for the TECHNOLOGY INTEGRATION PHASE. In particular, if you responded Disagree or Strongly Disagree to any previous item, please offer specific recommendations for improvement.	* “I was expecting to see more of a mention of social presence in this section.” * “Also, in this part you mention "Eliminate technological options from the LMS that do not support identified interaction purposes. Supplement LMS with additional technologies that do support interaction purposes." However, there are many issues that come into these sorts of decisions. Some instructors have very little control over the LMS and the tools they are given		* “Given what I know is going on in the arenas of interactive web design, app designs, mobile designs, games, click stream analyses, I just wonder if you wouldn't want to open up your framework a bit more to accommodate those developments.”

	in it. In my case, there are many LMS options that I do not use and I want to turn them off, but Information Technology Services refuses to enable that level of instructor control over the LMS. Also, supplementing the LMS with additional technologies is a great idea, but policies on some campuses require instructors to only use the institutionally supported LMS, or to only include other technologies if they have been properly vetted by the (usually non-academic) campus Information Technology groups. I believe your guidance in this area should recognize those issues and soften a bit with something like "When possible...		
13. Overall, the framework, when used by educators, will likely be effective in helping to improve the quality	Agree	Strongly Agree	Neutral

of interaction design in distance learning experiences.			
14. The framework will be reasonable to implement by educators, the intended user audience.	Agree	Neutral	Neutral
What additional recommendations do you have to improve this framework?	* “I was expecting to see some mention of activity theory, at least in the reference list.” * “I believe you have assembled a good product, but it may be more applicable to a general design of online "modules" rather than targeting "interaction" in those contexts specifically.” * “Your final statement: "The framework will be reasonable to implement by educators, the intended user audience." seems to	* “Probably a little much for the typical practitioner.”	* “Think about who this framework is really for. “Educators” is probably too broad. Are you thinking teachers? Instructional designers? Programmers? LMS administrators? Advisors? Content authors?” * “I really do love that you are trying to codify interaction strategies and tactics. It seems like you need to decide if this is going to be theoretically focused or pragmatically focused.”

	contradict some of your intro to the framework. On page 1 of the pdf you include "The purpose of the framework is to assist instructional designers, instructors, and researchers in designing high quality interactions in distance learning environments.", but with this last question you simply list "educators".	

Appendix L

Summary of Framework Revisions

Reviewer Feedback	**Reflection in Revised Module**
The framework needs to clarify the meaning of interaction in distance learning.	• Defined interaction in the introduction section.
Provide examples for learning objectives in the analysis phase.	• Provided examples for performance, conditions, and criterion. • Provided examples for good and bad learning objectives.
There is no need to address all elements for the motivational design component in the design phase.	• Added explanations for each element of the motivational design component. • Added a statement: "Based on any identified motivational deficits, select the appropriate motivation elements and strategies."
Recognize some issues regarding implementing the technology integration phase. Some instructors have very little control over the LMS and the tools.	• Reworded a statement as "Eliminate technological options from the LMS that do not support identified interaction purposes. When possible, supplement LMS with additional technologies that do support interaction purposes".
Include some contemporary technologies such as interactive web design, app design, app design, mobile design, and games in example technologies in technology integration phase's guidelines.	• A statement was added after the technology integration table: "Since technologies will continue to change, the technology integration phase guidelines was intentionally limited to address only affordances and not specific technologies (that may or may not be current) and that the examples in the guidelines chart for this phase are not exhaustive but only representative.

Social presence can be addressed more in the technology integration phase.	• Added a short explanation about the relationship between social presence and interaction in distance learning. • Added an explanation for the term social presence.
The framework needs to be better accessible for novice instructional designers.	• Added explanations and examples for social interaction. • Added explanations and examples for instructional interaction. • Added examples for collaborative or cooperative group work. • Provided examples for activities that help establish supportive and caring social connections. • Added explanations for learner-learner interaction, learner-content interaction and learner-instructor interaction. • Provided an optimal class size example. • Provided examples for synchronous interactivity and asynchronous interactivity.

Appendix M

A Revised Framework for Guiding Interaction Design in Distance Learning

Purpose and Introduction

Based on the findings from a systematic literature review of interaction research in distance learning, a framework for guiding interaction design was created as shown in Figure 1. The purpose of the framework is to assist instructional designers, instructors, and researchers in designing high quality interactions in distance learning environments.

In this framework, interaction is defined as interaction as two-way communication between students and the instructor, students and the content, or among students, that is facilitated by instructional strategies and mediated by technologies with the purposes of achieving instructional goals and social connections. The framework represents a systematic process for designing and evaluating the quality of interaction for learning in distance education through three phases: analysis, design, and technology integration. A user of the framework should complete one phase of the framework before starting the next one. In the framework figure, each phase is detailed in decision tree form, identifying key questions and components to be considered by users to design for quality interactions. More detailed guidance, along with the supporting research, for each element in each phase of the framework is also provided through Tables 1, 2, and 3.

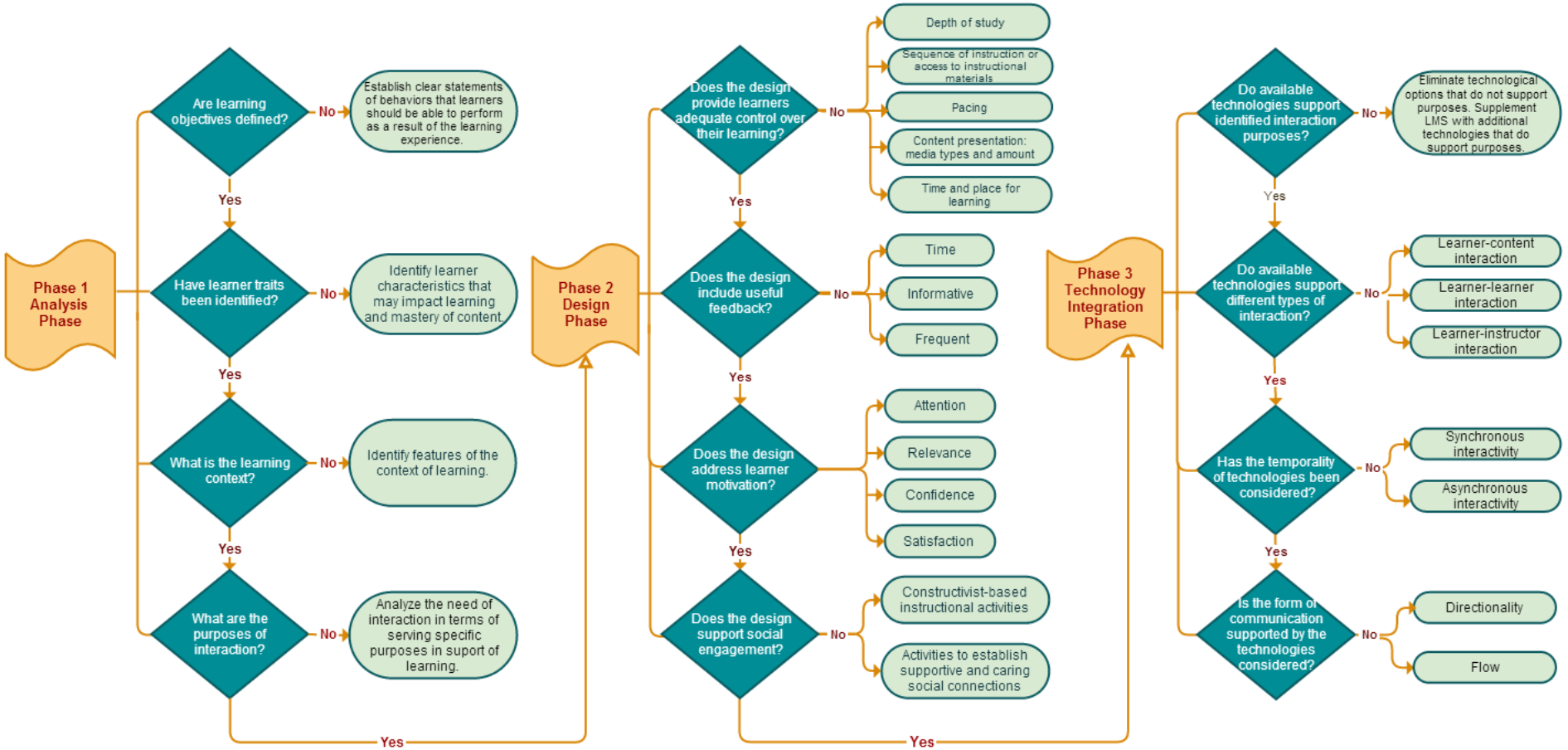

Figure 1. A framework for guiding interaction design in distance learning.
Note. ARCS motivation design elements used with permission. See Keller, J. M. (1987). Development and use of the ARCS model of instructional design, *Journal of instructional development*, *10*(3), 2-10.

Table 1

Guidelines for the Analysis Phase

Key Question	**Guidance**
Are learning objectives defined?	Establish clear statements of behaviors that learners should be able to perform as a result of the learning experience (Dick, Carey, & Carey, 2005). • Three components of an effective learning objective (Dick et al., 2005): ▪ Performance: A description of the behavior that learners will be able to do; e.g. write, present, solve. ▪ Conditions: The performance context in which the behavior will be applied. e.g. given a list of chemical elements, using a metric ruler. ▪ Criterion: A description of the criteria for an acceptable level of performance. e.g. writing with no spelling, grammar, or punctuation errors. ▪ Good example: Upon completion of this module, the statistics student will be able to describe a realistic distribution of data comprehensively by using numerical techniques and by addressing the concepts of shape, center, spread, patterns, and outliers. ▪ Bad example: This course will teach learners how to conduct literature review.
Have learner traits been identified?	Identify learner characteristics that may impact learning and mastery of content, e.g.: • Prior knowledge of subject matter (Anderson & Lee, 1995; Comeaux, 1995; Jung, Choi, Lim, & Leem, 2002; Monson, 2003; Ritchie, 1993; Tsui & Ki, 1996; Vrasidas, & McIsaac, 1999). • Prior online learning experience (Comeaux, 1995; Farahani, 2003; Vrasidas

	& McIsaac, 1999).
	• Gender (Arbaugh, 2000; Chou, 2004; Farahani, 2003; Herring, 1995; Im & Lee, 2004; Jeong & Davidson-Shivers, 2006; Monson, 2003):
	  o Males perceive online interaction more self-promoting and assertive (Herring, 1994).
	  o Females perceive feedback more important, while males perceive discussion more important (Monson, 2003).

What is the learning context?	Identify features of the context for learning: • Opportunities for asynchronous or synchronous learning (Chou, 2002; Meyer, 2003; Pena-Shaff, Martin, & Gay, 2001; Swan, 2002). • Class size (Chen & Willits, 1999; Fahy, Crawford, & Ally, 2001; Orellana, 2006; Tu, & McIsaac, 2002; Vrasidas & McIsaac, 1999; Zhu, 2006). o A class size of 16 was perceived to be the best class size for optimal interaction (Orellana, 2006). • Potential for face-to-face meeting(s) online (Angeli, 2003; Levin, Kim, & Riel, 1990; Vrasidas, & McIsaac, 1999).

What are the purposes of interaction?	Analyze the need of interaction in terms of serving specific purposes in support of learning:
	• Social interaction and instructional interaction (Berge, 1999; Gilbert & Moore, 1998).
	  o Social interaction: social exchanges between students and the teacher, or among students. e.g. body language, exchanging personal information, greetings.
	  o Instructional interaction: both teacher control of content delivery and learner control of processes that related to the presentation of and response to instructional content. e.g. questioning, answering, pacing, sequencing, branching, etc.
	• Interaction for participation, communication, feedback, elaboration and

	retention (enhance information provision, confirmation and correction), self-regulation, motivation, negotiation of understanding, team building, discovery, exploration, clarification of understanding and closure (Wagner, 1997). • Triggering interactions (e.g. communicates expectations), exploration interactions, integration interactions (constructing meaning) and resolution interactions (e.g. application to real world) (Garrison, Anderson, & Archer, 2001).
Information gathered from Phase I should be used to inform the next phase, Phase II: Design.	

Table 2

Guidelines for the Design Phase

In light of the identified learning objectives, learner traits, features of the learning context, and purposes for interaction, plan for the learning experience…	
Key Question	**Guidance**
Does the design provide learners adequate control over their learning?	Plan for appropriate opportunities for learners to control: • Depth of study. • Sequence of instruction or access to instructional materials. • Pacing. • Content presentation: Media types and amount. • Time and place for learning. (Anderson & Garrison, 1998; Chou, 2003; Garrison & Baynton, 1987; Gilbert & Moore, 1998; Harasim, 1987; Kinzie, 1990; McIsaac & Gunawardena, 2000; Sims, 1997; Wagner, 1994)
Does the design include useful feedback?	Provide timely feedback (Bates, 1990; Chou, 2003; Farahani, 2003; Yacci, 2000). Provide informative feedback: • Provide more than yes/no feedback in regard to whether the learner's response is correct (Dennen, Aubteen Darabi, & Smith, 2007). • Provide feedback that encourages discussion or dialogue about the quality of a learner's response (Bates, 1990; Dennen & Wieland, 2007). • Provide feedback that asks for learner reflections (Fulford & Sakaguchi, 2001). • Provide feedback that ask for learner clarification or elaboration (Fulford & Sakaguchi, 2001).

	Provide frequent feedback: • Support feedback frequency by using various channels: email, face-to-face, discussion board, phone (Hartman, Neuwirth, Kiesler, Sproull, Cochran, Palmquist & Zubrow; 1991). • Maintain frequency of contact through feedback (Dennen et al., 2007).
Does the design address learner motivation?	Integrate strategies into the learning experience based on Keller's ARCS model of motivation. Based on any identified motivational deficits, select the appropriate motivation elements and strategies: Selected Attention strategies allow learners to establish interests in learning: • Encourage or praise interaction, comments or responses (Fulford & Sakaguchi, 2001; Hara, 2000). • Present opportunities for student questions, comments, or ideas (Fulford & Sakaguchi, 2001). • Use games, role plays, or simulations that require learner participation (Abrami, Bernard, Bures, Borokhovski, & Tamim, 2011; Driver, 2002; Keller, 1987). • Use highlighting to focus attention (Woo, 2007). Selected Relevance strategies allow learners to establish connections of the new information presented and what they already know from previous experience: • Ask for learner information, experience, or personal examples (Fulford & Sakaguchi, 2001). • Provide tasks, material and activities that are relevant to learners (Abrami et al., 2011). • Allow learners to exercise control over the form of and context for learning (Kinzie, 1990).

	Selected Confidence strategies focus on establishing positive expectations for achieving success among learners: • Set and explain goals that motivate and direct learners (Garrison & Cleveland-Innes, 2005). • Communicate rules and expectations (Dennen et al., 2007; Driver, 2002; Farahani, 2003; Garrison et al., 2001). Selected Satisfaction Strategies allow learners to be more motivated about their accomplishments: • Reward interaction, e.g. through a score, grade, etc. (Dennen & Wieland, 2007; Driver, 2002). • Request or encourage real-time student contact (Fulford & Sakaguchi, 2001). Use small online group discussions to increase satisfaction (Abrami et al., 2011; Cornell & Martin, 1997; Dennen et al., 2007; Dennen & Wieland, 2007; Driver, 2002). • Use instructor feedback to increase student satisfaction (Swan, 2002).
Does the design support social engagement?	Include constructivist-based learning activities: • Cooperative or collaborative group work (Chou, 2002; Lally, 1999; Northrup, 2002). e.g. think-pair-share activity, group writing assignments. • Structured online discussions or debates (Abrami et al., 2011; Badia, Barberà, Guasch, & Espasa, 2011; Chou, 2003; Chou, 2004; Driver, 2002; Duemer et al., 2002; Farahani, 2003; Fulford & Sakaguchi, 2001; Kanuka, 2011). • Appropriate employment of the synchronous seminar enhances interpersonal connections (Abrami et al., 2011). • Asynchronous peer review provides opportunity for collaboration on building the knowledge base and sharing information (Abrami et al., 2011).

- Role playing (Farahani, 2003).
- Authentic tasks (Woo, 2007).
- Co-construction and negotiation of meaning (Dennen & Wieland, 2007).
- Sharing of learner-created artifacts (Dennen & Wieland, 2007; Garrison et al., 2001).

Include activities that help establish supportive and caring social connections (Garrison & Cleveland-Innes, 2005).

e.g. ice breakers

Information from Phases I and II should be used to inform the final phase, Phase III: Technology Integration.

Table 3

Guidelines for the Technology Integration Phase

In light of the identified learning objectives, learner traits, features of the learning context, and purposes for interaction and design decisions regarding learner control, feedback, motivation, and social engagement, identify technologies providing the most effective learning support…	
Key Question	**Guidance**
Do available technologies support identified interaction purposes?	Eliminate technological options from the LMS that do not support identified interaction purposes. When possible, supplement LMS with additional technologies that do support interaction purposes.

Do available technologies support different types of interaction?	• Learner-content interaction occurs when learner interact with content (Dunlap, Sobel, & Sands, 2007; Moore, 1989):
	  ○ Enriching interaction: Supports learner access to information.
	  ▪ e.g., links, forward and back buttons
	  ○ Supportive interaction: Helps learners understand and work with the material.
	  ▪ e.g., search function, zoom function
	  ○ Conveyance interaction: Provides ways to apply knowledge.
	  ▪ e.g., simulations, games
	  ○ Constructive interactions: Organizing and mapping knowledge and understanding.
	  ▪ e.g., concept map, organization charts
	• Learner-instructor interaction refers to dialogue between learners and instructor. The purpose is to motivate,

	stimulate and facilitate activities and strategies (Moore, 1989). o Provides for identified feedback opportunities. • Learner-learner interaction refers to interaction between one learner and other learner (Moore, 1989). o Provides for learner information exchanges, shared work, collaboration.
Has temporality of technologies been considered?	Synchronous interactivity: • Supports high social presence and immediate feedback (Chou, 2003; Tu, 2001). o Social presence primarily contributes to learners' social emotion. o High social presence is more likely to result in more social interaction in distance learning (Swan, 2002). • Supports more social interaction (Chou, 2002; Jonassen, 2001; Meyer, 2003; Pena-Shaff, Martin & Gay, 2001). • Effective in developing a sense of community among learners since it supports more cohesive interaction (Duemer, 2002; Jonassen, 2001). • Provides a higher level of immediacy than asynchronous technology (Horn, 1994). • e.g. video conferencing, webcasts, live presentation tools. Asynchronous interactivity: • Provides flexibility in terms of time and place, which can support learner control (Chou, 2002; Kiousis, 2002; Vrasidas & Zembylas, 2003). • Can provide an extended time period for interaction and

	more opportunity for reflection, critical thinking, and group problem solving (Angeli, 2003; Chou, 2002; Gilbert & Moore, 1998; Jonassen, 2001; Markus, 1994; McIsaac & Gunawardena, 2000). • e.g. email, blogs, bulletin boards.

Is the form of communication supported by the technologies considered?	Directionality:
	• One-way communication
	• Two-way communication
	  ○ Fosters interaction (McMillan & Hwang, 2002; Northrup, 2002; Roblyer & Wiencke, 2003; Woo, 2007).
	  ○ Supports interpersonal interaction and feedback capabilities (McMillan & Hwang, 2002; Oliver, McLoughlin, 1997).
	  ○ e.g., videoconferencing, teleconferencing and computer-mediated conferencing
	Flow:
	• One-to-one communication
	  ○ e.g., instant message, email
	• One-to-many communication
	  ○ e.g., blog, listerv, bulletin board
	• Many-to-many communication
	  ○ e.g., wiki, discussion forum

Note: Since technologies will continue to change, the technology phase diagram was intentionally limited to address only affordances and not specific technologies (that may or may not be current) and that the examples in the guidelines chart for this phase are not exhaustive but only representative.	

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