June 2015

APPLYING THE CASE-BASED METHOD IN DESIGNING SELF-DIRECTED ONLINE INSTRUCTION

Heng Luo
Syracuse University

Abstract

This study investigates the instructional-design theory of the case-based method and its application in designing self-directed online instruction, with the purpose of validating and refining the theory for this particular instructional context. Guided by the formative research methodology proposed by Reigeluth and Frick, this study first developed an online tutorial based on 13 design assumptions synthesized from the case-based instruction (CBI) literature, and then formatively evaluated the online tutorial as the design instance of the case-based method through two iterations of tutorial design, evaluation, and revision. It is assumed that the improvements made to the tutorial would reflect ways to improve the case-based method theory. The conclusions on the case-based method were drawn from a mixed array of empirical data collected from the tutorial learners, such as in-depth interviews, written documents, observations, and questionnaires. The major findings include: (1) learners' preference and perceived value of various CBI design features, (2) benefits and limitations of applying the case-based method in the tutorial design, and (3) validation and revision of a set of generic and context-specific CBI design assumptions. The findings in this study are expected to extend our understanding of the case-based method to the context of self-directed online instruction, and also provide useful insights and practical guidance to inform the instructional design practice in this specific design context.

APPLYING THE CASE-BASED METHOD IN DESIGNING SELF-DIRECTED ONLINE INSTRUCTION

by

Heng Luo

B.Eng., China University of Geosciences (Wuhan), 2005
M.A. China University of Geosciences (Wuhan), 2008
M.S., Syracuse University, 2013

Dissertation
Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Instructional Design, Development & Evaluation in the Graduate School of Syracuse University.

Syracuse University
June 2015

Acknowledgement

It is a long journey from saving the first draft of my dissertation proposal on January 5^{th}, 2012, to the present day. Luckily, I am not alone in this journey as I have the support and encouragement from my committee members, my teachers, my friends, and my family.

I would like to offer my greatest gratitude to my advisor, Dr. Tiffany A. Koszalka, for her exceptional guidance and mentoring, great patience and dedication, passion and humor, and providing me with an excellent example of educational researcher. I feel very lucky and honored to be your Ph.D. student.

I would like to thank Dr. Marilyn P. Arnone and Dr. Ikseon Choi, for your valuable feedback and kind encouragement during my dissertation process. I often feel enlightened and invigorated after reading your insightful comments.

Many thanks to Dr. Jing Lei, Dr. Nick Smith, Dr. Alan Foley, Dr. Jerry Edmonds, Ms. Linda Tucker, as well as other faculty and administrative staff at IDD&E, for providing me with all I need as a Ph.D. student. I would also like to take this opportunity to thank my friends: Yiyan 'Page' Wu, Liangyue 'Monie' Lu, Leigh Tolley, Laurene Johnson, Yan Huang, Ye Chen, Di Sun, Ashley Scott, Yufei Wu, Stacey White, Craig Howard, and so many others, for being my friends, peers, support group, reviewers, and co-authors.

I would like to thank Ann Taylor and Stevie Rocco at the John A. Dutton e-Education Institute in Penn State University, for offering me this great working opportunity as a Research Associate in the field of my research interests, as well as the tremendous research, financial, and visa support from the institute.

I also want to thank my parents, for always being there for me, no matter what.

Finally, I would like to thank my wife, Yuanyuan Yin, for taking care of me and cheering me up through good times and bad.

TABLE OF CONTENTS

List of Illustrative Materials

Tables

Figures

CHAPTER 1: INTRODUCTION

Background

Educational technologies have developed substantially in the past decade, in both the significant improvement of existing technologies such as educational websites and videos, and the growing popularity in using new digital teaching tools such as interactive whiteboards and mobile technologies. Aslan and Reigeluth (2011) observed that educational technologies' "rooted presence in our educational lives has continually increased over time" (p.1), as they have become increasingly interactive, customizable, multi-functional, and easy-to-use. However, despite this rapid development and growing usage of educational technologies, research seems to suggest that technologies have had limited impact on learning and instruction. Spector (2010) argued that the earlier promises of change and transformation in education through technologies like intelligent tutoring systems and large-scale virtual classrooms had failed to occur. Such arguments were later echoed by Selwyn (2011) who suggested that the "fundamental elements of contemporary learning and teaching have remained largely untouched by the waves of digital technologies that have been introduced inside and outside of the classroom over the last three decades" (p.714). Cuban (2012) expressed a similar view regarding the impact of new technologies on the traditional model of schooling. According to Cuban, the use of high-tech devices in schools is like "installing a jet engine in a Model T Ford" (Cuban, 2012, para.22). Technologies have rather limited impact on transforming education and appear to bring no fundamental changes to the traditional age-graded schools.

Educational technologies have often been found to merely support the teacher-centered, one-size-fits-all educational paradigm (Cuban, 2001; Aslan & Reigeluth, 2011) rather than transforming the educational paradigm with its advanced features and functions. Recent research indicates that technologies such as computers have been used infrequently and inconsistently in schools and had little conclusive effect on students' academic achievement (Brown & Green, 2008; Christensen, Johnston, & Horn, 2008; Cox, 2005; National Center for Education Statistics, 2010; Pea, 2000). For example, Brown and Green (2008) observed that computers in K-12 education have been mainly used for administrative purposes such as attendance, grading, and record keeping, rather than preparing lessons or facilitating instruction. Technology use in higher education has also been problematic. Take online instruction for example, Cox (2005) noticed that instructors of many online courses did not fully utilize the unique affordances of web-based technologies such as course management system or interactive media, and most online courses were still heavily text-based and didactic. As a result, only 32% of faculty members reported to have accepted the value and legitimacy of online courses according to a 2011 survey on more than 2500 U.S. colleges and universities (Allen & Seaman, 2011). In other words, while technologies are widely used in education, the powerful attributes (e.g., interactivity, multi-functionality) they offer are commonly underused, therefore their uses are failing to meet the needs and expectations of both teachers and learners.

To identify the causes of such problems, researchers started to scrutinize the research in educational technology. Reeves (1995) criticized many studies for being conducted without robust theoretical foundations, which led to poor "validity and social relevance" (p.468). Such criticism was supported by Ross, Morrison, and Lowther (2010), who argued that the proliferation of studies on cutting-edge technology applications often failed to be built on the well-established theories and principles in learning and instruction. Although there are studies that discuss the theoretical or pedagogical underpinnings of a technology application, most discussions simply specify what affordances of an existing tool can contribute to a theory-based instruction, rather than showing how theories are used to guide the design, development and evaluation of a technology application. Richey and Klein (2007) further pointed out that the practice of creating instructional products and tools was not sufficiently supported by scientific methods in the field of instructional design and technology (IDT), as “few models, design strategies and tools employed in practice have been empirically tested and validated” (p.3). As a result, several researchers have called for more research studies that examine the relationship between theory and technology through an iterative process of designing, testing, and revising theory-informed technology applications, with the purpose of refining theory and improving educational practice (Amiel & Reeves, 2008; Wang & Hannafin, 2005; Reigeluth & Frick, 1999). In line with such calls to research, this study investigates the case-based method instructional-design theory in the context of self-directed online instruction, and examines its theoretical assumptions in relation with web-based technologies based on empirical data from formative evaluation.

The Instructional-Design Theory of the Case-Based Method

Unlike learning theories that describe how learning occurs or curriculum theories that focus on the scope of instruction, instructional-design theory is rather prescriptive in nature, which “offers explicit guidance on how to better help people learn and develop” (Reigeluth, 1999, p.5). It aims to identify methods of instruction and the situations in which those methods apply or do not apply (Reigeluth, 1999). According to Pogrow (1996), research studies on instructional-design theories are much needed in the field of instruction as they can “develop techniques and determine implementation details that are applicable to most local conditions” (p.658). Examples of instructional-design theories include: Gagne's 9 Events of Instruction, First Principles of Instruction, Problem-based learning theory, and collaborative learning theory.

The case-based method is a widely used instructional-design theory that requires learners to "actively participate in real or hypothetical problem situations, reflecting the kind of experiences naturally encountered in the discipline under study" (Ertmer & Russel, 1995, p.24). The case-based method prepares learners for what they will encounter in their future professions by exposing them to similar scenarios or problems during the instruction (Andrews, 2002). The case-based method, often articulated as case-based instruction (CBI), seeks to develop learners' problem-solving skills in the complex and ill-structured contexts (Jonassen & Hernandez-Serrano, 2002), and has a long history of practice in many disciplines including law, business, medicine, and teacher education (Williams, 1992). Case-based method is considered to be "more engaging, more demanding, more intellectually exciting and stimulating, more likely to bridge the vast chasm between principle and practice" (Schulman, 1992, p.1).

It is important to note that the term *the case-based method* is often vaguely denoted in the literature without specific standards or criteria of what qualifies as its application in practice. As a result, many studies that investigated the effectiveness of CBI did not provide sufficient explanations of why the intervention under study was a good application of the case-based method. As Dooley & Skinner (1977) pointed out, "the phrase 'case method' embraces such an array of pedagogic practice that the term itself has no precise connotation. There are as many varieties of the case method as there are practitioners" (p.277). In other words, there are different ways of utilizing cases for pedagogical purposes. Instead of having only one model or theory, there are multiple learning theories that support CBI and there are multiple models of CBI developed in different fields and disciplines.

Regardless of different contexts and formats, three activities can be found in almost all types of CBI, thus should be considered as key components of CBI. The three activities include: (1) develop and present cases that are relevant, exemplary, problematic or controversial (Christensen & Hansen, 1987; Merseth, 1996; Stolovitch & Keeps, 1991); (2) provide reflective opportunities that seek comments, solutions, analysis or assessment from learners (Kleinfeld, 1992b; Jonassen & Hernandez-Serrano, 2002; Richert, 1991; Tippins et al. 2002); (3) facilitate small-group or large group discussion among learners regarding the cases (Merseth, 1996; Shulman, 1992; Wasserman, 1994). As a result, *the case-based method* in this study is used as an umbrella term for all forms of instruction that include the above three key activities rather than referring to only one method or model of CBI.

Many other terms were used to describe the pedagogy of teaching with cases in the CBI literature, such as *case-based instruction*, *case-based approach*, *case-based reasoning*, and *case-based learning*. With the purpose of distinguishing the case-based method from other similar terminologies, this study compares the common terms in CBI literature in Table 1.1 with regard to their definition, theoretical nature, and origin.

Table 1.1. *Comparison of Common Terms in the CBI Literature*

Terms	Definition	Theoretical nature	Theoretical origin
The case-based method (Luo & Koszalka, 2011)	An umbrella term for all methods that utilize cases extensively for pedagogical purposes	Prescriptive theory	Instructional-design theory
Case-based instruction (Andrews, 2002, Baker, 2002, 2009; Williams, 1992)	Instructional interventions that are designed using principles of the case-based method	Theoretical application	Instructional-design theory
Case-based approach (Ching, 2014; McNaught, Lam, Ong & Lau, 2007)	A specific solution to an educational problem that is guided by one or more principles of the case-based method	Theoretical application	Instructional-design theory

Terms	Definition	Theoretical nature	Theoretical origin
Case-based reasoning (Jonassen & Hernandez-Serrano, 2002; Kolodner, 1993)	The process of understanding and solving new problems by retrieving, interpreting and adapting cases (Kolodner, 1992)	Descriptive theory	Learning theory
Case-based learning (Allen, Otto & Hoffman, 2000; Choi et al., 2013; Flynn & Klein, 2001)	Learning that happens or gets enhanced as a consequence of case-based reasoning activities	Theoretical application	Learning theory

The advancement of web-based technologies enables multimedia and a variety of interactive functions to be built into web content more easily and integratively, therefore has provided opportunities for developing authentic and interactive cases for instruction. Rich media such as videos or images often convey more detailed information than text thus add a sense of authenticity to the cases. Interactive functions such as prompt questions, automated feedback, and navigation control allow learners to customize their learning process and actively reflect on the case scenario. As a result, interactive multimedia cases are considered as "far more complex and richer than paper-based or simple video-based cases" (Koury, 2009, p.299). Technology-supported CBIs integrating interactive multimedia have become popular and have led to a growing body of research since the mid-1990s (Baker, 2009; Choi, Lee & Jung, 2008; Choi & Lee, 2009; Jarz et al., 1997; Linn et al., 1996; Risko, Yount & McAllister, 1992;). Benefits of technology-supported CBI identified from this research include: engagement in generative discussions (Baker & Wedman, 2002), increased motivation (Hughes, Packard & Pearson, 2000), higher-level thinking (Risko, Yount & McAllister, 1992), enhanced knowledge transfer (Baker, 2009), and real-world problem-solving ability (Choi & Lee, 2009).

Statement of the Problem

While there is a growing body of research that investigates the effectiveness of technology-supported CBI, most studies were conducted in conventional classroom settings and nearly all of the CBI cases relied on instructor-facilitated instruction rather than instruction contained within the technology itself. There appears to be little research investigating the application of the case-based method in the context of self-directed online instruction. Only three self-directed CBI interventions, including a case-based e-learning module for environmental engineering design (Choi et al., 2012), an online case-based learning environment for teaching classroom management (Choi & Lee, 2009), and a multimedia-CBI lesson for anesthesiology instruction (Choi, Lee & Jung, 2008) were found during the review of the literature from 1990 to 2012. Consequently, a theoretical framework that embraces the key assumptions of both the case-based method and online instruction seems to be absent from the literature, and there is little empirical evidence regarding the strengths and limitations of applying the case-based method in the self-directed online setting.

At the same time, good instances of online CBI that demonstrate the key features of the case-based method are also few and sparse over the internet. For example, Luo and Koszalka (2011) searched for instructional materials that can be used for entrepreneurship education in elementary school. They found that most online materials only presented content that was abstract, general or fragmented, and failed to provide important contextualized information (e.g. implementation detail, student reaction) using narrative cases. Published materials were often missing instruction and activities that would facilitate learner reflection and discussion on cases. In other words, despite the opportunities for web-based technologies to develop and present rich cases, there were insufficient empirical findings on the design, development, and evaluation of

CBI in the online setting. The case-based method also seems to be rarely practiced by instructional designers when creating online instructional materials, evidenced in the absence of design precedents of self-directed online CBI.

To address the problem of insufficient research findings on the case-based method in the context of self-directed online instruction, this dissertation study investigates an online tutorial as the design instance of self-directed online CBI, and gathers empirical evidence on its key design features. According to Reigeluth and Frick (1999), any weaknesses found in a theory-based design instance may indicate the weaknesses of the theory, and any improvements made to the design instance may reflect ways to improve the theory. As a result, the dissertation findings on the case-based online tutorial are expected to extend our understanding of the case-based method in the subset context of self-directed online instruction, including its advantages, limitations, and possible ways of improvements.

The initial version of the tutorial was developed by the researcher and pilot-tested among 12 graduate students who majored in instructional design. The design features of the tutorial and the preliminary findings from the pilot test were reported in a study prior to the dissertation (Luo & Koszalka, 2011). This prior study documented how the tutorial design features (e.g. case selection and development, layout, structure, media selection, interactive functions, navigation control) were guided by a set of assumptions of the case-based method. Those assumptions include: (1) presenting cases in rich media, (2) developing cases with authentic materials, (3) including multiple perspectives in the presentation of the case, (4) providing ample opportunities for reflection and discussion, (5) including interactive features for guidance and scaffolding, (6) using cases for various pedagogical purposes. Based on data from the pilot test, this prior study analyzed the various tutorial design features in terms of learners' reactions, attitudes, and perceived usefulness, and proposed several ideas to improve the tutorial in its future versions.

Built upon the findings from the previous study, the researcher revised the online tutorial and conducted a second round of data collection, analysis, and revision by field-testing the revised tutorial among K-12 teachers, the target learners of the tutorial. The second round of formative evaluation provides a way to confirm earlier findings from the pilot study and justify the revised design features with empirical evidence. By documenting, analyzing, and assessing two iterative cycles of the tutorial design, test, and revision, this dissertation study aims to (1) describe and validate a set of theoretical assumptions for designing self-directed online CBI, (2) identify and discuss the benefits and limitations of applying the case-based method to design online instruction, and (3) provide new insights to improve and refine the theory of the case-based method for the subset context of self-directed online instruction.

The Case-Based Online Tutorial

The case-based online tutorial in this study was developed to teach educators how to design and conduct entrepreneurship programs for elementary school students. The tutorial is completely self-directed, using various cases from an exemplar after-school program to teach educators how to integrate entrepreneurial skills development into elementary school activities. Many studies have found that engaging students in entrepreneurial skills development at a younger age can bring many benefits, such as increased attendance, higher academic achievement, and enhanced locus of control (The Consortium for Entrepreneurship Education, 2004). However, there is a lack of well-designed online instructional materials for educators who are interested in conducting entrepreneurship enrichment programs in elementary schools. The development of this online tutorial was to address this need. After studying the tutorial, the educators were expected to design their own programs that engage elementary school students in entrepreneurial skills development. The first version of the tutorial was designed and developed in 2010 guided by the case-based method.

Apart from the aforementioned, well-known benefits of the case-based method (e.g., enhanced motivation and engagement, increased higher-order thinking and problem-solving skills), the selection of the case-based method for designing the tutorial was also due to the uncertain and complex nature of educators engaging children in entrepreneurial skills development. There is no single answer to what qualifies as the best content, format, and principles for entrepreneurship education. It is also hard to predict how children will react to prescribed learning activities as well as other possible problems that might emerge during entrepreneurship education. When facing a high degree of uncertainties, experts are known to rely more heavily on cases from past experiences rather than abstract principles (Klein & Calderwood, 1988). As a result, the tutorial can provide the target educators with vicarious experience packed in cases that they can reflect upon and draw lessons from, as opposed to teaching abstract definitions, techniques, and strategies for entrepreneurship education. The critical characteristics of the case-based method provided the basis for a set of theoretical assumptions for designing the online tutorial. The critical characteristics of the case-based method, the design assumptions, and the supporting literature will be further discussed in Chapter 2 – Literature Review.

The tutorial content was divided into three parts based on the three phases of entrepreneurship: *innovation & research*, *production & management*, and *publish & marketing*, with eleven entrepreneurial skills identified as associated with the 21st century skills (Partnership for 21st Century Skills, as cited in Luo & Koszalka, 2011) thus are desirable to teach to elementary school students. The cases in the tutorial were based on real stories, activities, instructional materials, or student products from Curiosity Creek, an exemplar after-school program that promotes entrepreneurial skills development in elementary school children (the program website: www.curiositycreek.org). Different types of multimedia (e.g. images, audios, videos, animations, etc.) and interactive features (e.g. prompt question, help and hint button, text-entry box, navigation control, etc.) were integrated into the tutorial during the case construction, using *Adobe Captivate 4.0* and *Dreamweaver CS 4*. Figure 1.1 shows the screen capture of a typical teaching case in the tutorial. The conversation in the exemplar between the Curiosity Creek program facilitator and students was presented in both text and multimedia. The scaffolding features like animations, hyperlinks, help buttons, and navigation control in the tutorial also allowed the teachers to reflect on prompt questions, review the definitions of entrepreneurial skills, seek help and guidance, and control their learning process. The major design features of the initial tutorial and revised tutorial are further described and analyzed in Chapter 3 – Methodology.

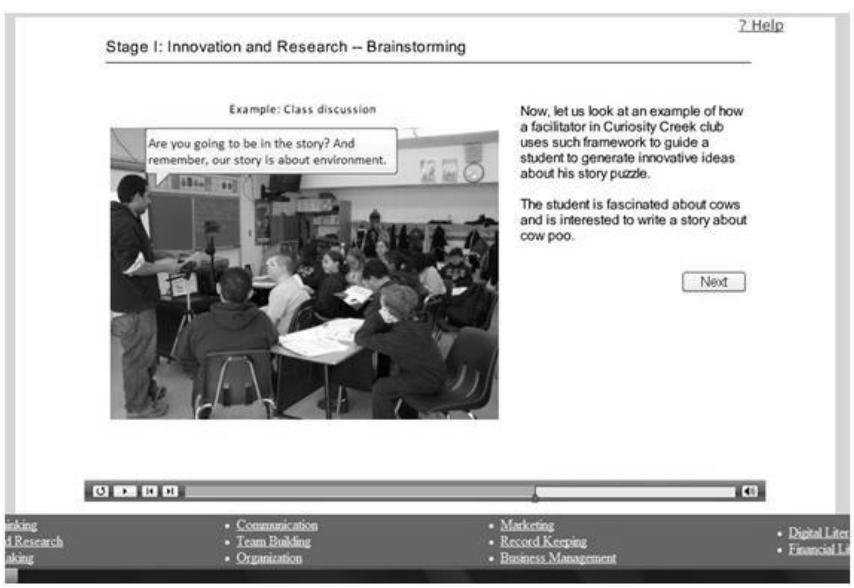


Figure 1.1. A screen capture of a case in the online tutorial

Research Questions

The tutorial is used as a design instance of self-directed online CBI in this study, using Curiosity Creek as the main case program. By examining the design features of the tutorial and their effects on learning, this dissertation study aims to refine the theory of the case-based method for its application in the online setting and validate a set of theoretical assumptions for designing self-directed online CBI based on empirical data. The research inquiry consists of five logical phases, the research findings and/or deliverables from a previous phase informs the research activities in the following phase. The five phases are:

Phase One: Identify key characteristics of the case-based method and describe theoretical assumptions for design online CBI. This phase identifies the critical characteristics the case-based method from the CBI literature and provides a set of theoretical assumptions for designing self-directed online CBI. The findings in this phase are summarized and included in Chapter 2 - Literature Review of the dissertation.

Phase Two: Develop a self-directed online tutorial as an instance of the case-based method. Based on the findings of Phase One, this phase documents the process of designing and developing a self-directed online tutorial and ensures it is based as exclusively as possible on the case-based method. The first version of the online tutorial (Tutorial 1.0) can be found at http://entrepforkid.syr.edu/. The major design features and development phases of Tutorial 1.0 are described and discussed in Chapter 3 – Methodology of the dissertation.

Phase Three: Pilot test - 1st iteration. A pilot test was conducted in Phase Three to identify and address the strengths and limitations of Tutorial 1.0, and collect the first round of empirical data on its functionality, usability, and design features. The preliminary findings from the pilot test include (1) effect of cases on learning, (2) perceived usefulness of multimedia, (3) findings regarding the interactive features, and (4) general learning patterns. Pilot test provided empirical evidence to refine the tutorial and helped identify issues with the research instruments and data collecting methods. The detailed description of the pilot test and its preliminary findings are included in Chapter 3 – Methodology of the dissertation.

Phase Four: Field-testing the revised tutorial among its target learners and repeat the data collection and revision cycle - 2nd iteration. Based on the findings of Phase Three, the researcher revised the tutorial and put it into a second round of formative evaluation (field test) with its target learners - elementary and middle school teachers, during Phase Four. The revised version of the online tutorial (Tutorial 2.0) can be found at https://courseware.e-education.psu.edu/cbi/tutorial2/story.html. This phase examined teachers' use of the tutorial, their perceived usefulness of its design features, and the evidence of learning. Empirical data collected from this phase were used to validate earlier findings in the pilot test and evaluate the revised design features in Tutorial 2.0. The research questions under investigation in this phase are:

- Research Question 1: What design features of the case-based tutorial are valued by the learners?
- Research Question 2: What design features of the case-based tutorial are not valued by the learners and what are the possible ways to improve them?
- Research Question 3: What are the benefits and limitations of applying the case-based method to design self-directed online instruction?

Phase Five: Refine the theory of the case-based method for designing self-directed online instruction. Based on the findings from previous phases and personal reflection, the researcher attempted to refine the theory of case-based method for the context of self-directed online instruction in Phase Five, and proposed a tentative theoretical framework for designing effective online CBI. Phase Five seeks to answer the following research question:

- Research Question 4: What possible improvements can be made to the case-based method in the context of self-directed online instruction?

Organization of the Dissertation

The remainder of this dissertation continues with a review of literature in Chapter 2. Chapter 2 defines the case-based method and provides an analysis of its key characteristics. Based on the review of both conceptual and empirical studies, this chapter then discusses the benefits and limitations of case-based instruction, especially technology-supported CBI based on both conceptual and empirical studies. It concludes with a set of theoretical assumptions for designing online CBI that were applied to the design and development of the case-based online tutorial.

Chapter 3 describes the formative research methodology used in this dissertation. The chapter begins with a brief description and review of formative research methodology. Based on the underlying logic of formative research, this chapter then explicates five interrelated logical phases that guided the dissertation study. The research instruments and data collection methods used in each phase are described, and justifications of instrument selection or development are also presented. There is a brief discussion about the results in Phase Two (development of tutorial 1.0) and Phase Three (pilot test) and how such results have informed the investigations in

Phases Four and Five. Summaries of related prior studies and their major findings are presented and discussed in Chapter 3 as part of the iterative methodology of formative research.

Chapter 4 presents an analysis of the findings from Phase Four of the study - the second round of formative evaluation (field test). Empirical data collected from this phase include learning patterns with the tutorial, perceived usefulness of tutorial features, and evidence of higher-order learning. Empirical data are analyzed to evaluate the design features of the revised tutorial and validate the theoretical assumptions for designing self-directed online CBI. Chapter 4 concludes with a discussion of the empirical findings for each of the Research Questions 1, 2 and 3.

Chapter 5 provides discussions on the dissertation methodology, implementation and results, with the main purpose to refine the case-based method theory for the self-directed online instructional context. The study findings are compared and contrasted with the findings from the existing CBI literature. The conflicting findings are further analyzed and discussed, and several improvements to the case-based method are proposed as a result, which provide tentative answers to Research Question 4. The limitations of the study and recommendations for further research are also discussed in this chapter. This chapter concludes with a set of validated and refined theoretical assumptions for designing self-directed online CBI.

Definition of Key Concepts and Terms

Case: a case in case-based instruction is defined as a “problem-oriented description of a believable event which provides enough details to allow for an analysis of the problem/solution process" (Stolovitch & Keeps, 1991, p.44). Merseth (1996) divided instructional cases into three categories based on their purpose and use: (1) cases as exemplars, (2) cases as opportunities to practice analysis and contemplate action, and (3) cases as stimulants to personal reflection.

Case-based instruction (CBI): CBI is the instruction practice guided by the principles of the case-based method. Rather than presenting general theories and concepts, CBI actively engages learners in the process of analyzing, discussing, critiquing, and reflecting on different scenarios, problems and situations, with the purpose of preparing learners for scenarios in their future professions by exposing them to similar contexts.

Instructional-design theory: Instructional-design theory is also known as instructional theory, which "offers explicit guidance on how to better help people learn and develop" (Reigeluth, 1999, p.5). Instructional-design theory is prescriptive in nature, with the purpose to prescribe a set of methods, strategies, principles, and activities to achieve a desired outcome under a given instructional condition.

Interactive features: Interactive features are designed characteristics or functions of instruction that allow learners to engage in meaningful activities such as self-navigating, selecting information, responding to questions, solving problems, completing tasks, constructing knowledge and collaborating with others (Reeves, 1999).

Multimedia: Multimedia is a combination of different media types such as text, audio, still images, animation, video, or interactive content. Multimedia is often used in contrast to traditional media content like text-only or paper materials.

Self-directed online instruction: Self-directed online instruction refers to instructional contents such as course modules, tutorials, educational websites that learners can access online and study by themselves without the facilitation of an instructor. It is also considered the primary format of online instruction for teaching adult learners in training settings (Driscoll, 2002; Kim, 2004).

The case-based method: According to Matejka and Cosse (1981), the case-based method is "an instructional technique that, rather than presenting general concepts and theories, provides situations to analyze data from which decisions must be made" (p.2). It is used as an umbrella term in this study for all methods that utilize cases extensively for various pedagogical purposes. The three key activities of the case-based method are: case presentation, case analysis, and case discussion.

Web-based technologies: Web-based technologies are defined as technologies for designing, managing and distributing digital content for online use. Web-based technologies used for the case-based online tutorial in this study include e-learning development tool (Adobe Captivate 5.5), web design software (Adobe Dreamweaver CS4), graphic editing software (Adobe Photoshop CS4), video editing software (iMovie 9.0).

Formative research: Formative research is a research methodology proposed by Reigeluth and Frick (1999) to develop or improve an instructional-design theory by formatively evaluate a design instance of the theory through iterative cycles of design, implementation, and revision. In many ways, formative research is similar to design-based research, but it focuses on design theory validation and refinement, and always involves the creation of an instructional intervention based exclusively on a single theory.

Summary of the Introduction

The introduction chapter begins by suggesting that technology use in education has increased over the decades, yet the powerful attributes of technology have not been effectively utilized in instruction. One possible reason for such problem may be that the design of technology-facilitated instruction often failed to be supported by the assumptions of well-established learning and instructional theories. The case-based method is introduced in this chapter as an instructional-design theory that may enhance the impact of technology. This method employs narrative cases extensively for various pedagogical purposes and often includes activities such as case presentation, case analysis, and case discussion. While there has been a growing body of research on the case-based method, most studies were conducted in face-to-face classrooms. There is insufficient research on CBI application in the online setting, and a lack of empirical evidence to support the theoretical assumptions for designing self-directed online CBI.

As a result, this dissertation continues the investigation of the case-based method theory in the context of self-directed online instruction by examining a case-based tutorial as its online application. After a brief overview of the tutorial, this chapter describes the logical phases to investigate the case-based design features in the tutorial through iterative cycles of data collection and revision. The findings are expected to extend the understanding of the case-based method and provide new insights on how to conduct research to refine instructional-design theory. Research questions, the organization of the dissertation, and the definitions of key terms are also provided in the introduction chapter.

CHAPTER 2: LITERATURE REVIEW

Introduction to the Literature Review

Chapter 2 of the dissertation reviews the relevant literature on the case-based method instructional-design theory. This chapter begins with a discussion on the definition of the case-based method, and analyzes its key characteristics including its theoretical foundations, pedagogical purposes and essential activities. It then narrows the scope of literature review to the context of teacher education since the instance of CBI under investigation in the dissertation was designed for teachers. After reviewing the existing research claims regarding the effects of the case-based method on teacher education based on the empirical evidence, this chapter further examines how CBI can be supported by different types of technologies such as video, hypermedia, computer and web technologies, and discusses the potentials and challenges of technology-supported CBI in various educational contexts. Chapter 2 concludes by proposing a set of theoretical assumptions for designing self-directed online CBI.

What is the Case-Based Method?

History of the Case-Based Method

Education has a long history of using cases to facilitate teaching (Doyle, 1990; Merseth, 1991; Skykes & Bird, 1992). The pedagogy of teaching with cases was believed to be introduced by Christopher Columbus Langdel, the dean of Harvard Law School in 1870s, who used selected cases from the records of appellate courts to facilitate discussion and analysis among students (Carter & Unklesbay, 1989). Due to its effectiveness in legal education, the pedagogy had been later employed in most well-known law schools in the United States by 1915 (Culbertson, Jacobson, & Reller, 1959), and soon spread to other fields such as medicine and business education (Merseth, 1991).

Despite its great success in other fields of education, the pedagogy of teaching with cases was not well received by faculty and administrators in teacher education at the beginning, and its implementation in teacher education programs was rather sporadic before the mid-1980s (Merseth, 1996). For example, the former Harvard President Lowell once vetoed a proposed case-based curriculum for the Harvard Graduate School of Education with the comment that "educational principles were more likely to emerge from mathematical analysis of large numbers of examples than from detailed analyses of particular cases" (Powell, 1980, p. 166).

However, since the mid-1980s, there has been a growing interest in cases and case knowledge among teacher educators, resulting in an increasing body of literature on Case Based Instruction (CBI) including textbooks, readings, casebooks, practice reports and empirical research (Merseth, 1996). Doyle (1990) believed the growing popularity of CBI was due to a fundamental shift in teacher education, which placed more emphasis on "the complex cognitive processes that underline successful performance in classroom settings" rather than a set of prescribed theories, propositions, and behaviors (p.8). Doyle's argument was supported by Shulman (1992), who noted:

> Apparently, learning is much more situation-specific than heretofore imagined…Thus, the specificity and localism of cases as instructional materials may not be problematic for learning; indeed, they may be far more appropriate media for learning than the abstract and decontextualized lists of propositions or expositions of facts, concepts, and principles. (p.24)

Definition of Cases

Stolovitch and Keeps (1991) defined case in CBI as a “problem-oriented description of a believable event which provides enough details to allow for an analysis of the problem/solution process" (p.44). Barnes, Christensen and Hansen (1994) later extended such definition for case and argued that a teaching case can be “a description of episodes of practice, a selection of reality, a slice of life, a story designed and presented as study material, an exercise, a puzzle, or a problem” (p. 71). According to this definition, cases might vary in the type and amount of information they include (e.g. fictional stories, authentic materials) and be presented in different medium (e.g. text, video, game) and genres (ethnography, official reports and records). While cases might take different forms, Riesbeck and Schank (1989) identified two critical aspects for most cases: knowledge elements and a specific context. Knowledge elements are organized and presented in a specific context to explicate how they are applied in the case event and what strategies or actions are likely to succeed in that specific context.

A good case should recognize the controversy and ambiguity of the practical world and include enough complexity and perplexity to inspire rich educational discussions (Barnes et al., 1994). The controversy in a case can promote open-ended discussions in which learners clarify and defend their positions. The ambiguity in a case reflects the reality more accurately with “all of its deception, contradictions, discrepancies of perception, and general resistance to orderly analysis”, and usually makes the case fun to analyze and discuss (Barnes et al., 1994, p.72). Cases are often used to explicate theories and principles in a specific context and promote reflective activities such as interpretation, problem solving, discussion, and reflection (Doyle, 1990, Sykes & Bird, 1992). As a result, a good case should include adequate contextualized information and critical decision points for learners to analyze a specific situation and evaluate their proposed actions.

Definition of the Case-Based Method

Despite its increasing popularity in various disciplines, there is no universally accepted term for the pedagogy of teaching with cases. The common terms that refer to such pedagogy include *case method* (Doyle, 1990; Merseth, 1991, 1996; McAninch, 1993), *case study* (Greenwood & Parkay, 1989; Kowalski, Weaver & Henson, 1990; Stolovitch & Keeps, 1991), *case-based approach* (Choi, in press; McNaught, Lam, Ong & Lau, 2007), *case-based learning* (Allen, Otto & Hoffman, 2000; Flynn & Klein, 2001), *case-based reasoning* (Jonassen & Hernandez-Serrano, 2002; Kolodner, 1993) and *case-based instruction* (Andrews, 2002, Baker, 2002, 2009; Williams, 1992). The meanings of those terms might differ slightly depending on contexts. For example, *case-based reasoning* is often considered as a learning theory that emphasizes the internal cognitive process of learning from cases while *case-based approach* usually refers to a prescribed instructional practice that relies on cases to solve a specific problem. A clear-cut distinction of those terms is neither practical nor necessary in this study because the differences in their meanings are usually quite trivial and they were often used interchangeably in the literature. To avoid confusion caused by the different names used to describe the case pedagogy, this study uses *the case-based method* as an umbrella term for all methods that utilize cases extensively for different pedagogical purposes.

The case-based method, as defined by Matejka and Cosse (1981) is “an instructional technique that, rather than presenting general concepts and theories, provides situations to analyze data from which decisions must be made” (p.2). There is more than one definition for the case-based method, as the characteristics of cases and related methods often differ from field to field, and even within the same field (Shulman, 1992). For example, in business education, the case-based method is also known as the case method of analysis, which is defined by Helms (2006) as follows:

> The case method of analysis involves studying actual business situations - written as an in-depth presentation of a company, its market, and its strategic decisions - in order to improve a manager's or a student's problem solving ability. Cases are typically used to investigate a contemporary issue in a real-life context. There are multiple issues to consider and many "correct" or viable alternatives to solve the case issues are presented. (p. 68)

In the field of legal education, the case-based method of teaching law is characterized by "teacher-led, large-group discussions" (Williams, 1992, p.377). The implementation of the case-based method in legal education is described by Williams (1992) as the following:

> Students learn the rules of law through the process of preparing briefs of appellate court cases and presenting these briefs in class. The point of view of the student who presents is challenged by the professor. Through questions and comments, the professor highlights the important features of the case, as well as any errors the student may have made. (p.377)

The case-based method in medical education is also known as *case conference* or *instance-based recognition* (Eshach & Bitterman, 2002). Unlike in the field of law, Williams (1992) observed that CBI in medical education was often conducted in student-directed, small cooperative groups, and provided the following description for the case-based method in medical education:

> As a group, students learn basic science knowledge and the process of making a diagnosis by studying the records of an actual patient. The records are presented in a format that allows students to simulate the process of examining and diagnosing the

> patient. Instructors provide guidance, but they do not direct. Students learn to monitor their own understanding of problems to determine what topics they need to study. Then they learn how to research these topics by trial and error rather than by being given a prepared list of references. (p.393)

The case-based method is playing an increasingly important role in teacher education (Merseth, 1996) and is considered as a solution to many problems in teacher education programs caused by "uninspired pedagogy, mindlessly memorizing and rotely rehearsing" (Shulman, 1992, p.1). The characteristics of the case-based method and their unique benefits in teacher education are summarized by Shulman (1992) as follows:

> I envision case methods as a strategy for overcoming many of the most serious deficiencies in the education of teachers. Because they are contextual, local, and situated...cases integrate what otherwise remains separated. . . . By using multiple cases and yeasty layers of commentary, teacher educators will resist the temptations of easy formulas...Complex cases will communicate to both future teachers and laypersons that teaching is a complex domain demanding subtle judgments and agonizing decisions. (p.28)

In summary, there is no easy answer to the question of *what the case-based method is* because the method has been referred to by different terms in the literature. The standards, purposes and practices it implies vary in different fields. As observed by Dooley & Skinner (1977), the case-based method (or *case method* in their words) "embraces such an array of pedagogic practice that the term itself has no precise connotation. There are as many varieties of the case method as there are practitioners" (p.277). As a result, rather than trying to come up with a universal definition for the case-based method, it is more useful to establish a conceptual framework for understanding the method by examining its key characteristics such as its theoretical foundation, pedagogical purposes, and essential activities .

Key Characteristics of the Case-Based Method

Theoretical Foundation

The case-based method is rooted in the belief that human mind operates like a pattern recognizer (Churchland, 1995; Clark, 1997, 2003; Elman et al., 1996; Nolan, 1994) – it has the capacity to identify, associate and organize similar structures, events, or contexts into a meaningful whole (Andrews, Hull, & Donahue, 2009), which enables learners to generalize from previous experiences and make informed decisions in future contexts (Hawkins & Blakeslee, 2004; Kolonder, 1993). Based on such belief, several learning theories can be identified from the literature that can be used to explain the underling mechanism of learning with cases. Those learning theories are: *depth of processing theory* (Craik & Lockhart, 1972), *recognition-primed decision (RPD) model* (Klein, 1989, 1997, 2008) and *situated learning theory* (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1990), and they are considered as the theoretical foundation for the case-based method in this study.

Depth of processing theory

According to the depth of processing theory proposed by Craik and Lockhart (1972), perception requires the analysis of stimuli at different *depths* or *stages*, and greater ‘depth’ means greater degree of cognitive analysis. Preliminary stages of processing deal with the sensory analysis of stimulus input (e.g. visual or acoustic features of perceived information), while later stages are mainly concerned with pattern identification, meaning extraction, and semantic association. Craik and Lockhart (1972) argued that the sensory coding in the preliminary stages was “shallow” processing, and the pattern/semantic association in the later stages was “deep” processing.

Research evidence indicates that the depth of processing determines the persistence of memory trace: Perceptual processing at a deeper level could result in more elaborate and longer lasting memory traces. For example, Elias & Perfetti (1973) conducted an experiment to compare the incidental word recall of two groups of participants, with one group performing the task of finding words that rhymed in a list and the other group finding words that are synonyms. Both groups didn’t know they would be asked to recall words from the list after the tasks. The rhyme task was considered as shallow processing since it involved only acoustic analysis, and the synonym task was considered as a deeper processing as it involved meaning extraction and sematic association. Research findings showed that participants who performed the synonym task recalled significant more words, indicating deeper level of processing can result in better recall. Hyde and Jenkins (1973) conducted a similar study in which participants were assigned to five different tasks and found that semantic tasks produced significantly better recall than graphic and syntactic tasks. One interesting finding from the study was that there was no significantly difference between the incidental learners and the intentional learners, suggesting it was the level of processing rather than the intention to learn that affected the learning outcomes.

In order to facilitate the desired ‘deep’ analysis in later processing stages, the case-based method packs stimuli in written cases and presents them to learners in a contextually ordered, meaningful way. Meaningful stimuli are believed to be analyzed more rapidly at a deeper level and integrated more easily to the extant knowledge. The case-based method emphasizes the importance of integrating new information into existing cognitive structure through the use of a case library. Cases and stories are often compiled and indexed into a case library that covers a variety of situations, which enables learners to retrieve stories and compare problems when needed, and expand their repertoire of experiences (Edelson, 1996; Kolodner, 1993; Jonassen & Hernandez-Serrano, 2002). According to Jonassen and Hernandez-Serrano (2002), those experiences "serve as a basis for interpreting current and future stories, forewarning us of potential problems, realizing what to avoid, and foreseeing the consequences of our decisions or actions" (p.69).

Recognition-primed decision (RPD) model

Case-based method is believed to optimize learners' decision making process in complex situations and better prepare them for what they will encounter in their future professions (Andrews, 2002). Recognition-primed decision (RPD) model is often used to explain how the decision making process can be facilitated by case-based instruction. The RPD model was proposed and revised by Klein (1989, 1997, 2008) and was originally used to describe how experienced firefighters made decisions under time pressure and uncertainty (Klein, Calderwood, & Macgregor; 1989). Klein et al (1989) interviewed more than 30 fire ground commanders with an average of 23 years of experience and analyzed the retrospective data on 156 highly challenging tasks. It was found that the commanders rarely compared and contrasted a list of solutions when making decisions but rather carried out the first solution they recognized from a similar situation, which they considered would achieve the outcome. Empirical evidence supporting the RPD model can be found in other professions such as naval officers (Kaempf, Klein, Thordsen, & Wolf 1996), chess players (Klein, Wolf, Militello, & Zsambok, 1995), paramedics and helicopter pilots (Klein, 1998).

The RPD model emphasizes the importance of *recognitional capacity* that distinguishes experts from novices. According to Klein (1989), *recognitional capacity* is the ability to identify cues in a given situation that allow one to recognize similar patterns and generate the most feasible action for that situation. Experts recognize situations differently from novices as they can perceive larger chunks of information, have a more holistic view of relationships, and detect subtle differences or similarities (Klein, 1989). The prior experiences provide experts with an archive of “prototypes” and “functional categories” that enables them to perceive new situations as typical cases and implement certain types of actions that are typically feasible and effective (Lipshitz, Klein, Orasanu, & Salas, 2001, p.336). In more complex situations, the typical course of actions might be subject to series of mental evaluation and modifications until a satisfactory solution is developed (Klein & Peio, 1989). The decision making logistics of the RPD model is shown in Figure 2.1., which helps explain how CBI help learners draw from prior experiences and make the right decisions in their own contexts. By exposing learners to authentic or hypothetical scenarios with the right instructional scaffolding, the case-based method highlights the similarities between a new situation and typical cases. It then guides learners to practice and refine their decision making skills by implementing or revising a course of actions based on the past experience.

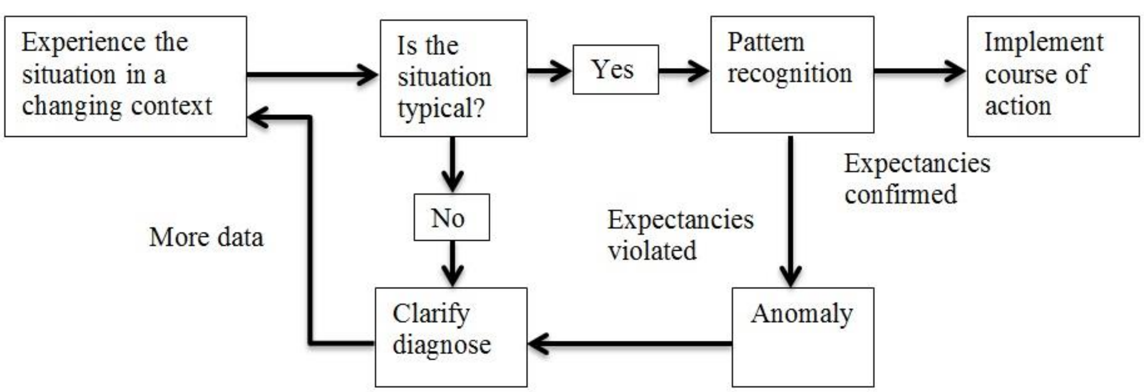


Figure 2.1. Decision making logistics of the RPD model (adapted from Patterson et al., 2009)

Situated learning theory

Situated learning, also known as situated cognition, is “the notion of learning knowledge and skills in contexts that reflect the way the knowledge will be useful in real life” (Collins, 1988, p.2). It embraces the epistemology that “activity and perception are importantly and epistemologically prior – at a non-conceptual level – to conceptualization” (Brown, Collins, & Duguid, 1989, p.41), and believes that meaningful learning often occurs unintentionally in authentic contexts with guided social interaction and collaboration (Lave & Wenger, 1991). Brown et al (1989) discussed the situated nature of learning by comparing two methods of learning vocabulary: learning from a dictionary and learning from authentic situations. They noted that learning words in the context of ordinary communication was “startlingly fast and successful” and learning words from dictionary definitions was “generally slow and unsuccessful” (p.32). As a result, Brown et al (1989) asserted that understanding was developed through “continued, situated use” that involves complex social negotiations in authentic situations (p.33). They further argued that:

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

By setting learning activities such as problem solving in situations that are authentic and relevant to learners, the situated learning theory also increases the “personal relevance and utility” of those learning activities thus benefits learning from the motivational perspective

(Paris, 1997, p.22). For instance, Schell and Black (1997) examined the situated learning activities in a doctoral-level management course and found that “motivation evolved from learner's self-empowerment in situated learning contexts” as learners seemed self-motivated to reflect on the application of acquired knowledge to their personal situations (p.25-26).

The situated learning theory includes four critical components: realistic context, authentic activities, expert performance, and multiple perspectives (Bransford, Vye, Kinzer, & Risko, 1990; Brown, et al., 1989; Brown and Duguid, 1993; Herrington & Oliver, 1995; Lave & Wenger, 1991; Tripp, 1993; Young, 1993). Situated learning theory emphasizes the role of context on cognition. The contextualized properties of an instructional problem facilitate how the problem is to be perceived and offer additional support and strategies to its solution (Ceci & Ruiz, 1993). The “episodic memory cues” embedded in the context also make the learning event more memorable and increase the retention of acquired knowledge (Jonassen, 1991, p.37). Authentic activities provide learners with hands-on practice to apply their newly acquired knowledge. The fact that there is rarely one single, neat answer promotes critical thinking and metacognition, and prepares learners for the complexity and uncertainty of the real-world (Bransford et al., 1990; Herrington & Oliver, 1995). Expert performance has its origin in a classic form of instruction – apprenticeship, where learners learn new skills by shadowing an expert (Collins, et al., 1989). The access to expert performance allows for constant comparison and evaluation of performance (Collins et al., 1989), accumulation of useful narratives and stories (Brown, et al., 1989), and implicit acquisition of strategies and habit of mind (Lave & Wenger, 1991). Situated learning is also known for the multiple perspectives it often present (Bransford et al., 1990; Young, 1993). The complexity owing to multiple perspectives enhances learners' understanding of a subject area (Sandberg & Wielinga, 1992), and the accumulation of practice from multiple perspectives is essential for the development of expertise that enables learners to view relevant connections in a complex case more holistically (Spiro, Feltovich, Jacobson, & Coulson , 1991).

The epistemology of situated learning theory and its emphasis on contexts, authentic activities, and multiple perspectives greatly influences the case-based method. Many activities in CBI can find their origins and rationales in the situated learning theory, including engaging learners in authentic situations, presenting real-world problems, providing conflicting perspectives, promoting group discussion, and including instructional scaffolding at critical times. Collins (1988) lists four benefits of situated learning and we believe the same can be said to the case-based method:

- Students will recognize the condition to apply the knowledge and be better prepared in a new situation by referring back to similar conditions during the learning.
- Students will be more engaged and are more likely to practice their problem solving skills in novel and diverse situations.
- Students will see the implication of the knowledge: how it is used in different situations and its significance.
- Students are supported in structuring knowledge for future use by learning and applying that knowledge in contexts.

Pedagogical Purposes

Cases have been used with a variety of intended purposes in different fields. For example, in the field of law, a legal case and its verdict becomes an official precedent that requires attention for all lawyers and jurists when facing similar situations (Shulman, 1992). In teacher education, cases such as classroom teaching videos are often used to exemplify how a principle or technique is implemented in a class so that student teachers can follow those examples in their future practice (Sykes & Bird, 1992). In business education, cases largely focus on prompting deep discussion and reflection among learners with the purpose to develop their critical and analytical reasoning skills (Christensen & Hansen, 1987). The Pedagogical purposes of CBI in a professional field were often determined by the nature of knowledge existing in that field, and would also define how cases were to be designed, presented and used in its context of instruction (Merseth, 1991; Merseth & Lacey, 1993). The relationship between case purpose, case development and instructional context was summarized by Sykes and Bird (1992), who asserted that "case development depends on the context of use and on the part cases will play in the knowledge of the field" (p. 479). As a result, it is important to understand the pedagogical purposes of CBI as they provide a premise to understand, analyze and evaluate the essential activities prescribed by the case-based method for a specific context.

Shulman (1992) surveyed the CBI literature across different disciplines and identified five major purposes of teaching with cases. He provided the rationale for his classification of case purposes and justified the rationale with concrete examples of how cases were employed in real teaching practice. The major purposes of cases and their rationale and examples are summarized in Table 2.1. In addition, Shulman also argued that cases can be used to: (1) create or increase motivation for learning, (2) provide unique benefits for those who participate in case writing, (3) avoid the danger of overgeneralization, and (4) allow learners to form communities for discussion or discourse.

Table 2.1. *The major purposes of cases and their rationale and examples summarized by Shulman (1992)*

Purpose	Rationale	Example
Teach principles or concepts of a theoretical nature	Cases provide contexts for theories to justify the appropriateness of actions. New principles or theories can be adduced from cases and tested through cases.	Conant (1947) presented vivid stories of scientific discoveries in his lecture to teach the principles of the tactics and strategies of science to nonscientists, and reject the prevailing, oversimplified view of scientific method.
Teach precedents for practice	If a case presents a problematic situation, a variety of possible approaches and an account of its solution, learners can treat the case as a model for practice, or a precedent for future action.	Researchers found out that chess expertise consists mainly of organized memory of thousands of chess games. A chess master relies on those game scenarios reminiscent of her current spot in the game to guide her decisions.
Teach morals or ethics	Cases have been used to teach morals or ethics for thousands of years. They can serve as parables to provide a model of attitude or behaviors worthy of emulation.	Stories of learners from low social economical background overcoming disadvantages in their life can send a moral message to teachers: we shouldn't prematurely label students and limit their growth through low expectations.
Teach strategies, dispositions, and habits of mind	The work of most professions is characterized by unpredictability, uncertainty and judgment. Cases are usually messy and complex, with no single right answer. They reflect the reality in many professional fields more accurately than didactic pedagogies therefore are ideal to train the neophyte to think like a professional.	Teaching teachers to be more reflective on their teaching practices is considered as an important goal for teacher education. Because of their inherent complexity and multiple layers, cases were widely used in teacher education programs to facilitate reflective practice among students.
Teach visions or images of the possible	Realities of most real works are mundane and habitual. Education that only focuses on reality enables learners to emulate and reproduce old methods rather than propose creative solutions for new problems. Well-designed cases can provide a middle ground between unfettered fantasy and unimaginative reality, and prepare learners for the possible future scenarios.	Lampert (1990) created a rich narrative case of an imaginative mathematics classroom, portraying the actions and dialogues of students when confronted with the mathematical tasks designed by the author. Her case demonstrates how mathematics should be taught and why it is possible to do so.

Shulman's classification of case purposes is based on the nature of knowledge to be taught in different instructional contexts. These purposes are determined by the instructional goals of CBI, describing *what cases can teach.* Another way to analyze case purposes is to examine the ways cases are used to facilitate learning, explicating *how cases can be taught*. For example, Doyle (1990) identified two common purposes of CBI in teacher education. The first purpose is to provide "prototypes" that "instantiate" (p.13) theories or principles with concrete examples, explaining how theories or principles can be derived from practice and be applied to solve a practical problem. The following is an example of such prototype. It is an excerpt from a case created by Lee Warren, describing a useful strategy to promote participation in a political science classroom (as cited in Barnes et al., 1994, pp.209-212).

> When we did court cases, which we did for a fair number of weeks, it was very helpful to assign the plaintiff or defendant role to specific people. They knew a week ahead of time that they would have to take the lead in presenting arguments. The feedback I've had was real positive. They enjoyed playing those roles. Sometimes they could step out of their own personality and express other views. There was a danger in this if students got too caught up in facts and didn't see the larger issues or paid all their attention to just one case and didn't read the other material. But if you kept an eye out for the dangers, the role playing was a nice change for a couple of weeks. (p.211)

The second purpose of cases identified by Doyle (1990) is to provide occasions to practice "problem solving and decision-making", as cases are often used "as pedagogical tools for helping teachers practice the basic professional processes of analysis, problem solving, and decision making" (p. 10). For example, Marina McCarthy wrote a case about the problem of late assignment (as cited in Barnes et al., 1994, pp.203-208). In this case, she described several encounters between a teacher and a student named Cecilia who constantly failed to submit her assignments, and ended the case with a dilemma and a few possible solutions. The following is an excerpt from the case that prompts learners to evaluate different aspects of the problem and make decisions for the teacher in the case:

> Cecelia came to take her exam December 22 without her paper. She asked for another extension. I told her I could hold off the registrar until January 3, but no later…Should I stall the registrar while I wait for Cecelia yet once again to send the promised Xerox copy? Should I go ahead and calculate her grade without the research paper? She did take the final exam. Maybe her grade will be passing after all. My options are limited. The Rhetoric program does not allow incompletes. Either I pass her or I fail her. (p. 208)

Sykes and Bird (1992) provided their analysis of case purposes and argued that cases were mainly used for providing “instances of theory” and “problems for deliberate and reflective action” (p.444). Like Dolye (1990), Sykes and Bird (1992) recognized the use of cases in providing examples and problem solving practice, and they also emphasized the role of cases in promoting learners’ conscious reflection on their decisions. According to Sykes and Bird (1992), the mode of reasoning with cases relies not on any explicit theory, but on the internal and tacit logic developed through the consideration of multiple cases.

Summarizing the work of Doyle (1990), Shulman (1992), and Sykes and Bird (1992), Merseth (1996) proposed a conceptual framework to examine the diverse literature of CBI in teacher education, which divided case purpose and use into three main categories, including 1) using cases as exemplars, 2) using cases as opportunities to practice analysis and contemplate action, and 3) using cases as stimulants to promote personal reflection. While this conceptual framework was proposed within the context of teacher education, we believe the three categories of pedagogical purposes identified by the framework can be applied to other fields of instruction as well.

Cases as exemplars are often used to demonstrate the desired principle, theory or instructional technique (Sykes & Bird, 1992) in a specific context. The exemplars prioritize the general and propositional knowledge (Doyle, 1990), with the purpose to theorize, prescribe, or model the best practice. Using cases as exemplars is believed to foster a deeper understanding of the connection between theory and practice.

Cases are also used to present problematic situations for learners to analyze the problem and explore different solutions. According to Sykes and Bird (1992), using cases in such a way provides learners with opportunities to practice professional skills such as "interpreting situations, framing problems, generating various solutions to the problems posed and choosing among them" (p.482). As a result, Jonassen (2010) considered cases as the "building blocks of problem-based learning environments" that enhance students' understanding of the problem and develop their problem solving skills (p.7).

The third purpose of cases is to stimulate and promote personal reflection. As Merseth (1996) noted, "reflection derives from a directly or vicariously experienced situation that puzzles or surprises" (p.729). By presenting learners with their own experience or the experience of others, cases appear to promote learners' reflective activities during the learning process. The ability of cases to enhance reflection was discussed extensively in the literature, especially in the field of teacher education, with empirical findings suggesting improved reflection on educational theories, increased awareness of teaching practice, and construction of teacher identities. (Hewitt et al, 2003; Hourigan, 2008; Kleinfeld, 1992b; Laboskey, 1992; Rosen, 2008; Shulman, Colbert, Kemper, & Dmytriw, 1990).

Essential Instructional Activities

By examining the theoretical foundation and pedagogical purposes of CBI, the characteristics of the case-based method were mainly analyzed on a conceptual level. To extend the analysis to a more pragmatic level, the literature review in this section focuses on the practice of CBI, identifying and discussing the essential instructional activities prescribed by the case-based method. Although CBI in different instructional contexts often vary in terms of pedagogical purpose, case material, delivery medium, and instructor role, three activities have been identified in almost all interventions of CBI, including (1) develop and present cases (Christensen & Hansen, 1987; Merseth, 1996; Stolovitch & Keeps, 1991), (2) provide reflective opportunities such as analysis, commentary and evaluation (Kleinfeld, 1992b; Jonassen & Campbell, 2002; Richert, 1991; Tippins et al. 2002), and (3) facilitate small group or large group discussion (Merseth, 1996; Shulman, 1992; Wasserman, 1994). These three activities are stated in a rather generic manner, and the specific operations within each activity are elaborated in the following.

Develop and present cases

Almost all instructional activities in CBI are based or partially based on the analysis of cases, thus the quality of CBI is largely determined by the quality of cases (Barnes et al., 1994; Levin, 1995; Williams, 1992). As a result, case development and presentation is an essential activity for any types of CBI. According to Barnes et al (1994), the objective of case development is to “find a provocative, puzzling story and recreate it for your readers” (p.287). First, a case writer should identify the potential material to collect and reproduce data for case writing. The case material can come from writer's own experience or from interviewing other people, and often includes "a web of decisions," different "points of view" from its key characters, "a complex context with characteristics that other settings share," "one broad applicable theme," and "one major decision point" (p.288).

When working with the case material, Barnes et al (1994) suggested that the case writer should "mentally reconstruct the 'who,' 'when,' 'where,' and 'what' with reasonable objectivity" (p.288), and tailor the case writing to include (1) narrative account of a typical problematic situation, (2) actions made by the characters to solve the problem, (3) responses or consequences as a result of the actions, and (4) characters' thoughts and reflections. Case writing should be guided by clearly defined objectives to help learners understand a specific problem (Stolovitch & Keeps, 1991). It should also consider the characteristics of the intended audience and context because CBI is affected by factors such as learning styles, previous learning experience, available resources, and contextual restraints (Baker, 2009; Choi et al., 2008; Ertmer et al., 1996). The case writer could also exercise certain control over how students will respond to a case by including or excluding specific case details as clues for analysis and discussion (Barnes et al., 1994).

Barnes et al (1994) noted that "good teaching cases come in many sizes, shapes, and styles. There is no perfect pattern, cut along the dotted line, will always yield a case of professional caliber" (p.292). The CBI literature has reported cases that were presented as anecdotes in formal lectures (Conant, 1947; Shulman, 1992), reading materials to elicit reflection and support learning (Cherubini, 2009; Haley, 2004), the background story to guide debate and discussion (Kleinfeld, 1992a; Lee, Lee, Liu, Bonk, & Magjuka, 2009; Williams, 1992), and simulated reality to practice analytical and problem solving skills (Allen et al., 2000; Baker, 2009, Choi et al., 2008). In some studies, students were also guided to draft, present, and evaluate their own cases in light of a theory with the purpose to improve their understanding of the theory (Floyd, & Bodur, 2005; Hammerness, Darling-Hammond, & Shulman, 2001; Hourigan, 2008; Saint-Germain, 1993). Common practices of presenting a case in instruction include:

- Articulating the purpose of CBI and creating a fun and relaxing learning environment (Hmelo et al., 1997, Williams, 1992)
- Activating learners' situational knowledge (Masoner, 1988; Merseth, 1996)
- Linking the case to prior instructional sessions (Aamodt & Plaza, 1996; Jonassen & Hernandez-Serrano, 2002; Kolodner, 1992)
- Providing clues and guidance for analyzing the case event (e.g. key characters, possible reasons for the problem, decisions made and possible alternatives) (Barnes et al., 1994; Christensen & Hansen, 1987)
- Observing student responses and providing feedback, comments, and sometimes opposing views (Barnes et al., 1994; Merseth, 1996; Williams, 1992)
- Leading the discussion with pre-specified or emerged questions (Barnes et al., 1994; Kleinfeld, 1992b; Richardson, 1993)

Educational technologies such as video, hypermedia, computer software and the Internet have been widely used in case presentation, facilitating many of the aforementioned practices. For examples, Choi et al (2008) described a case-based e-learning module for anesthesiology instruction. The module includes a video clip of a real surgery with a total of 10 critical decision points. It also includes expert commentary clips as feedback, and guides students to finish the case report with pre-specified questions. The module explains the purpose of instruction at beginning, provides resources to activate prior knowledge in the form of hyperlinked text content, and used a variety of scaffolding to emphasize the key points of instruction, and engage learners to reflect on the case problem and its solutions throughout the learning process.

Provide reflective opportunities

One major purpose and a unique benefit of the case-based method is to provide learners with opportunities to practice reflective actions such as analysis, interpretation, decision making and problem solving (Doyle, 1990; Merseth, 1996; Shulman, 1992; Sykes & Bird, 1992). The analysis and interpretation of cases provide the basis for the decision making and problem solving in CBI, as learners' ability to discern, analyze, and interpret key elements a situation allows them to collect adequate data to inform and evaluate their proposed actions (Wasserman, 1994). One way to facilitate the case analysis and interpretation was suggested by Barnes et al (1994) as the following:

> As a rule, the seminar group spends the first hour identifying key players in the story, laying out alternative actions that they might take, producing some analysis of how things got to this (usually sorry) state in the first place, and formulating predictions about what happened next. (pp. 291-292)

When guiding the students to analyze a complex case story, the instructor should avoid being either too vague or too explicit. Novices are often found to be confused and distracted by the irrelevant information in a complex case (Williams, 1992). As a result, the instructor should "untangle situations that are complex and undefined and offer certain guidance and facilitation to distinguish unimportant details from the critical elements in a case" (Barnes, 1989, p.17). However, the instructor should also embrace the openness and uncertainty in CBI and reject the urge to have students follow the teaching plan too rigidly. As Andrews (1954) noted, the instructor should “exercises control over an essentially ‘undirected’ activity, but at the same time he keeps out of the way, lest he prevent the class from making discoveries new also to him” (pp.98-99).

Based on the analysis of the case story and its key elements, the instructor then encourages learners to contemplate appropriate actions to solve the problem(s) presented in the case, which is realized through group discussions (Barrows, 1985; Christensen & Hansen, 1987; Kleinfeld, 1991), individual assignments (Cherubini, 2009; Choi et al., 2008), or a combination of the both (Baker, 2005, 2009, Haley, 2004). The instructor needs to create an open, friendly and tolerating atmosphere where learners feel free to offer their options. The primary function of the instructor is to guide the group, not to solve the problem for them (Williams, 1992). An example of such practice can be found in a study conducted by Barrows (1985), in which he described how instructors guided medical students to formulate and evaluate diagnosis based on mock patient interviews, a common practice of CBI in medical education:

> The second step is to identify the problem that the patient presents...The tutor may initiate this task by asking a question such as “What is the problem we are facing here?” When the information in the patient's presenting problem description is too vague, students must “ask” the patient questions…They look up the question in the *Master Action List*, and using the index provided, look up the answer in the *Patient Encounter Book*. The tutor will ask them to justify any question that they ask the patient…After a student volunteers an idea about the problem, the tutor asks, “How do you know?”, “How sure are you?”, or “Is this an area about which you need more information?”…The good tutor questions both correct and incorrect hypotheses so that students will not get clues about the tutor's personal opinion (as cited in Williams, 1992, pp.398-399).

While it is ideal for the case-based method to provide learners with experiences of actually executing the proposed solutions and evaluate their consequences in reality, most CBI failed to provide such experience in classroom settings. As a result, the instructor could consider implementing CBI in non-traditional contexts, such as field trip, laboratory experiment, or real-world project (Williams, 1992). Educational technologies, with its capacity of interaction and simulation, also offer great potentials to bring simulated reality into instruction that allows students to execute different actions to solve a problem and observe the results of those actions (Choi et al., 2008; Jarz, 1997; Shute & Glaser, 1990).

Facilitate group discussion

Group discussion has always been an integral part of CBI, allowing learners to exchange and construct knowledge through "shared inquiry" (Harrington & Garrison, 1992, p.719). Many researchers placed emphasis on the role of discussion in CBI, and asserted that it was the public articulation of views, perspectives, and actions that promoted the learning in CBI (Allen et al., 2000; Barnes et al., 1994; Barnett & Tyson, 1994; Harrington & Garrison, 1992; Merseth, 1996; Rosen, 2008). Richardson (1993) found that asking students to study cases without discussing them could actually have detrimental impact on learning as students often became confused, distracted and discouraged from merely reading the case stories.

Discussion in CBI, as Levin (1993) noted, was different from discussion in lecture-based instruction where an instructor initiates a sequence, seeks responses, and provides evaluation of the responses. This pattern of discussion is also known as the Initiation (I)-Response (R)-and Evaluation (E) pattern (IRE). By utilizing discourse analysis to examine the interactions between the instructor and students in a CBI class, Levin found out that the discussion in CBI often followed an IRRRRR–IRRRR–IRRRRRR pattern with the instructor accounting for less than 20% of the total utterance.

Although the instructor in CBI no longer dominates the conversation during the discussion, this does not mean that the instructor has a less important role. Besides providing information and monitoring the overall discussion and analysis process, Barnes et al (1994) asserted that the instructor in CBI "must facilitate a process of joint inquiry" and maintain the quality of such inquiry. It is important for the instructor to forgo the authoritative *sage on stage* role and become a member of the learning group, working in partnership with students to examine issues in the case story. Andrews (1954) elaborated on such role of instructor in CBI and described the common activities involved in facilitating case discussion as the following:

> The instructor provides the impromptu services which any group discussion requires. He keeps the proceedings orderly. He should be able to ask questions which invite advance in group thinking and at the same time reveal the relevance of the talk that has gone before. He needs the ability to wave together the threads of individual contribution into a pattern which not only he but his class can perceive. He needs the sense of timing which tells him that a discussion is not moving fast enough to make good use of available time or racing away from the comprehension of half the class. (p.48)

Based on the observation of a case-based seminar on mathematic teaching and learning, Barnett and Tyson (1994) identified four practices that fostered deeper understanding and higher-order learning during case discussion. These practices include:

- Establishing a learning environment that supports the diversity of beliefs.
- Phrasing questions carefully so as not to put words in students' mouth.

- Writing examples on the chalkboard to keep the discussion focused and well-paced.
- Requiring participants to clarify their statements and provide examples.

While technologies have been widely used to present cases in CBI and provide learners with interactive features to explore different actions (Berg, Jansen, & Blijleven, 2004; Choi et al., 2008; Jarz, 1997; Shute & Glaser, 1990), there was not much research investigating the potentials and limitations of technologies for facilitating case discussion. Only a few studies described the use of synchronous or asynchronous communicating tools in online discussion (Lee, et al., 2009; Levin, He, & Robbins, 2006; Mitchem et al., 2008). The most common form of case discussion in technology-supported CBI was still led and facilitated by instructor in the face-to-face learning environment. For example, Baker (2005, 2009) described a learning system that used multimedia to depict a literacy classroom, with interactive features granting learners access to different aspects of classroom instruction including the lectures, student responses, and artifacts of student writings. However, the case discussion was still carried out in a rather conventional form where learners reviewed and prepared the topics of discussion using study guides and shared their answers with peers at the end of the class. Similar examples can also be found in other studies in the literature (Berg, Jansen, & Blijleven, 2004; Bennett, Harper, & Hedberg, 2001; Smith, & Diaz, 2002).

Effects of the Case-Based Method on Teacher Education

With its emphasis on context, reflection and problem solving, the case-based method has been widely used in teacher education. Teaching is often considered as a highly contextualized and ill-structured domain (Clark 1988, Leinhardt & Greeno, 1986, Schulman, 1992), and teachers are constantly immersed in complex situations that require them to make quick decisions to various pressing problems (Baker, 2000; Hewitt, Pedretti, Bencze, Vaillancourt, &

Yoon, 2003). The effects of the case-based method on teacher education have been examined in different instructional contexts in the literature, resulting in various research claims regarding its benefits and limitations.

Thomas, O'Connor, Albert, Boutain and Brandt (2001) have identified four major benefits of the case-based method including enhanced knowledge recall, valuable vicarious experience, improved reasoning skills, and increased self-efficacy. The case-based method was also known to increase students' motivation, classroom participation, and self-confidence in learning (Haley, 2004; Hughes, Packard, & Pearson, 2000; Mayo, 2002). Many researchers argued that the use of cases was especially effective in teaching certain content knowledge such as multicultural perspectives, theoretical principles, and pedagogies (Cherubini, 2009; Kleinfeld, 1992a; McAninch, 1993; Noordhoff & Kleinfeld, 1991). Higher-order learning such as analysis, problem solving and reflection was also believed to be greatly facilitated by the case-based method (Barnes et al., 1996; Choi & Lee, 2009; Jonassen & Hernandez-Serrano, 2002). While most research on CBI reported positive findings, the case-based method is not without its drawbacks. The major limitations of the case-based method identified from the literature include risk of over-generalization, possible confusion among learners, and high demand on the instructor's facilitating skills (Barnes et al., 1994; Merseth, 1996; Shulman, 1992).

The aforementioned benefits and limitations of the case-based method were not always supported by empirical data. As Merseth (1996) commented, "the collective voice of its (the case-based method) proponents far outweighs the power of the existing empirical work" (p. 722). As a result, this section focuses on the empirical studies of the case-based method, and reviews the various research claims regarding its effects on teacher education based on the empirical evidence. By examining the effects of CBI on three important domains of learning (cognitive, affective and metacognitive), this section discusses the benefits and limitations of applying the case-based method in teacher education.

Effects of the Case-Based Method on Cognitive Learning

Cognitive learning deals with the acquisition of *knowledge* and development of *intellectual skills* (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). The *knowledge* in teacher education can be divided into several main categories including content knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners and educational context, knowledge of educational ends, purposes and values (Shulman, 1987). The critical *intellectual skills* for teachers include identifying and analyzing problems in teaching, selecting and applying appropriate teaching methods and techniques, assessing student learning and providing differentiated support (Cochran-Smith, 2005). This literature review identifies three major aspects of cognitive learning in teacher education that can be enhanced by the case-based method. These include the pedagogical content knowledge, the knowledge of learners and educational contexts, and the intellectual skills of decision making and problem solving.

Pedagogical content knowledge

Pedagogical content knowledge is the professional understanding of how to transform subject content into effective teaching (Mishra & Koehler, 2006). Shulman (1987) argued that among all types of knowledge, pedagogical content knowledge should be emphasized in teacher education as “it represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction” (p. 8). Research found that the use of cases in teacher education could facilitate the development of pedagogical content knowledge in pre-service teachers (Baker, 2005, 2009; Barnett & Tyson, 1994; Cherubini, 2009; Haley, 2004; Merseth, 1996; Kleinfeld, 1992a; Wilson, 1989).

For example, Barnett (1991) and her colleagues have developed a number of cases on different mathematical topics (e.g. fraction, multiplication) and have those cases studied by both novice and experienced math teachers. Research findings revealed that the case discussions greatly expanded teachers' pedagogical content knowledge and enhanced their pedagogical thinking and reasoning. One teacher described how she improved her pedagogical thinking through case discussion in the following words:

> Reading alone, you focus on certain things. Then when you get in here and discussion starts, other people come up with different ideas that you are able to add on to. [I think of] things I never thought of before. When somebody else says something, I go, "Oh yeah! I know!" (Barnett, 1991, pp.270-271)

Based on the research findings, Barnett (1991) argued that "by prompting mathematics teachers to frame problems, analyze situations, and argue the benefits and drawbacks of various alternatives, cases can play a critical role in expanding and deepening pedagogical content knowledge" (p.263). However, Barnett also noticed that novice and experienced teachers approached the cases and case discussions somewhat differently, with experienced teachers placing more emphasis on the pedagogical content knowledge than the novices.

Kleinfeld (1992a) investigated the use of an exemplar case (teaching *Hamlet*) in a method class for teaching literature, and found that the case improved learners' pedagogical awareness and knowledge transfer. The study examined students' learning outcomes by coding their writing reflections on three teaching tasks: revising teaching *Hamlet*, teaching *Julius Caesar* and the teaching a Langston Hughes poem. The statistical results indicated that students showed significant growth in their pedagogical content knowledge such as the rationale for selecting literature, the understanding of potential problems and different perspectives, pedagogical methods and curriculum alternatives, and the general understanding of fundamental purposes in the teaching of literature. The study also found that most students were able to apply such knowledge in a similar pedagogical task (teaching *Julius Caesar*), and about half of them were able to transfer the knowledge to a more distant task (teaching the Langston Hughes poem).

Other researchers who have investigated the influence of CBI on the development of pedagogical content knowledge include Wilson (1989) in language arts, Richardson (1993) in teaching motivation theories, Haley (2004) in foreign language education, and Baker (2009) in elementary school literacy education. Empirical findings in those studies indicated that CBI fostered the connection between pedagogy, content and the teaching practice, and enhanced learners' understanding of the desirable pedagogical theories, strategies, and techniques within specific instructional contexts.

Knowledge of learners and educational contexts

Good cases can portray settings, locations, people, cultures, and perspectives that are unfamiliar to teachers (Merseth, 1996). By exposing teachers to various real or hypothetical scenarios, the case-based method can provide them with vicarious experience that allows them to understand the characteristics of learners they have never met and increase their awareness of teaching in unfamiliar educational contexts (Andrews, 2002; Ertmer & Russel, 1995; Noordhoff & Kleinfeld, 1991).

Baker (2005) investigated the use of a set of multimedia cases – *Children As Literacy Kases (ChALK)* in a literacy education course of Midwestern state university, and found that studying rich cases of target learners can increase pre-service teachers' awareness of their different learning needs. *ChALK* documented the literacy growth of five elementary children with 22 hours of classroom video, 135 samples of children's writings, and 115 samples of children's readings. It allowed pre-service teachers to observe, track, and evaluate the literacy growth of each child for the duration of a school year. Research findings suggested that the use of cases increased pre-service teachers' confidence and ability to observe and assess children's different literacy needs. Some pre-service teachers even ranked the vicarious experience gained from CBI higher than the actual field experience and believed that the analysis, discussion and reflection in CBI offered them more focused and purposeful learning experience. As one pre-service teacher explained in the interview:

> I think I have grown a lot. I look at some of the work I did earlier and I can look back and just see [that now I can see] more accurately [while kidwatching by citing] specific examples...I see that [a student] is starting to do this and he's starting to do that. I think that I'm able to create lesson plans now to focus on a certain literacy ability that my children, my students need to know or to learn about...Without this class I would be nowhere! So I really think it has helped a lot. (p.424)

While cases were often used in teacher education to portray (usually implicitly) the characteristics and educational needs of a specific learner group, Cherubini (2009) found that they could also prompt teachers to question and challenge the stereotypes associated with different learner profiles. He investigated how undergraduate student-teachers made sense of the complex dilemmas in four cases presented in an education course, and found that the stereotypical portrayal of under-achieving students in those cases made student-teachers to openly question “what they perceived as intrinsic stereotypical assumptions" such as disruptive behavior, poor attendance, and unsupportive family and community (p.231). For example, one student addressed the danger of stereotypes and commented, “The kid doesn’t have a fighting chance in this case. The adults in the school have already made up their minds about him.” (p.231). Another student questioned the practice of teachers and administrators in the case and critically reflected:

> It’s amazing how the school accepts the label of under-achievers and justifies it by the community the kids come from – as if all parents just don’t care. And not one teacher or administrator even questioned this assumption. I don’t get it. (p.231)

Good cases in teacher education often include rich descriptions of the educational context (Barnes et al., 1994). Such descriptions can provide teachers with vicarious experience and contextualized knowledge that prepare them for similar scenarios they may encounter in the future (Merseth, 1996; Shulman, 1992). For example, Angeli (2004) developed 10 cases of teachers integrating different information communication technologies (ICTs) in K-3 classrooms and used those cases in an ICT course for pre-service teachers. She found that the contextual information in the cases such as school environment, culture, and infrastructure enabled pre-service teachers to "have a realistic picture of the factors inhibiting or facilitating the integration of ICT into school classroom" (p.143). Kleinfeld (1992b) also used cases to prepare student teachers for dramatic but unlikely situations that were rarely explored in teacher education, such as sexual harassment and emotional exploitation of student teachers. She asserted that the particularity of cases provided opportunities to talk about the taboo topics in teacher education and prepared student teachers emotionally for dealing with the complex and unjust world (Kleinfeld, 1992b).

Decision making and problem solving skills

One important purpose of the case-based method is to facilitate higher-order thinking and develop learners' intellectual skills such as decision making and problem solving (Doyle, 1990; Shulman, 1992; Sykes & Bird, 1992). Cases can be used as "problems for deliberate and reflective action" (Sykes & Bird, 1992, p.466) and "serve as precedents to provide occasions to practice analysis, interpretation and problem solving" (Doyle, 1990, pp.13-14). The ability of the case-based method to promote critical analysis, decision making and problem solving has been claimed by many researchers as a major advantage of CBI (Barnes et al., 1994; Jonassen & Hernandez-Serrano, 2002; Merseth, 1996; Wasserman, 1994). However, only a few studies have been identified in the literature that provide empirical evidence for such claims.

Hewitt et al (2003) described the decision making practice in a case-based teacher education classroom, which used a series of video cases to portray a third grade science lesson on the topic of photosynthesis. The instructor in the case was in her first year of teaching and encountered many unexpected situations that needed immediate reactions. The video cases would stop at each decision point, allowing pre-service teachers to quickly suggest decisions for the instructor to deal with the situation. Pre-service teachers would then write down the proposed decisions on a reflection sheet, and later shared, analyzed, and revised them during the case discussion. The analysis of learner reflection and the end-of-class questionnaires indicated that the CBI encouraged teachers to view teaching in terms of the moment-by-moment decisions and actively engaged teachers to examine their decision making through reflection and discussion. As one teacher reflected:

> I think today's exercise is really helpful in training teachers to have better reactions i.e., giving teachers scenarios and asking them what they would do. It trains teachers to react appropriately and also gives them a pool of scenarios and responses to store in their memory and refer to when similar situations arise. (p.496)

Choi et al (2008) examined the effects of a multimedia CBI lesson for teaching anesthesiology in which an anesthesiologist had to make 10 critical decisions in an operation. Students in the CBI lesson were guided by the commentary of an expert at each decision point in order to solve the given problem. The research finding reported generally positive findings regarding the CBI lesson, including higher level of motivation, increased anesthesiology knowledge, and improved problem solving skills. One important finding of the study was that different learning styles affected the perceived effectiveness of CBI, as students of sequential, sensing, and reflective learning styles reported to have a more meaningful learning experience.

Another empirical study that explored the effect of CBI on teachers' decision making skills was conducted by Floyd and Bodur (2005), who found that accompanying field experiences with case studies and case writing can help pre-service teachers make informed decisions on a variety of educational issues such as diversity, inclusive classroom, religion sensitivity, and English for speakers of other languages (ESOL). Floyd and Bodur (2005) argued that such finding was consistent with the finding from an earlier study conducted by Doebler, Roberson, and Ponder (1998), which showed that the analysis of critical decisions in cases allowed teachers to develop a "progressive sophistication of response" (p.358) to deal with complex teaching problems and come up with reasonable and informed solutions.

Many researchers considered the case-based method as an effective pedagogical approach to develop learners' problems solving skills (Choi & Lee., 2009; Jonassen, 2010; Merseth, 1996;

Schank, 1999). Because the case event can provide a context for framing the problem (Williams, 1992), and case-based reasoning can help learners recognize, analyze and refine solutions through experience-based knowledge construction (Jonassen & Hernandez-Serrano, 2002). One empirical study that examined the effect of the case-based method on problem solving was conducted by Choi and Lee (2009), who proposed a case-based instructional model (CBL-CMPS) for teaching classroom management, and investigated its effectiveness on the development and transfer of problem solving skills. The statistical results showed that the treatment group (CBI) increased all seven sub-skills of problem solving (e.g. multiple perspectives, justification, critical thinking, linking to theory) significantly in each stage of the CBL-CMPS model ($\alpha<0.036$), and there was a significant difference between the treatment group (CBI) and the control group (non-CBI) in the transfer measurement of those skills [$F(7, 38) = 4.95$, $p<.001$]. The research finding indicated that CBL-CMPS was effective for developing the problem solving skills and facilitating the transfer of learning in solving other problems.

Another notable experiment study was conducted by Kleinfeld (1991), where 54 student-teachers enrolled in an introductory foundations course were randomly assigned to weekly section meetings taught by either the case-based method (treatment group) or the general discussion of readings (control group). The treatment group taught by the case-based method demonstrated significantly greater ability to identify and analyze educational problems than the control group. Student-teachers' responses to a problematic situation were measured in the mid-term exam as the learning outcomes, and the analysis of the exam data showed that the case-based method increased student-teachers' "abilities to spot issues in problematic situations, analyze educational dilemmas in sophisticated ways, and identify possible alternatives for action" (p.1).

Effects of the Case-Based Method on Affective Learning

Affective learning refers to the emotional and attitudinal aspects of learning, including attention, interest, motivation, engagement, concern, and values (Krathwohl, Bloom, & Masia, 1956). While few empirical studies were designed to systematically investigate the impact of CBI on teachers' affective learning, our review of CBI literature still identified several positive findings in this aspect, including stronger motivation, increased emotional involvement, and increased self-confidence.

Motivation

Many researchers considered CBI as more motivating than the traditional lecture-based instruction, and argued that cases were quite effective to stimulate learners' interest to study the subjects, topics and problems they presented (Barnes et al., 1994; Shulman, 1992; Wasserman, 1994; Williams, 1992). For example, Berg, Jansen and Blijleven (2004) examined the use of a multimedia case named *Dwarf Trail* in facilitating a 90-minutes workshop that taught student-teachers how to incorporate science education into project-based activities in elementary schools. The responses from the evaluation questionnaires showed that 87% of student-teachers considered the multimedia case as a useful and motivating learning tool. Student-teachers also demonstrated great interest to study the case according to the observation data. As noted by Berg et al (2004), "some students even cancelled other obligations to work with the case until the end of the session" (p.499).

Although many studies did not investigate the construct of motivation in particular, the empirical data often suggested that student-teachers demonstrated greater interest for studying cases and preferred CBI over lecture-based instruction. For example, Herreid (1994) compared the student attendance in a science education course and found that after redesigning the course with the case-based method, students seemed to be more interested in the course as they were more likely to attend classes (95% attendance), as compared to the traditional lecture-based course (50-65% attendance). Bailey (2000) investigated the use of cases in preparing senior-level music teachers, and found that cases made pre-service teachers feel greater need and relevance to engage in the music instruction. She asserted that "case effectiveness for students in this study was related to the perceived need…cases worked when they were seen as being applicable to the situations faced by these pre-service teachers" (p. 327). A potential limitation of these studies is that the construct of motivation and interest were primarily examined based on the researchers' observation or the measurement of time on task or attendance, while few studies actually collected students' own commentary on the motivational aspect of the instruction and their own explanations or arguments for such commentary.

Emotional involvement

One widely acclaimed benefit of CBI is its ability to emotionally involve learners during the instruction. The "emotional engagement or entertainment", as Andrews et al (2009) argued, is an important purpose of narrative cases that differentiates CBI from other types of instruction (p.9). Shulman (1992) expressed similar views and asserted that CBI was "more engaging, more demanding, more intellectually exciting and stimulating" (p.1). For example, Kang and Lundeberg (2010) investigated how a case-based online learning environment could leverage female students' participation in science teaching. The CBI in the study allowed learners to watch video cases of HIV patients, gather relevant information from the internet, run simulated tests on case patients, and create diagnosis reports. Focusing on the learning experiences of two female students (Becky and Julie), the study found that presenting realistic cases of HIV/AIDS allowed the two female students to connect more emotionally with the subject matter and get more engaged in the learning activities. As one student reflected, “pictures and words showed emotion more. It made you more attached to the case and made you look in a textbook and read more. It’s like you are seeing someone going through this” (p.1132).

Research findings also suggested that the use of cases could actively involve teachers in various learning activities such as analysis, discussion, and reflection. For example, Angeli (2004) reported that pre-service teachers were more willing to participate in case analysis and discussion, since cases portrayed the complexity of real teaching practice, which was considered as both challenging and fun by pre-service teachers. Baker (2009) also recognized the effectiveness of CBI in engaging learners in active and generative learning, noticing that the pre-service teachers in a case-based literacy course “consistently asked more questions, higher-level questions, took multiple perspectives, and generalized knowledge” (p.257). Similar findings were also reported in other empirical studies in the literature (Brooke, 2006; Haley, 2004; McNaughton, Hall, & Maccini, 2001; Risko, Yount, & McAllister, 1992; Schrader et al., 2003).

Self-confidence

The case-based method was also found to increase students’ self-confidence to offer critical insights and make informed decisions. For example, Cherubini (2009) investigated how pre-service teachers developed their critical thinking in view of the *Standards of Professional Practice* through studying four cases of educational dilemma. One interesting and unexpected finding was that pre-service teachers demonstrated steady growth in their self-confidence to offer opinions and make ethical decisions. Cherubini (2009) observed that when studying the first two cases, pre-service teachers were reluctant to express their views, and often considered the expert commentaries as “the answers” (p.230). However, by the fourth case, pre-service teacher showed greater confidence to critically analyze the competing perspectives and propose their own solutions for the case problems. As one teacher reflected, "There are many ways of approaching the [case subject] parent, and I understand how important it is do so from the viewpoint of who I am as a teacher" (p.230) Another teacher commented, "Yeah, we might only be just starting off our careers as teachers, but we have a voice too and I think it can be as valuable as any other" (p.230).

Lundeberg, Bergland, Klyczek and Hoffman (2003) investigated the changes in the beliefs, knowledge, and confidence of 10 pre-service teachers who were engaged in implementing and evaluating a multimedia case-based learning project (*Case It!*) in high school science classrooms. Using judgments-of-knowing measures, the researchers measured the pre-service teachers' confidence of using of interactive multimedia in science teaching before and after the implementation of the *Case It!* Project. The statistical results showed significant difference in teachers’ confidence measurement [$t(4) = 3.81$, $p < .02$]. Although the sample size was too small to generate sufficient statistical power, Lundeberg et al (2003) still made an argument that engaging teachers in researching cases of technology-supported science classroom could improve their confidence of “integrating technology projects in their future science classrooms” (p.5). The effect of the case-based method on increasing students’ confidence has also been reported by research in other fields such as business, law, and medicine (Barnes et al., 1994; Ertmer, Newby, & MacDougall, 1996; Williams, 1992).

Effects of the Case-Based Method on Metacognitive Learning

The term *metacognition* was coined by John Flavell to describe the “cognition about the cognitive phenomena” or the “thinking about thinking” in laymen’s language (Flavell, 1979, p.

906). Metacognition is often defined as a form of executive control that involves observing, monitoring and regulating one's cognitive process in learning activities (Hennessey, 1999; Kuhn & Dean, 2004; Martinez, 2006; Schneider & Lockl, 2002). There are no clear-cut boundaries between metacognition and cognition (Eisenberg, 2010; Martinez, 2006; Schraw, Crippen, & Hartley, 2006), since "Metacognition draws on cognition. It is very hard to have adequate metacognitive knowledge…without substantial (cognitive) domain-specific knowledge" (Veenman, Van Hout-Wolters & Afflerbach, 2006, p.5). Many researchers also considered affect as a critical element of metacognition, since emotional states such as motivation and confidence also impact how learners manage their learning process (Eisenberg, 2010; Martinez, 2006; Paris & Winograd, 1990). In other words, the domain of metacognitive learning was not well-defined and usually overlapped with cognitive and affective learning domains. As a result, the literature review in this section excludes such overlaps and the ambiguities, and focuses on one learning activity that was widely accepted as a key component of metacognitive learning – reflective thinking (Hofer, 2004; Kitchener, 1986; King & Kitchener, 1994; Wood, 1997).

Stimulating learners' reflective thinking is considered as an important purpose and a major benefit of CBI (Barnes, 1994; Merseth, 1996; Jonassen & Hernandez-Serrano, 2002; Shulman, 1992). For example, Kleinfeld (1992b) asserted that the use of cases could help learners develop "the habit of reflective inquiry" (p.47), which is an essential part of effective learning. Shulman (1992) also considered the case-based method as a proper pedagogy for teacher education because the complex nature and multiple layers of cases could elicit reflective practices from teachers, making them more aware of their teaching decisions. Empirical evidence that supported such acclaimed benefit of CBI was found in the literature and will be described below.

Rosen (2008) conducted a quasi-experimental study to investigate the impact of CBI on student-teachers' reflection on facilitating children's learning. Sixty-eight participants were put into three groups: two treatment groups receiving CBI in written and video format, and a control group receiving non-CBI. Student-teachers' reflective thinking was measured by the Reflective Thinking Scale (RTS) before and after the instruction. The posttest RTS scores of the two treatment groups (5.14 and 4.15) were much higher than the pretest scores (2.95 and 3.10), and there was not much difference between the pretest and posttest RTS scores (3.37 and 3.53) for the control group. Based on the statistical findings, Rosen argued that CBI in teacher education “can result in improved reflection on educational theories and in instructional practices that facilitate children's learning” (p.33).

Hewitt et al (2003) reported that almost all pre-service teachers in a CBI course found case discussion and analysis to be “professionally valuable”, and “increased their awareness of their own reaction to teaching situations” (p.496). As one pre-service teacher reflected, “I enjoyed this activity that we did today. It allowed me to think of my decisions and obtain an immediate chance to collaborate with my colleagues.” Another pre-service teacher considered the case discussion as specifically useful in making her evaluate her own thoughts about teaching, and commented, “Very useful, allows us to see how a teacher thinks, how we think...to see differences or how common we as educators think about a particular theory or subject” (p.496).

Apart from case analysis and discussion, the case writing activity was also found to induce and enhance reflective thinking for student-teachers (Hourigan, 2008; Richert, 1991; Shulman et al., 1990). For example, Richert (1991) investigated the construction of self-reported cases in a teacher education class and found that preparing cases was a reflective practice that engaged student-teachers in making and evaluating the key decisions of case construction (e.g. selecting topic, developing stories, and emphasizing certain details), and also reflecting on their own teaching experiences. Hourigan (2008) also found that student-written cases was greatly appreciated by student-teachers enrolled in an instrumental music methods class, since case writing provided them with opportunities to “reflect on their past,” “express their opinions and beliefs about music teaching and learning,” and “construct their own identity as music teachers” (p.30). As one student revealed in the interview, “This (case writing) forced me to dedicate some time for reflection that I would have not done otherwise.” (p.30)

Disadvantages of the Case-Based Method

While the literature review has identified various positive effects of the case-based method on learners’ cognitive, affective, and metacognitive learning, there have been much fewer discussions regarding its disadvantages and limitations. The acclaimed disadvantages of the case-based method were often supported by theoretical assumptions rather than empirical evidence. The following is a list of potential disadvantages of the case-based method identified by Shulman (1992), which were well cited in the CBI literature.

- Cases are expensive and time-consuming to produce;
- Cases are difficult to teach well and require longer time for preparation, placing higher demands on teachers;
- Cases can be inefficient for teaching certain content, with very little material being covered for long periods of time;
- Cases can be episodic, discontinuous and lack of integration, difficult to be structured and organized by certain students;

- CBI is susceptible to over-generalization with too much emphasis on the particularities of one single case.

Admittedly, well designed and implemented CBI has many potential benefits for teaching and learning. However, not all instructors are skilled in writing cases and facilitating case-based discussion, and "badly executed case discussion can be a disaster: inefficient in use of time and ineffective in student motivation" (Barnes et al., 1994, p.48). As a result, a few studies found no significant difference in students' learning outcomes when comparing CBI and traditional lecture-based instruction (Kirschner, Sweller, & Clark, 2006; Uribe & Klein, 2003). Such ineffectiveness of CBI, as a few researchers pointed out, might be caused by cognitive overload, since poorly designed cases or poorly-facilitated discussion often include too much irrelevant information that overwhelms learners' cognitive capacity and interferes with the learning process (van Merrienboer, Kester, & Pass, 2006; Paas, Renkl, & Sweller, 2003). Barnes et al (1994) also noticed the skepticism from teachers regarding the use of cases as a teaching tool. As one teacher commented, "It's a blinking bit of intellectual chaos and so darned inefficient! Why let a class 'muck around' for an hour trying to work through a point when I can explain it in a few minutes. They call that teaching?" (p.48). Barnes et al (1994) further explained that such skepticism might be due to the non-traditional role the instructor plays in CBI.

Perhaps the most commonly discussed disadvantage of the case-based method is its ineffectiveness for certain groups of students. As Cossom (1991) argued, "clearly (case-based instruction) is not a teaching/learning method that appeals to all students, nor is it one that draws neutral responses" (p. 151), because the inherent features of CBI such as "ambiguity, lack of 'right' response, and multiplicity of views" (p.150) were perceived and appreciated differently by learners with varying levels of moral and cognitive development. Ertmer et al., (1996) expressed similar view in their investigation of a case-based physiology course. They found that not all students enjoyed and benefited from CBI. Difference in certain learner characteristics such as goal orientation, evaluative lenses, levels of self-awareness, openness to challenges, perceived levels of relevant knowledge, and contextual vulnerability could result in limiting or facilitative approach to CBI. Students with low self-regulation “tended to focus their efforts on learning facts and being right” when studying the cases, and “appeared to fluctuate in their perceptions of the value of the case method, as well as in their confidence for learning from cases” (pp.745-746). Choi et al (2008) further explored the relationship between the learning experience in CBI and learners’ learning styles and found that concrete thinkers, practice-oriented learners, and those who prefer to learn in small incremental steps tended to have more meaningful experience with CBI. In opposition to the common belief, visual learners and verbal learners reported no significant difference in their learning experience with the CBI lesson.

While it is important to acknowledge and understand potential problems and challenges for implementing CBI, it is also important to note that many of the acclaimed problems of CBI may be resolved with the support of educational technologies. For example, e-learning development tools can assist the development of cases by providing case writers with various templates and resources, multimedia technologies can present a case in multiple media forms to accommodate different learning preferences, and the use of animated cues and interactive elements can also guide the case learning process and provide necessary scaffolding. The role of technology in supporting CBI will be discussed in detail in the next section.

Technology-Supported Case-Based Instruction

The development of technologies such as web-authoring software, e-learning development tools, learning management systems, communication tools, and the Internet has provided opportunities for the development and presentation of cases. As a result, technology-supported CBI has become the prevailing form of case-based instruction since the mid-1990s. At the same time, there has also been a growing line of research examining the use of technologies in CBI, including video (Friel & Carboni, 2000; Hughes, Packard, & Pearson, 2000; Winkler & Polich, 1990), hypermedia (Boling, 2007; Baker, 2009; Koehler & Lehrer, 1998; Koury et al, 2009), e-learning module (Choi & Lee, 2009; Choi et al., 2008; Choi et al., 2012) and the internet (Guest, 2007; Lee et al., 2009; Kumta, Psang, Jung, & Chenge, 2003; Scott et al., 2010). This section reviews the technology use in CBI with the purpose to identify the affordances of technologies that facilitated the essential activities of CBI and examine the unique benefits or limitations of technology-supported CBI.

Video Cases

Video has been widely used to present cases in CBI because of its ability to capture the detail, authenticity, and complexity of case events. Many researchers argued that video cases were more effective and more engaging than written or verbal cases, helping learners construct richer mental models of the context more effectively (Bencze, Hewitt, & Pedretti, 2001; Carter, 1993; Choi et al., 2008; Hewitt et al., 2003). Becker et al (2002) explained how learning can be promoted by video cases and identified three ways the video format can support learners' cognitive processing:

- Authenticity. The spatial and dynamic (moving) quality of video makes scenes richer and more realistic, contributing to the authenticity of what is captured (CTGV, 1990, as cited in Beck et al., 2002).
- Dual coding. Video cases can better reveal the ambiguity and complexity of classroom events because so much detail can be shown, thus adding to their apparent authenticity.

- Interpretation. Events and contexts that are seen as authentic are usually encoded easily into memory because they are believable to the viewer and can therefore be readily connected to prior knowledge in existing mental representations (Baddeley, 1990, as cited in Beck et al., 2002). (p.347)

Beck et al (2002) further pointed out that unlike written cases with only verbal encoding available, video cases were presented in audiovisual format that allowed learners to encode case events in both visual and verbal modes. Such dual encoding mechanism “promotes understanding over and above verbal encoding alone” (p.347). According to Beck et al (2002), video cases also provide learners with more freedom to interpret the case events as learners can select any detail or trivia to focus on, in contrast to written cases where the relevance of case material is largely determined by the case writer.

Hylton (2000) compared the effects of using video vignettes and using lectures in teaching the classroom management strategies. Students’ declarative, procedural and attitudinal knowledge of classroom management were measured and analyzed. The results of the study indicated that video modeling significantly improved students’ procedural knowledge of selected classroom management strategies. However, Hylton (2000) cautioned readers that it was difficult to isolate the impact of video cases on learning in her study because of the inherent problems in the measuring instruments and the research design. Beck et al (2002) conducted a similar study that investigated the effects of video case construction on pre-service teachers’ skills in observation of teaching. Participants were randomly assigned into two groups: a treatment group who constructed their own video cases of teaching, and a control group who experienced only classroom observation of teaching. The statistical results showed significant difference in the observation skill measurement in three different subject areas [$t(60) = 4.58$, $p < .001$, for language arts; $t(60) = 3.66$, $p < .01$, for math; and $t(60) = 3.03$, $p < .01$, for science], indicating video case construction can improve teachers' ability to identify, interpret, and analyze exemplary teaching.

Video cases were also found to have the potential to engage learners, promote discussion, and stimulate reflection. For example, Friel and Carboni (2000) conducted a case study to investigate the impact of using video vignettes on pre-service teachers' understanding of math teaching. The video episodes were initially used to show pre-service teachers exemplary math-teaching, but later it was found that they also provided a common point for discussion and reflection. The interview data indicated that pre-service teachers "engaged in reflection and reconstruction of their beliefs about how children learn mathematics and moved from a more didactic perspective of teaching mathematics toward a student-centered perspective" (p.118). Such movement, as argued by Friel and Carboni (2000), "appears to have been influenced by the use of video-based pedagogy" (p.118).

However, video cases also suffer from a number of limitations. First, video is by nature a passive medium with little interactivity. Simply viewing a video case from beginning to end provides few opportunities for learners to practice decision making and problem solving (Hewitt et al., 2003). Second, many video cases lacked the necessary scaffolding and guidance to prompt reflective thinking. As a result, video cases were rarely used alone and were often accompanied with activities that promote analysis, reflection and group discourse (Copeland & Decker, 1996). Lastly, it is quite difficult to isolate and measure the effect of video technology on learning, since other components of the CBI (e.g. case story, discussion, case writing) can also contribute to the overall impact on learning (Baran, 2006; Friel & Carboni, 2000; Hylton, 2000).

Hypermedia Cases

Similar to the concept of hypertext, hypermedia is a special form of multimedia that integrates different media content (e.g. audio, video, image, animation, text) through interactive linking, which enables the presentation of information in a non-linear fashion (Ayersman, 1996; Jonassen & Reeves, 1996; Lacey & Merseth, 1993). The affordances of hypermedia technologies may significantly expand and enhance the learning space defined by cases (Koehler & Lehrer, 1998; Merseth & Lacey, 1993). Hypermedia present case events in more than one medium therefore can employ the unique benefits of different media forms for more effective learning. The nonlinearity of hypermedia cases also allows cases to be indexed in a more flexible way and studied from multiple perspectives simultaneously (Bolter, 1991; Horvath & Lehrer, 2000).

Take the hypermedia case ChALK (*Children As Literacy Kases*) (Baker, 2009) as an example, it includes case materials in different media formats such as video clips of teaching scenarios, images of artifacts (e.g. books used in class), and text of both student writing and reading samples. It also allows learners to customize their own learning process by selecting the video cases and the supplementary materials that are interesting and relevant to them. Baker (2009) described in detail in her study how pre-service teachers interacted with ChALK:

> The ChALK interface gives users access to video clips of the selected children reading and writing. The video clips are accompanied by scenarios which describe the setting of the video. When the user selects a video clip of a child reading, the interface provides access to the text that the child reads and the ability to print the text so that the users can take anecdotal notes. The video clips are also accompanied by artifacts. When the user selects a video of a child reading, the artifact is the book he is reading. The pages of the book turn as the video proceeds and the child turns pages. Users can examine the

illustrations and text-flow of the book that the child is experiencing. When the user selects a video of a child writing, then the artifact is of the child's completed writing (p.252)

Hughes et al (2000) studied a video-based hypermedia tool – RCE (Reading Classroom Explorer) that allowed learners to easily access, revisit, compare and share different video cases of teaching literacy from its database. Hughes et al (2000) argued that such affordances of RCE had the potential to result in enhanced classroom discussion and higher motivation from learners. This argument was supported by Boling (2007), who investigated the impact of RCE on transforming pre-service teachers' knowledge and beliefs about literacy instruction. Pre-service teachers worked in groups in a computer lab and used RCE to view, discuss, and search for video clips that they believed could help them design literacy lessons for future field teaching. Boling (2007) observed and interviewed one pre-service teacher – Lizzy, and found that RCE provided Lizzy with exemplary teaching practices which she later incorporated in her own lesson plan. Hypermedia cases in the RCE also engaged Lizzy in actively thinking about how literacy can be taught in new ways, and created cognitive dissonances for Lizzy by showing her images of learning literacy that were quite different from her own experience as a child. Boling (2007) concluded that hypermedia programs like RCE helped learners make personal connections with the case content and promoted learners' critical thinking and reflection, therefore "supported students in forming new understandings about literacy instruction" (p.199).

Horvath and Lehrer (2000) documented the design and assessment of HyperMeasure, a case-based hypermedia measurement teaching tool. Eight cases were cross-indexed in HyperMeasure to illustrate developmental trajectories of children's mathematical reasoning on different measures (e.g. linear, area and volume). Each case can be easily accessed from the main menu and was linked to supplementary information such as brief descriptions of related measurement principles. It was found that the learning experience with HyperMeasure resulted in "a rapid increase in understanding of the relationship between student thinking and teaching practice" (p.115), evidenced in the outcome measurement of three learning activities (sorting task, video commentary, and diagnosing student works). One interesting finding from the study was that participants approached HyperMeasure in different ways. For example, one participant navigated HyperMeasure by its default structure and spent most time watching video cases, while the navigation pattern of another participant was very theme-driven, focusing on investigating particular topics of measurement through hyperlinks. However, the statistical results showed that both participants improved significantly on measures of learning. As a result, Horvath and Lehrer (2000) believed that "HyperMeasure supported individual differences in learning styles and preferences" (p.115)

Case-Based E-Learning Module

E-learning modules in this study refer to instructional units or lessons in electronic format that are self-directed in nature and can be implemented without the facilitation of an instructor. Case-based e-learning module is different from hypermedia case as it is more structured and usually provides one or several suggested learning sequences to go through the instructional content. While case-based e-learning modules might include some online components (e.g. hyperlinked instructional content, web-based interface) or might be accessed online; most of such modules can be considered as self-contained instructional packages that can be used in the offline environment if downloaded. In recent years, Choi and his colleagues have conducted a series of design-based research that investigated the ways of designing effective case-based e-learning to promote college students' real-world problem solving abilities across different disciplines, including medicine (anesthesiology) (Choi et al., 2008), teacher education (classroom Management) (Choi & Lee, 2009), and engineering (environmental engineering and sustainability) (Choi et al., 2012).

Choi and his colleagues (2008) described a case-based learning module for teaching anesthesiology, where students watched the video case of an anesthesiologist making important decisions during the surgery. At each decision point, video would pause and students listened to an expert's commentary and reviewed relevant textbook information and patient data from the text-boxes in the module interface. After reviewing a decision point in the case, students were required to complete a case report in which they articulated the problem situation, the decision made, and the rationale. The learning module would then provide students with a problem story in narrative form without the solution part, and ask students to apply their knowledge and experience to develop their own solutions for the problem. Choi et al (2008) believed that "the benefits of case-based instruction can be enhanced by providing richer case representations and more meaningful interactions" (p.22), but also cautioned such benefits might be mediated by students' different learning styles. As a result, Choi and his colleagues argued that the design of CBI interface should build in adequate flexibility and adaptability to accommodate the diverse learning styles in order to maximize the benefits of case-based e-learning.

Based on Jonassen's constructivist learning environment model (1999) and the general process of ill-structured problem solving (Jonassen, 1997), Choi and Lee (2009) conducted a design-based research in which they proposed, refined, and validated a five-phase model for designing case-based e-learning modules to promote learners' epistemic growth and problem solving abilities in the context of teacher education. The five phases are: (1) reviewing problems, (2) analyzing problems, (3) creating solutions, (4) making decisions, and (5) reflecting on results. In Phase 1, students studied an audio story describing a real-world case problem without the solution part, and then they would listen to multiple stakeholders' perspectives and experts' opinions in Phase 2 and 3. In Phase 4, additional readings were provided to students to help them generate their own solutions for the problem. The solution part of the case was given in Phase 5 where students would make comments on the case conclusion and reflect on the lessons learned. A variety of scaffoldings, guidance, and instructional strategies were also embedded in the case-based e-learning module to facilitate students' self-learning. The five-phase model was later modified and applied to the design a case-based e-learning module for environmental engineering design (Choi et al., 2012). Both studies showed that students' problem solving performances were improved through the different phases of the case-based e-learning modules, when adequate scaffoldings and learning resources were provided.

While it is not specifically mentioned in Choi and his Colleagues' works, most of those case-based e-learning modules can be considered as self-directed. The learning experience with those modules are expected to be highly individualized, and "the conceptualization, design, conduct and evaluation of a learning project are directed by the learner" (Brookfield, 2009, p. 2615). The collected findings provide examples of building self-directness into the case design and implementation, and highlight the importance of scaffolding features and flexible and adaptive interface design. The initial results indicate that well-designed self-directed CBIs are effective in developing students' problem-solving skills in real world contexts.

Online CBI

The aforementioned video cases, hypermedia cases, and e-learning modules are all technology-supported CBIs created in digital format, thus can be uploaded to the internet and be accessed online by learners. However, such CBIs don't necessarily utilize the unique affordances of the internet and web technologies such as online discussion, synchronous and asynchronous communication, online searching, personal learning environment, and educational networking, thus do not fit our criteria of online CBI. Many researchers believe that the online learning environment has great potential for CBI as the affordances of the internet and web technologies can provide learners with new opportunities to interact with a case in different ways and settings (Andrews, 2002; Eberly & Rand, 2003; Lee et al., 2009; Scott et al., 2010; Vinaja & Raisinghani, 2001).

Vinaja and Raisinghani (2001) summarized six advantages of applying the case-based method in online learning environment, which are: (1) external resources such as websites and databases can be linked to an online course, (2) students' participation can be easily tracked and quantified by the instructor, therefore it is more difficult for students to remain passive in an online CBI course, (3) online CBI allows learners to access the cases without the constraint of time and space, (4) the asynchronous and written communication in online CBI allows learners to spend more time thinking about the cases, (5) online CBI can carry out different discussions simultaneously (e.g. e-mail, discussion board, chat rooms) and integrate instructional content in multiple media formats to facilitate comprehension, (6) online learning management systems (LMS) offer instructors more flexibility in a CBI course by allowing easy customization of the sequence, content and communication forms for studying cases. The sense of anonymity offered by the online course seemed to enhance students' participation in CBI as students were more willing to take risks and express their opinions during the online case discussion (Eberly & Rand, 2003). The content of online CBI can also be accessed from mobile devices such as smartphones and tablets, providing students with "the freedom to do [self-directed study] whenever and wherever" (Scott et al., 2010, p.889).

There is a small but growing body of empirical research that investigated the effectiveness of online CBI. Kumta et al (2003) conducted an experiment study that compared the performance of 163 final year medical students who were randomly assigned into a treatment group (online CBI) and a control group (didactic lecture). The treatment group studied a series of web-based clinical cases on orthopedics with links to external educational resources (e.g. the National Library of Medicine (U.S.A.), the Chinese University Medical Library). The control group received the conventional teaching program including didactic lectures, bedside tutorials, ward attachments, and outpatient clinics. Students' clinical examination skills, critical thinking abilities, and specific factual knowledge were measured in both pre-module and end-of-module tests. No significant difference was identified in the pre-module test, but there was a statistically significant difference ($p< 0.001$) between the treatment group (58.72, SD ± 6.8) and the control group (52.89, SD ± 5.6) in the end of module test scores. It was also found that the web-based clinical cases was well received by students, as they felt those cases deepened their understanding of patient care, and they could relate information in the cases to the real practice in the ward. Students who received online CBI also seemed to be more motivated as they spent significantly longer time for self-study on clinical patients at the bedside in the ward.

Hayward and Cairns (2001) examined the case-based learning experiences in an advanced cardiopulmonary science course that had students study clinical cases over the internet. Students' perceptions of and experiences with the online CBI were collected by an online survey and follow-up interviews. The results indicated that the online case learning experience assisted students to connect theoretical knowledge with practical application. Students also expressed a preference for online CBI and believed that the online case assignments were better than traditional lectures for teaching advanced cardiopulmonary sciences. It was also found that while the internet could increase students' access to information, it was challenging and distracting for some students. Students also considered working with others in online groups as quite stressful and indicated a preference to work individually when studying cases online. Guest (2007) conducted a similar study investigating the student performance and satisfaction of three groups of students who received individual online CBI, small-group online CBI, and lecture-based instruction in an educational psychology course. It was found that student satisfaction about the course differed significantly among the three groups, with the online individual CBI group reporting the highest satisfaction. One interesting finding was that when studying cases online students preferred individual work to group work, which supported the finding from Hayward and Cairns' study (2001). Guest (2007) compared the student performance among the three groups but found no statistically significant difference. She believed several limitations of the research design might have caused such *no difference*, including short instruction time, high attrition rate, unbalanced incentives, and potential experimenter bias.

Scott and her colleagues (2010) explored the ways to design online CBI that can be used on mobile devices to assist medical students in bedside learning in hospitals. The case content included scenario descriptions, reading materials, relevant lectures, web resources, and a multiple choice quiz. The three cases were developed based on the standards of HTML5 and CSS3, with interactive functions such as question selection and bookmarking embedded using JavaScript. Students could access and navigate the case content using the web browsers on their mobile devices such as iPod touch or smartphones, and download the content for offline use. The results from the field test showed that case-based learning scenarios on mobile devices had potential to enhance bedside learning, and students had positive attitudes towards such learning experience, especially the portability, flexibility, and freedom afforded by the mobile technologies.

Lee et al (2009) examined the case-based learning practices in an online MBA program in a large American university. The contents and instructional practices of 27 online courses (e.g. discussion boards, synchronous chat rooms, and shared workspaces) were coded and analyzed, with a 0.81 inter-rater reliability. Student perceptions towards the online CBI courses were collected from both students and instructors using an online survey and follow-up interviews. Research findings showed that the course content was highly valued when instructors included opportunities for case-based study. About 87% of students believed that CBI fostered the application of newly learned concepts and skills into practices, and about 79% of students acknowledged the positive effects of technology integration in supporting the case-based online learning. The common activities in online CBI courses include class discussions, self case studies, individual write-ups, role playing, and team projects. The most common case format was still text-based such as textbooks or text material packages (10 courses), and fewer courses presented cases in multimedia format such as simulation (5 courses) or video clips (2 courses). However, it was found that students had mixed attitudes towards multimedia cases, and text-based cases were still preferred by a good number of students. The instructors reported that they experienced a change of role from lecturer to coach or mentor, and contributed such role change to the online learning environment. As one instructor commented, "coaching sounds more like what you do online... (Meanwhile) lecturing is what you do in the regular classroom" (p.183). Instructors also identified the potential problems for conducting online CBI, including lack of social presence, absence of emotional cues, and high potential of misinterpretation. Based on the research findings, Lee et al (2009) proposed a set of guidelines for designing effective online CBI courses, including:

- Maximize the use of asynchronous technological tools for case-based activities.
- Increase the visibility of the instructor and students and provide timely feedback.
- Create a collaborative learning environment by having students working in groups.
- Diversify the use of technology to facilitate learning activities such as discussion, communication and providing feedback.
- Exploit the technological attributes to create richer contexts in cases.

Theoretical Assumptions for Designing Self-Directed Online CBI

Based on the findings of the literature review, this section proposes a set of theoretical assumptions for designing self-directed online CBI. Using the three essential activities of the case-based method as an organizing scheme, Table 2.2 summarizes 13 design assumptions, and provides theoretical rationale behind each assumption. The supporting technology affordances are also described and discussed in the table.

Table 2.2. *Theoretical Assumptions, Rational and Technology Affordances for Designing Self-Directed Online CBI*

Essential Activities	Assumptions for Design	Rationale	Technology Affordances
Design and present cases	Assumption 1.1: Case materials can be collected from various authentic sources (e.g. own experience, anecdotes of others, documentation of a real event, artifacts) and in different formats (e.g. narratives, video clips, simulation).	It is recommended to use authentic materials for case development since they reflect the complexity of reality and are more engaging for students (Barnes, 1994; Merseth, 1996). Different sources can offer additional information about a case event (Baker, 2009; Choi et al., 2008), and provide a more holistic picture of the case problem, allowing learners to analyze and interpret the case problem from more than one aspect (Bransford et al., 1990; Herrington, 1995; Merseth, 1996).	Source materials in different formats can be converted into the digital format such as videos, digital pictures, scanned images, and interview audios, thus can be integrated into one online case.
	Assumption 1.2: Case content should include narrative accounts of typical problematic situations that can be interpreted, analyzed and solved from different perspectives.	One important purpose of CBI is to expose learners to various problems or scenarios so that they will have vicarious experiences to deal with similar situations in their future professions (Andrews, 2002). Case problems provide learners with opportunities to practice professional skills such as analysis, problem solving and decision making (Merseth, 1996; Sykes & Bird, 1992). Multiple perspectives should also be included to reflect the complexity of the reality (Bransford et al., 1990; Sandberg & Wielinga, 1992; Spiro et al., 1991; Young, 1993).	Different media offer different benefits for the description of case problems. Text narratives allow case writers or instructors to offer students proper direction during CBI by including or excluding certain case details to keep case discussion focused on the major themes. Text is also effective in describing characters' thoughts and reflection. Videos and images convey more information than text and capture more contextual details, which provide opportunities for learners to analyze and interpret case problems from multiple perspectives.
	Assumption 1.3: Case content should include adequate contextual information and details about the case problem or scenario.	Contextual information and details emphasize the typicality of a context, which can help learners recognize similar situations in the future. They also allow for analysis and interpretation from different perspectives, and provide additional clues and support for solution generation (Ceci & Ruiz, 1993; Collins, 1988; Herrington, 1995; Jonassen, 1991a; Lave & Wenger, 1991).	Video technology conveys a sense of authenticity, making context richer and more realistic and capturing and preserving the details and trivia in a case event. It also provides learners with more freedom to interpret the case events as learners can select any detail or trivia to focus on. (Becker et al, 2002; Bencze, Hewitt, & Pedretti, 2001; CTGV, 1990)

Essential Activities	Assumptions for Design	Rationale	Technology Affordances
	Assumption 1.4: Case design should be determined by its instructional purpose. Different purposes (e.g. demonstrating examples, practicing decision making) place emphasis on different types of instructional activities.	Cases as examples should provide the detailed description of the context and the problem, the actions taken, rationale for the actions, and consequences in order to explain how theories or principles can be derived from practice and be applied to solve a practical problem (Dolye, 1990). Cases for decision making and problem solving should emphasize the critical decision points and include adequate supporting material and scaffolding to prompt reflection and elicit learner action. The desired actions and consequences should not be offered when presenting the case in the first time in order to have learners interpret, analyze and generate solutions by themselves. (Barnes et al., 1994; Choi & Lee, 2009)	Web technologies such as interactive multimedia and e-learning development tools can assist case writers to design and develop cases for different purposes. The unique benefits of different media types can be employed to demonstrate a model practice from different aspects such as external behaviors and internal thoughts or reflections. The built-in interactive and scaffolding features (e.g. pause at critical times, customizable learning sequence, multiple decision options, and prompt questions) allow learners to practice decision making and problem solving, and engage them in active reflection on learning.
	Assumption 1.5: Online cases should articulate the purpose of CBI and emphasize the connection between case events and prior instructional sessions. Links to supplementary information should also be included to facilitate the comprehension and analysis of the cases.	CBI can be inefficient and confusing for both teachers and students, as they can be episodic, discontinuous, poorly-structured and overwhelming (Barnes et al., 1994, Paas et al., 2003; Shulman, 1996). Having students understand the purpose of the case and its relation with their prior knowledge not only motivates students to learn, it also makes them see the implication of the knowledge they gained from the CBI (Aamodt & Plaza, 1996; Collins, 1988; Jonassen & Hernandez-Serrano, 2002).	If the online CBI is in the format of a website, the purpose of the online CBI should be introduced in the website homepage. If the online CBI is an e-learning module, the purpose should be stated at the beginning of the module. Interactive hyperlinks can be used to link the case content with the case purpose and objectives, key points of prior instruction, and supplementary materials

Essential Activities	Assumptions for Design	Rationale	Technology Affordances
	Assumption 1.6: The design of online CBI cases should emphasize adaptivity, interactivity and flexibility, offering sufficient learner control for learners to customize their own learning sequence and access instructional contents in their preferable formats.	Not everyone will benefit from CBI in the same way. The differences in learner characteristics such as prior knowledge or learning styles affect the perceived usefulness of CBI and the overall learning experiences (Baker, 2009; Choi et al., 2008; Ertmer et al., 1996). Contextual restraints such as available time, resources and technology support also affect how cases will be implemented (Shulman, 1996). As a result, case design should address such differences in learner characteristics and instructional contexts, and accommodate such difference by allowing learners to control and adjust their own learning process.	Multimedia technologies enable case content to be developed into different formats such as visual, audio or verbal formats, to enhance memorization by activating multiple sensory perceptions, and facilitate comprehension for learners of different learning styles (e.g. visual, aural, verbal, logical) (Fleming & Mills, 1992). Hypermedia integrates different cases or case contents through interactive linking, allowing learners to access, search for, compare and organize cases at ease (Baker, 2009; Boling, 2007; Hughes et al., 2000)
	Assumption 1.7: Online cases should provide explicit instruction and clear visual/verbal cues on how to navigate and study the self-directed online CBI.	Because there is no instructor to facilitate the self-directed online CBI, learners are likely to suffer from problems such as information overload and misinterpretation (Lee et al., 2009; van Merrienboer et al., 2006; Williams, 1992). Some learners might also have limited knowledge and experience of studying online. As a result, learners will benefit from explicit and implicit guidance during their learning process.	The instruction on how to navigate the online CBI can take many forms such as a pop-up webpage, a short video introduction, or an interactive simulation. E-learning development tools such as Adobe Flash, Articulate and Captivate allow a variety of visual and verbal cues to be easily integrated into case content, including emerging captions, highlights, and annotations.
Provide reflective opportunities	Assumption 2.1: Critical decision points and a variety of scaffolding features should be included in online cases to guide learners to practice decision making and problem solving.	One important purpose of CBI is to promote higher-order learning and develop professional skills such as problem identification, analysis, solution generation, and evaluation (Dolye, 1991; Sykes & Bird, 1992). Online CBI should guide learners to understand the critical decisions involved in a case event and actively engage them in conscious reflection on decision making, either by analyzing expert decisions or contemplating and evaluating their own actions for solving the case problem (Choi et al., 2008; Hewitt et al., 2003; Wasserman, 1994).	Technologies allow a variety of scaffolding features to be integrated in online cases to engage learners in active reflection on decision making and problem solving. For example, video editing software can divide a video case into several segments based on different decisions, and add brief descriptions or prompt questions as instructional scaffolding. Online cases can also be made into computer simulations where learners can select different solutions for a given problem, then view and evaluate the consequence of their decisions.

Essential Activities	Assumptions for Design	Rationale	Technology Affordances
	Assumption 2.2: Online cases should present multiple (sometimes conflicting) perspectives regarding certain decisions made in the case events.	Multiple perspectives reflect the complexity of the reality in a subject area, and encourage learners to critically assess their analysis of case problems and proposed solutions from the viewpoints of different stakeholders. The accumulation of practices from multiple perspectives enables learners to view the connections within a complex case more holistically, which is an essential part of expertise (Sandberg & Wielinga, 1992; Spiro et al., 1991).	Hypermedia technology allows cases to be indexed in a flexible, nonlinear way, and studied from multiple perspectives simultaneously (Bolter, 1991; Horvath & Lehrer, 2000). Online CBI can also be set in the setting of a virtual world such as Second Life where learners can talk to different virtual avatars to get their different perspectives on case events.
	Assumption 2.3: Timely feedback and expert commentary should be provided in online cases to have learners compare, evaluate, and reflect on their proposed decisions or solutions for the case problems.	While CBI encourage learners to contemplate their own solutions for the case problems, many researchers asserted such process should be guided by timely feedback and comments ((Barnes et al., 1994; Lee et al., 2009; Merseth, 1996; Williams, 1992). The purpose of feedback and comments is not to give learners a correct answer, but rather engage them in higher-order learning activities such as comparison, critical analysis, and evaluation.	Feedback and expert commentary can be included in online cases in the form of video/audio clips (Choi et al., 2008), hyperlinked content (Kumta et al, 2003), interactive quizzes (Scott et al., 2010), synchronous and asynchronous communication tools ((Lee, et al., 2009; Levin et al., 2006; Mitchem et al., 2008).
Facilitate group discussion	Assumption 3.1: Self-directed online CBI should establish a learning environment that is fun, relaxing and tolerating, which supports the diversity of viewpoints and beliefs.	Cherubini (2009) found that learners who are not familiar with CBI are likely to merely look for the right answers rather than critically explore and discuss different solutions available. Since there will be no instructor to facilitate the discussion in self-directed online CBI, explicit guidance and special design features should be included in online cases to encourage learners to express their opinions openly and freely, without worrying their answers are not the right answers (Barnett, Tyson, 1994; Hmelo et al., 1997, Williams, 1992).	The sense of anonymity offered by online instruction and asynchronous communication can enhance learners' participation in online CBI and make them more willing to take risks and express their opinions (Eberly & Rand, 2003). E-learning development tools (e.g. Captivate, Dreamweaver, and Articulate) also allow case writers to easily change certain design and graphic features such as text font, image style, and interface layout to infuse a sense of fun and comfort for appropriate learner groups.

Essential Activities	Assumptions for Design	Rationale	Technology Affordances
	Assumption 3.2: Pre-specified questions that induce and guide discussions should be phrased and sequenced carefully so that they are non-leading, open-ended, engaging, and relevant.	Case discussion is usually facilitated by instructors with pre-specified or emerged questions (Barnes et al., 1994; Kleinfeld, 1992; Richardson, 1993). It is very difficult to provide emerged questions in self-directed online CBI as there is no instructor to monitor, evaluate, and respond to learner discussion. As a result, pre-specified questions should be carefully designed and integrated in cases to promote group discussion or personal reflection.	Discussion questions can be integrated in online cases in different formats, such as video recordings of an instructor raising the questions, audio clips that can play automatically or manually, and emerged text captions or images. The timing, length, position, and triggering mechanism of those questions can be easily designed using e-learning development tools.
	Assumption 3.3: Self-directed online CBI should allow learners to submit and share their responses to the discussion questions.	Many researchers believed it was the public articulation of views, perspectives, and actions that promoted the learning in CBI (Allen et al., 2000; Barnes et al., 1994; Barnett & Tyson, 1994; Harrington & Garrison, 1992; Merseth, 1996; Rosen, 2008). Self-directed online CBI can realize such public articulation by providing a platform for learners to publish and share their views and perspectives.	E-learning development tools offer a variety of interactive elements (e.g. text entry box, voice recorder, and upload links) that collect learners' responses to the discussion questions. Web 2.0 also provides many third-party platforms and tools that allow learners to publish and share their responses with peers synchronously and asynchronously. The commonly used platforms and tools include: blogs, online discussion forums, learning management systems, and web-conferencing tools.

Summary of the Review of Literature

The case-based method is a well-established and well-researched instructional-design theory, and has been widely used in many disciplines in the past. However, there is no clear and widely accepted definition for what qualifies as the case-based method, as it can take many forms and consist of different learning activities. Despite the many differences, the review of literature has identified several key characteristics of the case-based method, including its theoretical foundations, pedagogical purposes, and essential activities. The essential activities prescribed by the case-based method for a given context are often determined by its pedagogical purposes, and the pedagogical purposes of CBI are supported by the learning theories that underline the pattern recognizing capacity of human mind. Those key characteristics are interrelated, and can be used to define the case-based method and CBI in different instructional contexts.

To address Merseth's (1996) criticism that many acclaimed benefits and limitations of the case-based method were not verified by empirical data, this chapter presented a review of the empirical research on CBI in teacher education, and summarized research findings that support the various claims regarding its effects on cognitive, affective, and metacognitive learning. The case-based method was found to facilitate the development of pedagogical content knowledge, increase teachers' understanding of learner characteristics and educational contexts, promote higher-order thinking such as decision making and problems solving, and stimulate metacognitive reflection during the learning process. The emotional and attitudinal aspects of learning were rarely investigated systematically in the CBI literature, but many studies have reported positive findings such as stronger motivation, increased emotional involvement, and increased self-confidence. The effectiveness of the case-based method is largely dependent on the quality of cases and case discussion. Poorly designed and implemented CBI is believed to be inefficient and confusing for both the instructor and learners. A few more disadvantages of the case-based method have been identified from the literature review, but most of them were only discussed on a conceptual level, without the supporting empirical evidence.

Furthermore, this chapter explored how the case-based method can be supported by computer technologies. Based on the characteristics and affordances of different technologies, the literature review classified technology-supported CBIs into four different types (video case, hypermedia case, case-based e-learning module, and online CBI), and discusses the benefits and limitations of each type based on empirical research findings. The review of literature shows that video and hypermedia are the most commonly used technologies to facilitate CBI, while instances of online CBI – especially self-directed online CBI – seems to be quite rare in the literature, despite the development of the internet over the past several decades. The chapter concluded by proposing a set of theoretical assumptions for designing self-directed online CBI, supported by the CBI literature and technology affordances.

The literature review has shown that most CBI research investigates the instructional interventions that already existed, thus little was known regarding how the key design decisions were supported by the case-based method theory and technology affordances during the actual design practice. In addition, a design instance of online CBI was often examined as a single intervention, and the research findings were usually about the overall effectiveness of the intervention rather than the effectiveness of its individual design features. As a result, there is a lack of research body that provides in-depth analysis of the case-based method theory and pragmatic guidance on how the theory can be applied in design practice. To address such gap in the CBI literature, this dissertation study employs the formative research methodology

(Reigeluth & Frick, 1999) to describe and formatively evaluate the critical theoretical assumptions and design features of self-directed online CBI, in the hope of validating and refining the case-based method for the online setting. The research design and methodological details will be described and discussed in Chapter Three.

CHAPTER 3: METHODOLOGY

Introduction

This dissertation study employed a primarily qualitative methodology known as formative research to validate and refine the case-based method instructional theory for designing self-directed online CBI. This chapter first discussed the philosophical perspectives of different research inquires in the field of instructional design and technology (IDT), and then provided the rationale for the choice of formative research as the dissertation methodology. Based on the underlying logic of formative research, this chapter then explicated five interrelated logical phases of the research design and described detailed methodological procedures in each phase. The first three phases were completed prior to the dissertation and include research activities such as design theory selection, design instance development, and pilot testing. Those activities were critical to reach the point of this dissertation as they set the context and rationale for the study and prepared the foundation for the research work completed in Phase Four (field test) and Phase Five (theory improvement) of the research methodology.

This chapter presented a detailed plan for collecting and analyzing data from the field test, specifying the procedures, instruments, and coding schemes used in Phase Four and Five of the study. The chapter concluded with a discussion on the methodological issues related to formative research, including procedures of ensuring trustworthiness of the study and transferability of the research findings. Thus, Chapter 3 describes the overall methodological approach to this dissertation study, the activities and findings from the initial phases (up through the pilot test) of the methodology that led to the final dissertation work (field test), and thoughts on affordances and methodological issues of research design.

Philosophical Foundations of Research

Researchers have employed various methodologies to investigate the diverse topics and problems in the field of IDT. The methodology selected by a researcher reflects his or her philosophical beliefs and assumptions about educational research, such as the nature of truth, the origin of knowledge, the goals of research, and the means best fit for achieving those goals (Frankel & Wallen, 2003). Guba and Lincoln (2005) proposed a framework to compare the philosophical beliefs behind the different paradigms of inquiry, which examined three important and interrelated factors: ontology that examines the nature of reality and truth, epistemology that explores the origin and nature of knowledge, and methodology that prescribes the best approaches to acquire knowledge about a given issue. Using this framework, this chapter reviewed and compared three major inquiry paradigms (positivism, constructivism, and functional contextualism) in the field of IDT, and summarized the major findings in Table 3.1. As shown in Table 3.1, the choice of quantitative or qualitative research design for a study can be traced back to the ontological, epistemological, and methodological assumptions that are held by educational researchers.

Table 3.1. *Major Paradigms of Inquiry, Assumptions, and Research Designs of IDT Research*

Paradigms of Inquiry	Ontological Assumptions	Epistemological Assumptions	Methodological Assumptions	Research Designs
Positivism	True reality exists and is apprehendable, in terms of fixed properties and relations between its entities. (Bednar et al., 1995; Mackay, 1997; Reber, 1995)	Reality under investigation is an independent entity. Researchers can find out how things really are or how things really work following certain procedures. (Guba & Lincoln, 1994)	Variables should be carefully manipulated and controlled to verify research questions or hypothesis stated in propositional form. (Guba & Lincoln, 1994)	Quantitative research designs (e.g. true experiment, quasi-experiment, correlational research)

Paradigms of Inquiry	Ontological Assumptions	Epistemological Assumptions	Methodological Assumptions	Research Designs
Constructivism	Absolute truth and reality does not exist. Meanings of experiential or physical events are constructed within the relationship between them. (Guba & Lincoln, 1983; Reber, 1995)	Truth and falsity are relative to the observer and its cultural context. Knowledge is socially, culturally and experientially constructed, local and specific to the observer and the context. (Guba & Lincoln, 1994; Johnson & Christensen, 2012)	Research should be conducted in naturalistic settings and allow learners to describe their experience and construct their own reality through dialectical interaction. (Schwandt, 1994)	Qualitative research designs (e.g. ethnographic and narrative research, case study)
Functional Contextualism	Rooted in pragmatism and contextualism, it believes truth is contemporary, context-bound, and a matter of degree, determined by its real effects to a practical solution. (Dewey, 1999; Fox, 2006; An & Reigeluth, 2006)	Knowledge is essentially a plan of action, and proposes practical ends to be attained. The genetic and instrumental character of knowledge makes it likely to be applicable to similar contexts. (Dewey, 1999 ; Fox, 2006; Johnson & Onwuegbuzie, 2004)	Non-experimental design is preferred, as it allows considerable manipulation of methods within authentic context, better addressing the complexity of learning and producing preferable solutions for the specified situations. Both quantitative and qualitative data can be used. (An & Reigeluth, 2006)	Primarily qualitative research designs or mixed method (e.g. design-based research or formative research)

The debate about the merits and validity of quantitative and qualitative research has been incessant in the history of educational research. Researchers like Campbell and Stanley (1966) advocated for the quantitative methodology of experiment, and considered it “as the only means for settling disputes regarding educational practice, as the only way of verifying educational improvements, and as the only way of establishing a cumulative tradition” (p.2). However, the ontological and epistemological assumptions of quantitative research have been challenged by other researchers. Ebel (1967) questioned the value of experimental research in education, arguing that “the process of education is not a natural phenomenon of the kind that has sometimes rewarded scientific investigation…It is manmade, designed to serve our needs” (p.81). Reeves (1995) also questioned the positivist paradigm of quantitative research. He disputed the realist ontological assumption that education is part of an objective reality governed by natural laws like basic science, and commented, “If this assumption about the nature of the phenomena we study is erroneous (and I believe it is), then we inevitably ask the wrong questions in our research" (p.461). Guba (1992) at the other end of the continuum rejected objective reality completely and recommended to use a variety of qualitative methods to study the multiple realities that are socially constructed.

Many researchers agree it is unproductive to polarize educational research into the quantitative–qualitative dichotomy and try to decide which methodology is superior. In choosing a proper methodology, Guba (1981) suggested to select the one "whose assumptions are best met by the phenomenon being investigated" (p.76). Howe and Esienhart (1990) expressed similar view, arguing that the research methodology employed in a study should be evaluated by its success "in investigating educational problems deemed important" (p.2). Furthermore, Firestone (1987) believed that quantitative and qualitative methodologies should not be mutually exclusive, but should complement each other to enhance the strength of the research findings. Ross et al (2010) agreed and predicted that different methodologies, both quantitative and qualitative, would continue to exist in the field of IDT to improve the relevance and quality of research.

However, it is important to note that the qualitative research is gaining more and more attention from researchers in the field of IDT, which has resulted in an increasing number of publications of its kind in recent years. As noticed by Savenye and Robinson (2004), "research questions and methods that might once have been deemed unacceptable are gaining acceptability; studies using a variety of qualitative methods and based on alternate paradigms may now be published" (p. 1045). Take the *Educational Technology Research and Development* (ETR&D) journal for example, 81% of the published research articles between 1989 and 1994 were quantitative in method (Reeves, 1995). However, between 2006 and 2008, this number has declined to 37%, and the majority of the published research studies (58%) were qualitative in method, including case studies, design-based research, and formative research (Ross et al., 2010). Such methodological shift in IDT research, according to Ross et al (2010), is likely due to the shift of research focus from proving the effectiveness of technology to explicating "which technology applications work to facilitate learning, in what ways, in which contexts, for whom, and why" (p.31)

Formative Research Methodology

Overview of Formative Research

Formative research was proposed by Reigeluth and Frick (1999) as a methodology to create and improve instructional-design theories. It is rooted in the paradigm of functional contextualism that focuses on "producing practical knowledge applicable to similar events regardless of time or place" (An & Reigeluth, 2006, p. 49). Reigeluth and Frick (1999) found that "traditional quantitative research methods (e.g. experiments, surveys, correlational analyses) are not particularly useful for improving instructional-design theory, especially in the early stages of development" (p.634). They therefore drew from various qualitative methods such as formative evaluation, case study, and developmental research and have developed a new methodology with a particular focus on creating generalizable design knowledge. Reigeluth and Frick (1999) explained the underlying logic of formative research as follows:

> If you create an accurate application of an instructional-design theory (or model), then any weakness that are found in the application may reflect the weakness in the theory, and any improvements identified for the application may reflect ways to improve the theory, at least for some subset of the situations for which the theory was intended. (p.636)

Reigeluth and Frick (1999) acknowledged that the logic of formative research is similar to the logic of experimental design, in which researchers design an instance (or intervention) based as exclusively as possible on an independent variable, and collect data on the instance with the purpose to generalize back to the concepts related with the independent variable. However, rather than determining whether a method or theory works, formative research asks a different set of questions, such as “What worked and what did not work?” “Why something worked but not the others?” “How can a design theory or method be improved?” According to Yin (1984), when a research inquiry involves asking *how* or *why* questions about a contemporary set of events, a single case study should be considered as an appropriate research method. As a result, formative research is heavily influenced by the case study method, as the instance of an instructional-design theory is often considered as a holistic single case. Furthermore, formative research draws on the formative evaluation techniques and collects empirical data (primarily qualitative) in an iterative fashion, allowing the design instance to be refined and improved over several iterations (Dick & Carey, 1990; Reigeluth & Frick, 1999).

Reigeluth and Frick (1999) argue that unlike research on descriptive theory whose major methodological concern is validity (i.e. how well the description matches the reality), the major concern for research on design theory is *preferrability* (i.e. how much better a method is than other known methods for attaining the desired goal). The three dimensions of value determining preferrability are (1) *effectiveness* that is measured by the extent to which the application of the theory attained the goal, (2) *efficiency* that is measured by the cost time, effort and resources, and (3) *appeal* of the resulting designs for different stakeholders such as teachers, students or administrators.

The formative research can be used for two purposes: improving an existing instructional-design theory, or developing a new theory for instructional practices or processes. The design instance is usually created by the researcher based on the theoretical assumptions under investigation, but it can also be a naturalistic case which is not specifically designed using the theory but serves the same goals and contexts (Reigeluth & Frick, 1999). Based on its purposes and the nature of design instances, formative research can be classified into four major types, as shown in Table 3.2: (1) designed case for an existing theory, (2) designed case for a new theory, (3) naturalistic case for an existing theory, and (4) naturalistic case for a new theory.

Table 3.2. *Major Types of Formative Research Studies*

	For an existing theory	For a new theory
Designed case	An instance of an existing theory is specifically created by the researcher, and is formatively evaluated with the purpose to improve the theory.	An instance of instruction is created by the researcher based on intuition and experiences, and is formatively evaluated with the purpose to develop a tentative theory.
Naturalistic case	An instance of an existing theory is identified and analyzed by the researcher, and is formatively evaluated with the purpose to improve the theory.	An instance of instruction is identified by the researcher, who collects and analyzes the formative data on the instance with the purpose to develop a tentative theory.

Note. Adapted from "Formative research: A methodology for creating and improving design theories," by Reigeluth, C. M. & Frick, T. W. ,1999, In C.M. Reigeluth (Ed.), *Instructional-Design Theories and Models – A New Paradigm of Instructional Theory,* p. 638. Reprinted with permission.

According to Reigeluth and Frick (1999), the most common type of formative research is to use a designed case to improve an existing theory, which includes the following six steps:

1. Select a design theory.
2. Design an instance of the theory.
3. Collect and analyze formative data on the instance.
4. Revise the instance.

5. Repeat the data collection and revision cycle.
6. Offer tentative revisions for the theory.

Reigeluth and Frick (1999) have identified three techniques that are useful for collecting formative data in Step 3 and 5, including observation, documents, and interviews. Observation allows the researcher to verify the presence of key elements of the design theory and examine learners' interactions with the elements. Documents include design documents (e.g. blueprint, prototype, work plan) and outcome documents (e.g. assignment, course project, artifact), which help the researcher to make evaluative judgments on the elements of the design theory. Interviews with the learners are believed to reveal the most useful data for formative research, as they allow researchers to identify strengths and weaknesses in the design instance and seek input from learners about the possible improvements of the instance in different instructional contexts. For formative research, Reigeluth and Frick (1999) recommended "starting with the richer but less valid data-collection technique and moving to progressively less rich but more representative techniques to confirm the richer findings" (p.642). They also suggested that data analysis (e.g. data reduction, data display, and conclusion drawing) should be conducted while the data collection was in process.

Rationale for Choosing the Formative Research Methodology

The selection of formative research for this dissertation study was driven by the researcher's own philosophical beliefs and assumptions about the research on instructional-design theories, including the nature of knowledge, the goals of research, and the best means to attain those goals. Those beliefs and assumptions are discussed in the following paragraphs in relation with different paradigms of inquiry and research designs. The purpose is to explicate the rationale for choosing the formative research methodology.

The phenomenon under investigation in this dissertation is the case-based method, an instructional-design theory. According to Reigeluth (1999), instructional-design theories are goal-oriented and prescriptive in nature, focusing on prescribing methods best fit for attaining given goals in a specific situation. As a result, the knowledge of instructional-design theories is context-specific, as different situations require different set of methods. Such knowledge is probabilistic rather than deterministic, meaning it increases the chance of attaining the goals but does not ensure such attainment (Reigeluth & Frick, 1999). The contextual and pragmatic nature of instructional-design knowledge rejects the existence of a *true* design theory with fixed properties and relations, therefore contradicts with the positivist paradigm of inquiry. The knowledge of design theory is also generalizable and transferrable in nature, seeking to provide guidelines that are applicable in similar settings and produce findings that can inform and improve the theory. Such emphasis on generalizability and transferability also contradicts with the paradigm of radical constructivism which believes knowledge is individually experienced and constructed. Functional contextualism, on the other hand, offers a middle ground between positivism and constructivism, and its *acts-in-context* philosophical belief maps perfectly with the epistemological assumptions about design theories (Reigeluth & An, 2006). As a result, the inquiry paradigm of functional contextualism is selected for this dissertation study based on the researcher's belief that it is a proper paradigm to investigate instructional-design theories.

Within the paradigm of functional contextualism, there are two major methodologies: design-based research (DBR) and formative research (An & Reigeluth, 2006). DBR is also known in other names such as design research, development research or design experiments (Brown, 1992; van den Akker, 1999; Oha & Reeves, 2010; Reeves, Herrington, & Oliver, 2005). In general, DBR and formative research are very similar and share many same characteristics.

For example, both DBR and formative research are interventionist (a design instance is created for a real world setting), contextual, iterative (development and research take place through cycles of design, test, analysis and redesign), utility-focused (primary research question is not whether a design instance works, but how well it works and why), employing a variety of methods, and seeking to produce generalizable knowledge (Cobb et al., 2003; Collins et al, 2004, Design-Based Research Collective 2003; van den Akker et al., 2007; Wang & Hannafin, 2005).

The major difference between DBR and formative research lies in their level of flexibility and research goals. DBR focuses on improving educational practice to solve a realistic problem (Reeves et al., 2005; Wang & Hannafin, 2005). It is considered to be more pragmatic and flexible: the design instance in DBR is not necessarily based on a single theory, and can draw from different learning theories, instructional theories, and instructional system design (ISD) models. Consequently, the findings of DBR could be a set of design principles that inform different design theories. Compared to DBR, formative research is less flexible and more single-theory oriented. The goal of formative research is to improve an existing design theory or develop a new theory, which requires the design instance to be based as exclusively as possible on a specific theory so that the research findings can be generalized back to the theory (Reigeluth & Frick, 1999). The goal of this dissertation study is to evaluate and improve a single instructional-design theory (the case-based method), therefore aligns more closely with the goal of formative research. As a result, formative research was chosen over DBR as the research methodology for this dissertation study.

Research Design

This dissertation study has formatively evaluated an online tutorial designed based on the theoretical assumptions of the case-based method, with the purpose to evaluate and refine the theory for the context of self-directed online instruction. Since the case-based method is an existing theory, the dissertation study belongs to the first type of formative research, designed-case for an existing theory. Following the 6 step research design proposed for this type of formative research (Reigeluth & Frick, 1999) and combining Step 3 and Step 4 as one iteration of data collection and revision, this dissertation study consists of the following five interrelated logical phases:

1. Identify key characteristics of the case-based method and describe theoretical assumptions for designing self-directed online CBI.
2. Develop a self-directed online tutorial as an instance of the case-based method.
3. Pilot test - 1st iteration.
4. Implement the revised tutorial among its target learners and repeat the data collection and revision cycle - 2nd iteration.
5. Refine the theory of the case-based method for designing self-directed online instruction.

Phase One: Propose Theoretical Assumptions for Self-Directed Online CBI

The key characteristics of the case-based method (e.g. theoretical foundations, pedagogical purposes, and essential activities) were summarized and discussed in the review of literature in Chapter 2. Based on such characteristics, thirteen theoretical assumptions for designing self-directed online CBI were proposed in Chapter 2, providing guidance for the design and development of a self-directed, case-based online tutorial in Phase Two. The tutorial was examined in this study as an instance of the case-based method in the self-directed online setting.

Phase Two: Design and Develop the Case-Based Online Tutorial

The case-based online tutorial is completely self-directed, employing various cases from an exemplar after-school program to teach educators how to design and conduct entrepreneurship programs for elementary school students. The first version of the tutorial (Tutorial 1.0) was design and developed in Phase Two of the study and can be found at http://entrepforkid.syr.edu/.

The tutorial speaks to elementary school teachers, and aims to address the gap between the lack of effective instructional materials for elementary-level entrepreneurship education and the need to develop entrepreneurial skills in young students. Eleven entrepreneurial skills have been identified from the literature as appropriate and preferable for elementary school students, including creative thinking, research and planning, communication, team building, digital literacy, and financial literacy. Those skills are listed in Tutorial 1.0 with brief a brief description in terms of what an elementary student will be able to do (see Figure 3.1). The 11 entrepreneurial skills guided the selection and development of cases, as the relevance of a tutorial case is largely determined by how well the case content can inform the development of a specific entrepreneurial skill. Based on those entrepreneurial skills, the learning objectives of the tutorial are that: After studying the tutorial, learners should be able to

- gain basic ideas about entrepreneurship and entrepreneurial skills
- identify a set of entrepreneurial skills that benefit elementary school students
- design activities that engage students in entrepreneurial skill development
- apply various techniques that facilitate effective instruction
- identify, revise and apply existing instructional materials for entrepreneurial activities in their own context
- handle problems during the instruction that are common for the students' age group

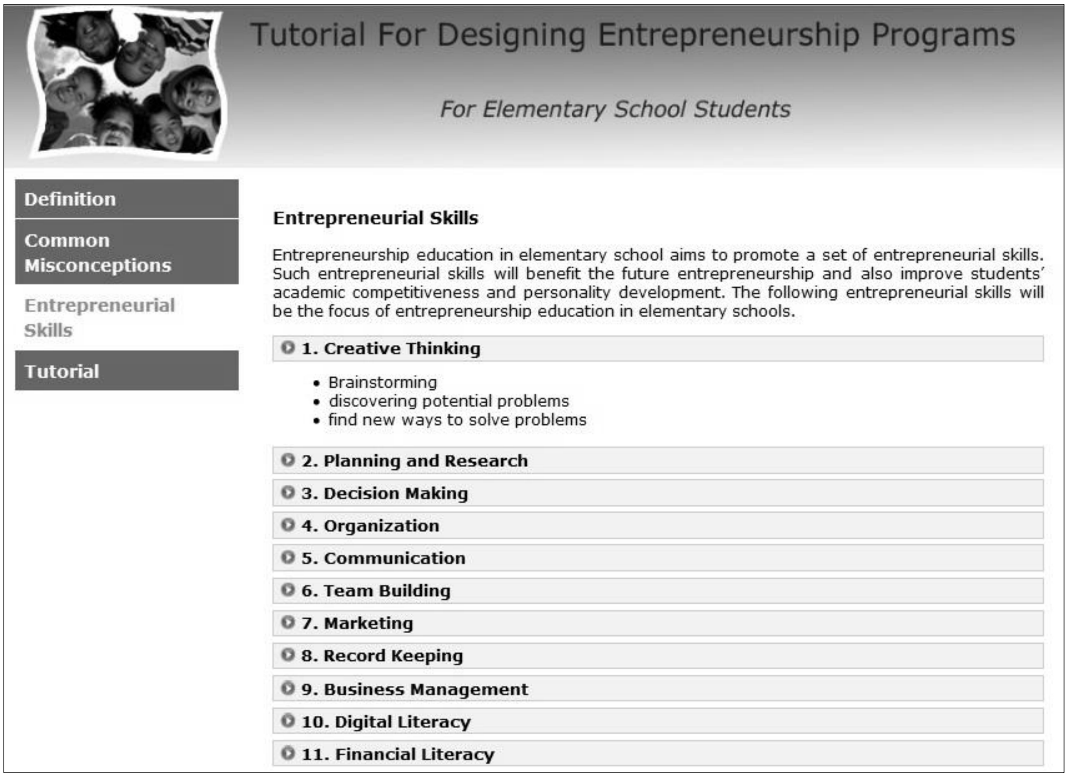


Figure 3.1. Eleven entrepreneurial skills listed in Tutorial 1.0 as appropriate for elementary school students

The major decisions behind the design and development of Tutorial 1.0 were described in detail in a design article (Luo & Koszalka, 2011), with discussion on their rationale and theoretical underpinning. The major findings of the design article were summarized in below to provide an overview of the important design features of the case-based online tutorial.

Instructional components of Tutorial1.0

The instructional content of Tutorial 1.0 is consisted of five critical components based on their different functions in the tutorial, as shown in Figure 3.2. Those five components are:

1. Definitions of entrepreneurship and entrepreneurial skills. This component aims to provide learners with prior knowledge on entrepreneurial skills and entrepreneurship education that

are appropriate for elementary school students. Learners can access such instructional content through hyperlinks or rollover captions.

2. General description of strategies, techniques, and activities in text format. This component prescribes a set of teaching strategies, techniques, and learning activities for developing children's entrepreneurial skills in elementary school settings.
3. Cases in multimedia format. Multimedia cases (e.g. interesting stories, pictures, video footages, lesson plans, student works, student feedback, and instructor reflections) further demonstrate or explain the prescribed strategies, techniques and activities.
4. Interactive elements. Three types of interactive elements are included in the tutorial to scaffold the learning process, including *learner controls* that customize the learning process (e.g. navigation bar), *animated cues* that facilitate learner reflection (e.g. prompt questions, emerging highlights), and *automated feedback* that enable self-assessment (e.g. suggested answer).
5. Guidance on how to use the tutorial. Explicit guidance on how to navigate the tutorial is provided in the form of brief text description and the *Help button*, for learners who have little self-directed online learning experience.

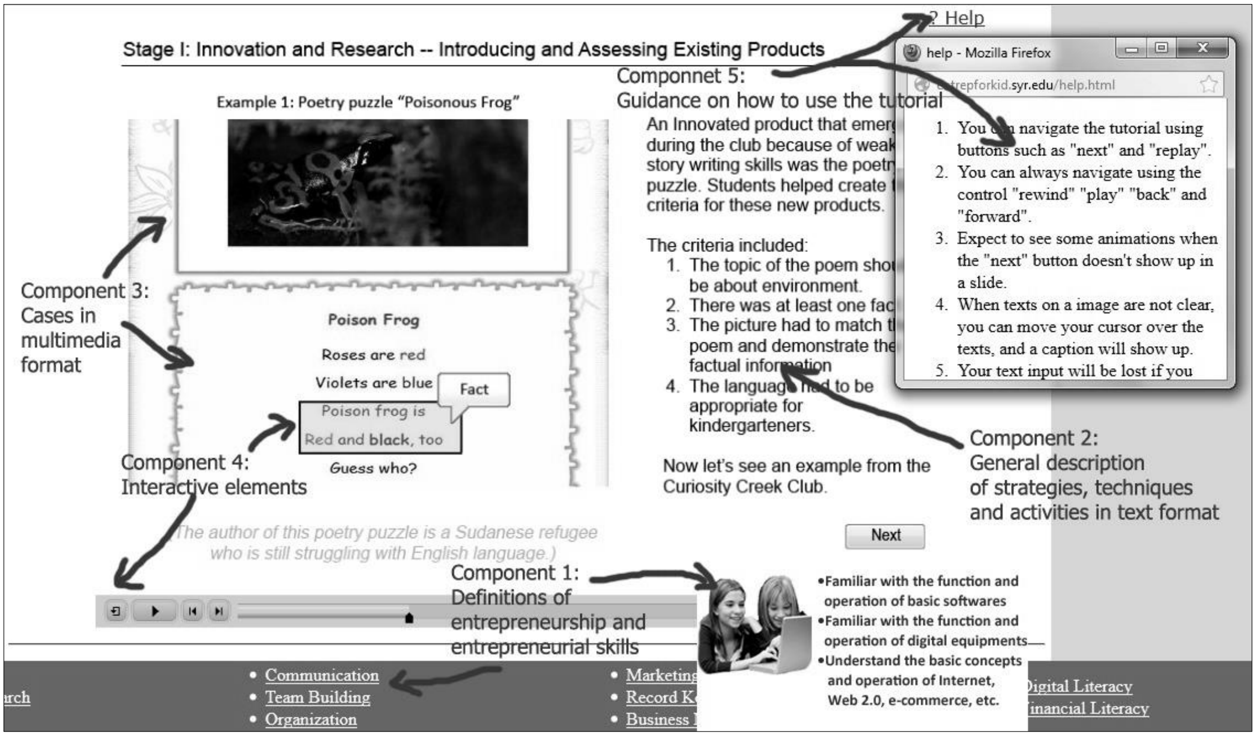


Figure 3.2. Five critical components of Tutorial 1.0

Case development

Most cases in Tutorial 1.0 were developed based on the designers' first-hand facilitating experience in an exemplar after-school program named *Curiosity Creek*. *Curiosity Creek* engages elementary and middle school students in technology-supported activities to turn their innovative ideas into educational products (e.g. digital storybooks, educational videos) for younger children, and aims to develop students' entrepreneurial skills and other essential skills during such process. The theme of this program is Curiosity Creek©, a website (http://curiositycreek.org) created and maintained by Dr. Marilyn Arnone. Luo and Koszalka (2011) further explained the rationale of choosing the *Curiosity Creek* as the source for case development with the following statement:

> We believed that many important entrepreneurial skills can be developed in the program activities, such as creative thinking, decision-making, communication, teamwork,

> management, and some basics of marketing and finance. More importantly, we really liked the program's concept of developing students' subject-matter expertise and skills through fun, hands-on and themed activities rather than the lecture-based instruction…We also saw Curiosity Creek as a good example showing that an entrepreneurship program can go beyond the "Business 101" type of instruction and embrace different themes and formats appropriate for children. The program theme can be in history, arts, or science, as long as students are turning their innovations into valuable products or services and develop critical skills along the way. (p. 16)

Cases integrate otherwise separate techniques, strategies, and materials into a context-specific, meaningful unit. They are used in the tutorial to exemplify how those techniques, strategies, and materials were implemented and provide learners with useful contextualized information such as student responses, facilitator reflections, and effectiveness of instruction. Case materials were selected from different aspects of the *Curiosity Creek* program, including conversations between the facilitator and students, problems and challenges in the instruction, instructional materials used by the facilitator, and student comments, responses and final products. The process of case selection, adaption, and development was guided by the aforementioned eleven entrepreneurial skills to ensure that the case content is relevant and aligns with the learning objectives of Tutorial 1.0.

Take the case *brainstorming* for example (see Figure 3.3), it first describes three general strategies for conducting a brainstorming session with elementary school students (Scene 1), then presents a worksheet used by the Curiosity Creek facilitator to guide students to brainstorm ideas for their digital stories (Scene 2). The case later shows how the facilitator actually implemented the strategies and the worksheet in teaching practice to help a student who wanted to write a story about cow poo (Scene 3). In the end, the case presents the final "Cow Poo story" created by the student, and highlights the evidences in the story that indicate the effect of the brainstorming strategies (Scene 4). In this way, entrepreneurial skills, teaching strategies, learning activities, instructional materials, and learning outcomes are all integrated in one case.

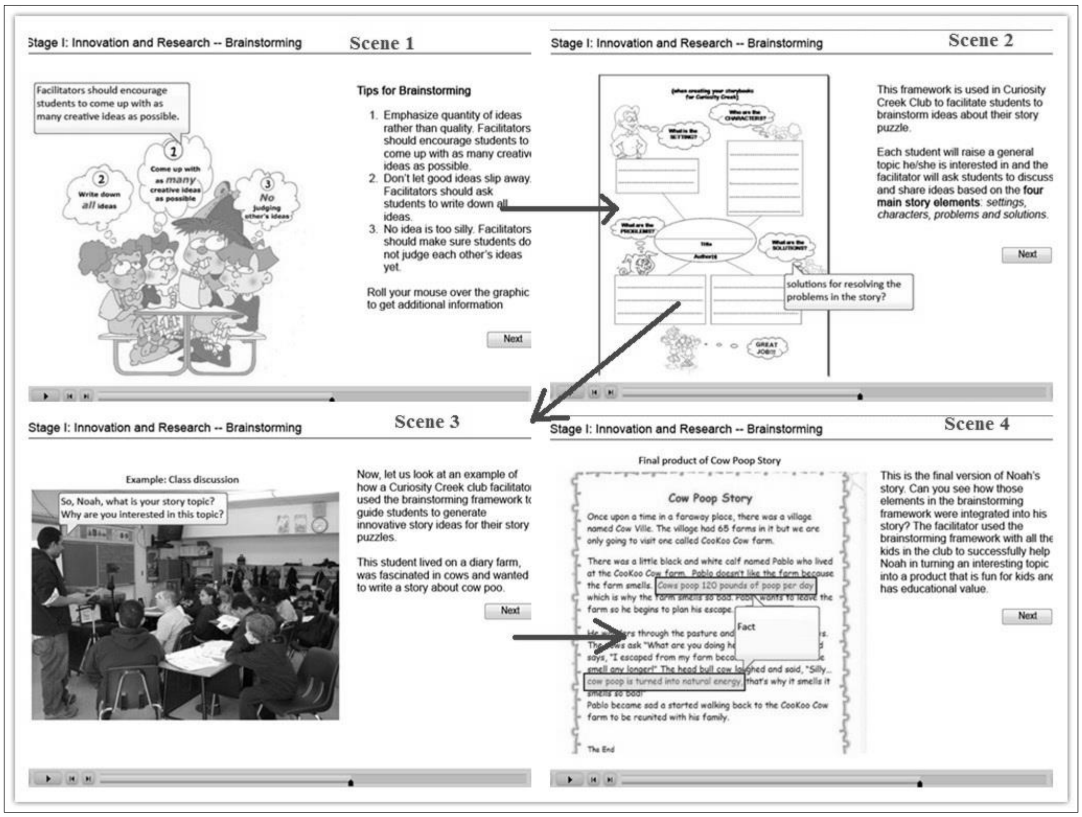


Figure 3.3. Four scenes in the case Brainstorming

The use of multimedia

The instructional content of Tutorial 1.0 includes a variety of media forms, such as text, still images, animations, and videos. Text content in Tutorial 1.0 describes the factual and conceptual knowledge such as definitions of key concepts, instructional strategies, principles, and techniques. Text content is displayed on the right side of the tutorial screen. Multimedia content (e.g. images, animation, and videos) provides learners with contextualized information on how a strategy or technique is implemented in the teaching practice, including information on students and the learning environment, interactions between the facilitator and students, comments and reflections regarding the teaching practice, artifacts used or created by the students. The multimedia content is displayed on the left side of the tutorial screen. Animated visual cues (e.g. emerging caption, highlight box, and rollover image) are widely used in Tutorial 1.0 to emphasize the connections between the text content and the multimedia content. Examples of different types of media forms used in Tutorial 1.0 are shown in Figure 3.4.

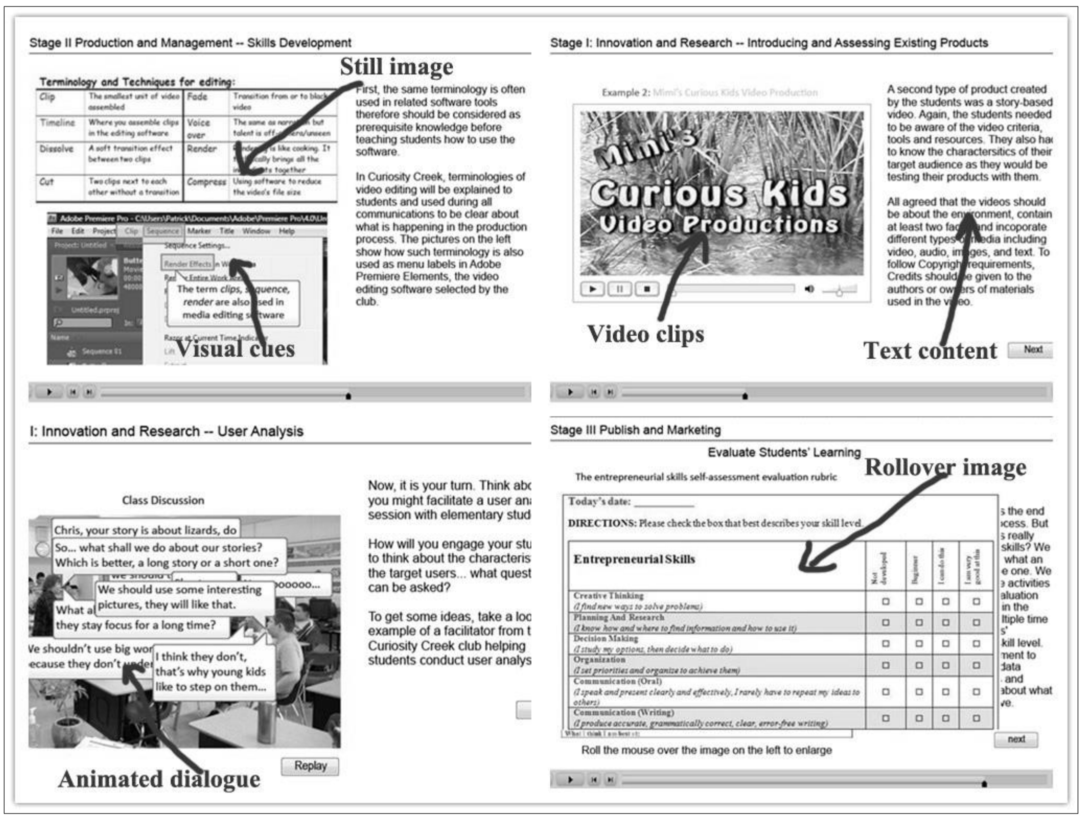


Figure 3.4. Different types of media forms used in Tutorial 1.0

Interactive elements as instructional scaffold

Various interactive elements are built into Tutorial 1.0 to provide learners with procedural and cognitive support, which is essential for self-directed instruction. Such support, also known as instructional scaffold, guides learners to customize their learning process and actively construct their own knowledge of conducting entrepreneurship education programs. The interactive elements in the tutorial include prompted questions, the help button, emerging captions, rollover images, text-entry boxes, highlight boxes, hyperlinks, and navigation controls, as shown in Figure 3.5. They are integrated in Tutorial 1.0 to serve five different scaffolding functions as suggested by Schwier and Misanchuk (1993). Those five scaffolding functions are:

- Knowledge construction: by responding to prompt questions and seeking answers to inquiries, learners will constantly reflect on their learning process and start to construct their own knowledge of the best way to develop entrepreneurial skills for children.
- Performance support: Learners are offered a wide range of hints, cues, help options, and supporting resources along the way to help them better comprehend the cases and answer their own inquiries.
- Verification of learning: feedback is provided to learners in the forms of rollover caption or image when learners click on the button of “suggested answer” or certain images after a prompt question is given.
- Navigation control: the use of navigation bar and plenty of hyperlinks make it easy for learners to access a specific content during their learning by clicking the control buttons such as “next”, “replay”, “pause”, “fast forward” and “rewind”.
- Learner control: learners are able to control and customize their learning process by selecting their own learning sequence and choosing which part of the tutorial to study and skip.

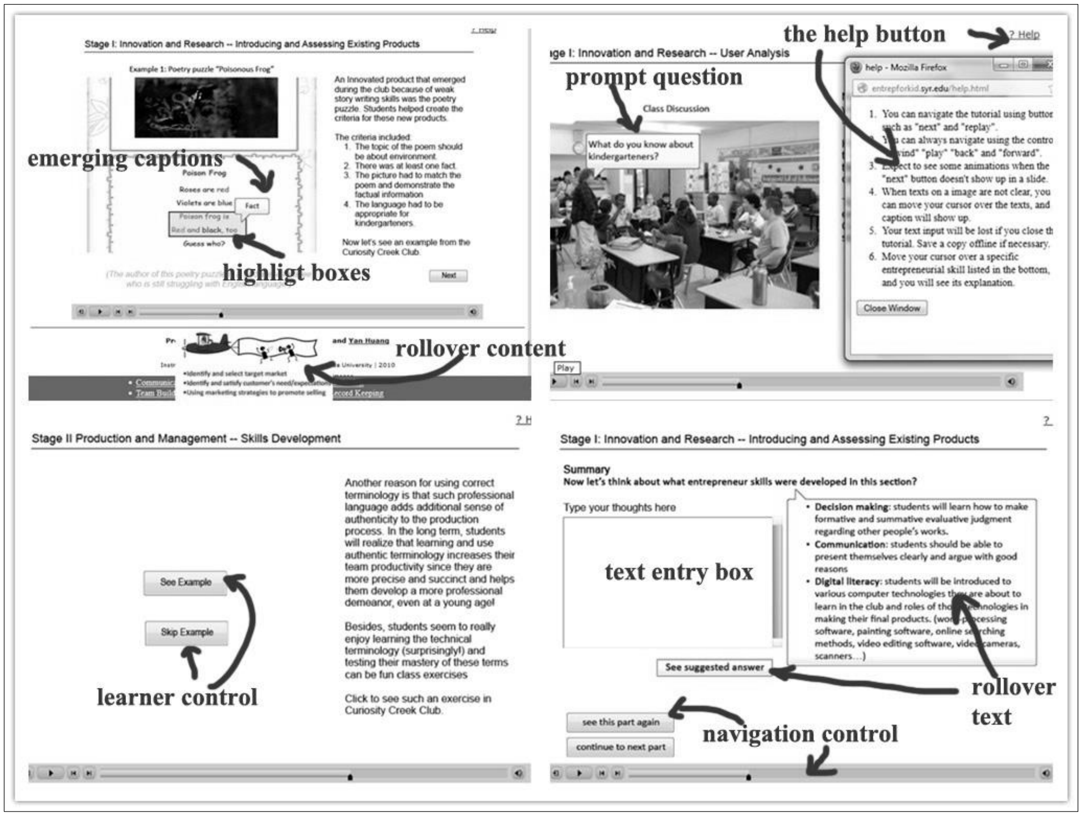


Figure 3.5. Different types of interactive elements in Tutorial 1.0

Organization and structure

The content of Tutorial 1.0 is broken into small chunks based on different activities in the exemplar program. The focus of each chunk is to demonstrate how a specific strategy, technique, or activity can be used to develop certain entrepreneurial skills for elementary school students, using various cases from Curiosity Creek after-school program. As shown in Figure 3.6, the case-based tutorial is part of the tutorial website, and is consisted of three major parts in line with the three major phases of the Curiosity Creek, with each part further divided into sub-units.

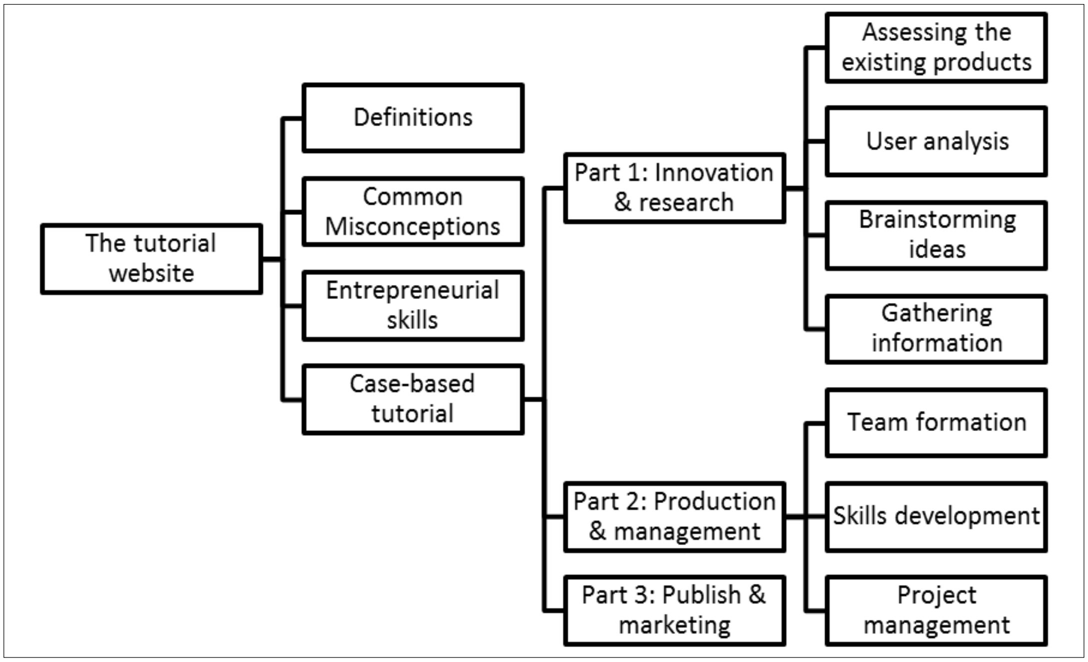


Figure 3.6. The organization and structure of the tutorial website

A summary page is included at the end of each instructional sub-unit, asking learners what entrepreneurial skills are covered in this unit and providing suggested answers as feedback (see Figure 3.7). The summary page can serve as both a review of the instructional content and an assessment of the learning outcome.

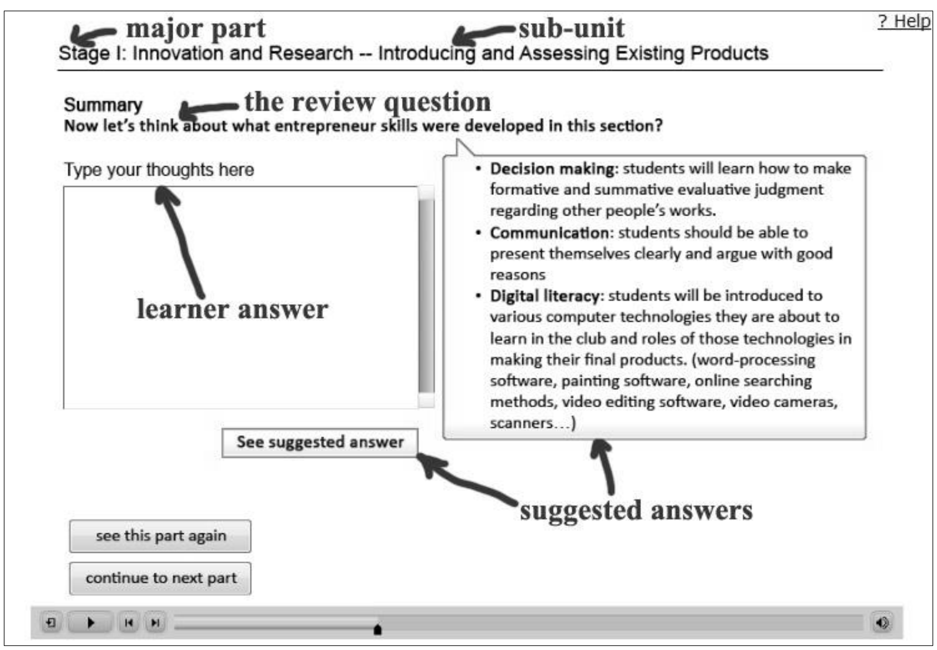


Figure 3.7. The screen capture of a summary page in Tutorial 1.0

Theoretical assumptions of the case-based method and related Tutorial 1.0 Design Features

For the self-directed online tutorial to be a good design instance and an accurate application of the case-based method, it is important to follow the theoretical assumptions of the case-based method during the tutorial design and development process. While the previous sections provide an overview of the major design features of Tutorial 1.0, this section summarizes and further analyzes those design features in relation with the thirteen theoretical assumptions for designing self-directed online CBI, as identified in Phase One of the research design. The summary is provided in Table 3.3.

Table 3.3. *Theoretical Assumptions for Designing Self-Directed Online CBI and the Related Tutorial 1.0 Design Features*

Theoretical Assumptions	Design Features of Tutorial 1.0
Assumption 1.1: Case materials can be collected from various authentic sources and in different formats.	Case materials are based on real events in the Curiosity Creek after-school program, in the form of narrative stories, documentation of a teaching event, artifacts, and reflections, in the forms of text, image, and videos.
Assumption 1.2: Case content should include narrative accounts of typical problematic situations that can be interpreted, analyzed and solved from different perspectives.	Learners are prompted during the learning process to explore the connection between text content and the multimedia content of a specific case and make their own interpretations of which entrepreneurial skills can be developed through the case activity.
Assumption 1.3: Case content should include adequate contextual information and details about the case problem or scenario.	The use of images and videos provide learners with detailed contextual information about the learners, learning environment, learning task, and learning outcome.
Assumption 1.4: Case design should be determined by its instructional purpose. Different purposes place emphasis on different types of instructional activities.	The primary purpose of the tutorial cases is to expose learners to situations they are likely to encounter when they conduct their own entrepreneurship program at K-6 level and provide them with vicarious experiences of implementing certain strategies, techniques and activities to deal with the possible problems.
Assumption 1.5: Online cases should articulate the purpose of CBI and emphasize the connection between case events and prior instructional sessions. Links to supplementary information should also be included to facilitate the comprehension and analysis of the cases.	The purpose of Tutorial 1.0 is explained at the homepage of the tutorial. The tutorial website first introduces 11 entrepreneurial skills, and then guides learners to explore the relationship between the skills development and the case events. Prior knowledge of entrepreneurship and entrepreneurial skills can be accessed easily through hyperlinks and rollover content.
Assumption 1.6: The design of online CBI cases should emphasize adaptivity, interactivity and flexibility, offering sufficient learner control for learners to customize their own learning sequence and access instructional contents in their preferable formats.	Learners can customize their learning process by choosing which part of the tutorial to study first, which example to focus or skip, and which scaffolding cues to respond. Learners can access different contents of the tutorial by clicking either buttons such as “next”, “back”, “skip”, and “replay”, or use the default navigation bar at the bottom of Tutorial 1.0.

Theoretical Assumptions	Design Features of Tutorial 1.0
Assumption 1.7: Online cases should provide explicit instruction and clear visual/verbal cues on how to navigate and study the self-directed online CBI.	A variety of visual cues are included in Tutorial 1.0 such as emerged captions, highlight boxes and arrows to direct learners attention to certain details of the multimedia case content that are related to the general instruction in the text content.
Assumption 2.1: Critical decision points and a variety of scaffolding features should be included in online cases to guide learners to practice decision making and problem solving.	Prompt questions are included in the text content to have learners think about they will do under the circumstances presented in the cases.
Assumption 2.2: Online cases should present multiple perspectives regarding certain decisions made in the case events.	Both positive and negative consequences as a result of the implementation of a strategy, technique or activity are presented as part of the case content.
Assumption 2.3: Timely feedback and expert commentary should be provided in online cases to have learners compare, evaluate, and reflect on their proposed decisions or solutions for the case problems.	At end of each instructional unit of Tutorial 1.0, there is a summary page that asks learners to reflect what entrepreneurial skills are developed in this section, and provide learners with a suggested list of sills and rationale.
Assumption 3.1: Self-directed online CBI should establish a learning environment that is fun, relaxing and tolerating, which supports the diversity of viewpoints and beliefs.	Tutorial 1.0 does not specify which entrepreneurial skills can be developed in the case event, but rather guides learners to make their own interpretations with carefully phrased prompt questions.
Assumption 3.2: Pre-specified questions that induce and guide discussions should be phrased and sequenced carefully so that they are non-leading, open-ended, engaging, and relevant.	Pre-specified questions are mostly *what* and *how* questions, such as "How would you engage students in brainstorming?" "What are the possible challenges?" "What entrepreneurial skills were developed in this section? "
Assumption 3.3: Self-directed online CBI should allow learners to submit and share their responses to the discussion questions.	Learners can submit their reflections and study notes by typing into the text-entry boxes. Tutorial 1.0 can also be easily integrated into online learning and management systems such as Blackboard or Wiki, in which learners can share their reflections in online journals or discussion forums.

The close alignment of the tutorial design features and the 13 theoretical assumptions of the case-based method indicates that Tutorial 1.0 was based on the theory of the case-based method. The fact that Tutorial 1.0 was published as a design case of online CBI by Luo and Koszalka (2011) in the International Journal of Designs for Learning (IJDL), a peer-reviewed publication of Association for Educational Communications and Technology (AECT), also supports its validity as a good design instance of the case-based method.

Phase Three: Pilot Test – First Iteration

Tutorial 1.0 was put into a pilot test in Phase Three to collect the first round of empirical data on its functionality, usability and effectiveness, and explore the strengths and weaknesses of its design features informed by the case-based method. The pilot test was conducted to (1) explore how the participants interact with the design features of Tutorial 1.0, (2) identify the design features of Tutorial 1.0 that are valued and not valued by the participants, and (3) examine the impacts of Tutorial 1.0 on participants' learning outcomes. The pilot test was considered as a pre-dissertation research activity, and its procedure and key findings are briefly summarized in this section.

Participants

Tutorial 1.0 was pilot-tested among 12 graduate students from the School of Education of a private research university in the northeastern region of the United States. They all enrolled in a graduate level course GRD999 (real course name removed for anonymity) offered in 2010 fall semester, which teaches theories, techniques and models of designing instruction. Nine participants were in their twenties who recently graduated with a bachelor's degree in education, and three participants were in their forties with many years of education-related professional experience. The majority of the participants (8 out of 12) had some experience of working with students in K-12 contexts. Two participants were international students, with good command of English.

Procedure

All the participants took part in a two-session instructional design activity in a computer lab, as part of the course requirement for GRD999. The two sessions were one-week apart, with each session lasting for about three hours. In the first session, participants were given a task of designing an after-school program that engages 6th grade students in activities that develop their entrepreneurial skills and related competencies. While participants were encouraged to use their creativity to approach their design task in whichever way that they feel appropriate, they were made aware of two basic requirements for their design task: (1) the instructional goal of the program is to develop certain entrepreneurial skills for 6th graders, (2) the program should be activity-oriented and the students in the program should work together to create products or services with educational value in it. Basic information about the school and the characteristics of 6th graders were also given in the description of the design task (See Appendix B).

Two paper-based tutorials were given to the participants to assist their design. One provided participants with definitions on entrepreneurship and entrepreneurial skills, which contained the same content as that in Tutorial 1.0; the other was the National Standards of Practice for Entrepreneurship Education (NSPEE) downloaded from the *Consortium for Entrepreneurship Education* website (http://www.entre-ed.org/_what/stds-prac-brochure.pdf), introducing the standards for designing and implementing entrepreneurship education. Paper-based tutorials were text-based, without the use of any cases, scenarios, or problems in the instruction. All instructional materials handed to the participants and participants' in-progress design plans were collected at the end of the first session, and were handed back to them in the second session.

In the second session, all participants received the URL of the Tutorial 1.0 in an e-mail, and were asked to spend about an hour studying the tutorial before continuing to work on their design plans for the rest of the session. They were told that they can add, delete, and revise any content of their design plans from last week, and they can elaborate on certain ideas, concepts or activities in their design plans to make them more detailed and easy to implement. A questionnaire was administered at the end of this session, asking participants to rate their learning experience with the online tutorial (See Appendix C). The questionnaire consisted of 27 items in total. Questions 1 to 11 ask participants about their opinions of the use of cases in the tutorial. Features for effective CBI were built into six questions (Question 1, 3, 5, 7, 9 ,11) and the features of other instructional methods such as *rote learning, learning by doing* or *WebQuest* were also included in the questionnaire as distracters (Questions 2, 4, 6, 8, 10). This design aimed to find out if the tutorial was perceived by students as based on the case-based method, as compared to the other methods. Questions 12-20 were designed to measure participants' perceived usefulness of multimedia content in Tutorial 1.0, and Questions 21-27 were designed to measure the perceived usefulness of the interactive elements in Tutorial 1.0. The use of multimedia content and the level of interactivity influence how a case was presented and cognitively perceived, thus were also explored in the pilot study. On a 5-point scale of "-2" to "+2", students were required to rate on how much they agreed with an item statement: "-2" means completely disagree, and "+2" means completely agree.

The questionnaires and the design plans were collected at the end of the second session. Within two weeks of the second session, 10 semi-structured interviews were conducted with the participants, with the purpose to have participants (1) describe their learning experience with Tutorial 1.0, (2) provide formative feedback on the strength and weaknesses of the tutorial design features, and (3) make suggestions for the further improvement of Tutorial 1.0. The interview protocol used in the pilot test can be found in Appendix D. Six interviews were fully transcribed and the rest were partially transcribed for analyzing pilot test data.

Data collecting and analysis

Empirical data on participants' learning experience with Tutorial 1.0 (e.g. learning pattern and process, learning attitude, learning feedback, perceived usefulness and feedback) were collected from various sources using different data collecting methods. Table 3.4 shows how the constructs of interest, data sources and data collecting methods were aligned in the pilot test.

Table 3.4. *Data Collecting Matrix for the Pilot Test*

Construct	Data Source	Collecting methods
Learning pattern and process	Observation notes on how participants actually interacted with the online tutorial, interview excerpts where participants described their own learning process	Observation, semi-structured interview
Learning attitude	Observed emotions exhibited by participants during the learning process; interview excerpts on participants' attitudes toward online CBI, questionnaire questions about the learning attitude	Observation, semi-structured interview, questionnaire
Learning outcome	Participants' in-progress design plans collected from the first session and the complete design plans collected from the second session.	Participants' design plans
Formative feedback	Interview excerpts regarding learners' preference on the tutorial features and suggestion for revision, evaluative items in the questionnaire.	semi-structured interview, questionnaire

Data collected in the pilot test were subject to a low level emergent coding process, where different data sources were thoroughly examined and coded by key words or short phrases that "symbolize(s) and thus attribute(s) interpreted meaning to each individual datum for later purposes of pattern detection, categorization, theory building, and other analytical processes" (Saldaña, 2013, p.4). For example, the following is an excerpt from the observation field-notes, describing a phenomenon observed when a participant studying the online tutorial:

> Mary stopped reading (text) and immediately diverted her attention to the 'one minute story' help aid when a caption popped up. She studied the content in the captions until all the captions were showed.

The excerpt above was first coded by two In Vivo codes, "caption" and "attention". Those two codes were later grouped into the category "Visual Cues and Effects," and a possible theory to be extracted from this category might be that "the use of visual cues in self-directed online instruction has many positive effects on scaffolding a learner's learning process, such as designating the learner's attention to the cued content." In this manner, data were reduced by an inductive process that concentrated upon the emerging themes and complex relationships that were grounded in the data (Strauss & Corbin, 1990).

Results

Four themes were derived from the data analysis, including (1) cases to facilitate learning, (2) multimedia as effective delivery format, (3) mixed findings about built-in interactive features and (4) navigation pattern of studying the online tutorial.

Cases to facilitate learning

Participants had no idea that Tutorial 1.0 was designed and developed using the case-based method, yet their acknowledgement of the positive role cases played in their learning process can be found in many occasions. Results from the questionnaire showed that the online tutorial was a good application of the case-based method, with participants giving higher ratings on the features of effective CBI (mean= +0.77), and much lower ratings on the non-CBI features (mean= -0.2) (See Table 3.5). High ratings on Question 1, 7 and 11 showed that most participants agreed that cases in the online tutorial provided the instruction that is context-specific, objective-focused, and relevant for their design task.

Table 3.5. *Ratings on the CBI and Non-CBI Features of Tutorial 1.0*

No	Statement	Sum N=11	Mean
1	The content in the tutorial presented specific knowledge within the context of an after-school program for elementary and middle school students.	14	1.27
3	The scenarios discussed in the tutorial helped me understand my instructional design context better.	8	0.73
5	I often got bored during the tutorial.	1 (reversed)	0.09
7	The cases discussed in the tutorial helped me focus on designing for entrepreneurial skills development.	11	1.00

No	Statement	Sum N=11	Mean
9	My design ideas at the end of the tutorial were inspired by studying the cases in the tutorial.	6	0.55
11	I learned useful lessons of how to develop entrepreneurial skills for children by completing the tutorial.	11	1.00
	Mean rating on the CBI features	8.5	0.77
2	I needed to memorizes many facts during the tutorial	-1	-0.09
4	I needed to assess my comprehension of the content in one tutorial before moving to the next.	4	0.36
6	I engaged in many hands-on activities during the tutorial.	-6	-0.55
8	What I found the most useful in the tutorial were the definitions of key concepts *(e.g. entrepreneurial traits, innovation, etc.)*	6	0.55
10	My learning heavily relied on the external information sources *(e.g. websites, database, linked documents)* provided by the tutorial.	-14	-1.27
	Mean rating on the non-CBI features	-2.2	-0.2

Participants agreed that cases in Tutorial 1.0 helped them comprehend the abstract concepts in the tutorial by elaborating the meanings of those concepts in authentic contexts. As one participant commented in the interview, “it (the abstract concept) is not above my head, it is something that I can connect at a practical level and use that information to inform whatever my design is going to come out to be.” On many occasions, participants mentioned how studying a specific case furthered their understanding about a teaching strategy or activity, and inspired new ideas for their design task. One participant described how a case in Tutorial 1.0 helped broaden her view on the entrepreneurial theme of the after-school program in the following statement:

> I learned information from the context, and it also broadened my limited view on this whole entrepreneurial theme. Because I think the examples in the tutorial include doing something for the environment, something with insects; and I am like: ‘Mm, why I was thinking of this project in such a limited way!’ I didn’t even think of doing a project that can be focusing on the environment, or promoting that aspect of it.

Such examples can also be found from the design plans created by the participants. When designing activities to increase students' marketing skill, one participant originally planned to teach elementary students how to write marketing plans and give "fake" business presentations. After studying Tutorial 1.0, she changed her original plan and wrote, "Students can share their final business project with the school in the setting very similar to a science fair; students will be able to invite family members to come and see as well as the fellow students in the school..." This new idea of hers was very likely to come from a similar case in Tutorial 1.0, where students exhibited their final educational products in a science fair to their teachers and parents.

The study also found that the narratives of teaching scenarios or activities can be used as cases and artifacts such as students' sample works and projects or instructional materials used in the teaching practice can also be useful cases for students. One student said in the interview that she really liked the demonstration of student products in Tutorial 1.0, because she liked to see "examples of how students take the direction and apply it." Another student noticed that different types of worksheets were described in the tutorial cases, and adapted some of the worksheets to be used in her own designed program. "I just described them in my own way and made them a little different than yours", the participant explained. Several participants also suggested the tutorial should allow the sample worksheets to be downloaded and printed out, so they were more "ready-to-use" in the actual design practice.

Multimedia as effective case delivery format

The pilot testing results suggested that the use of multimedia was appreciated by the participants in general. Participants exhibited greater interest to study the instructional content in multimedia format and spent more time on tutorial slide with the presence of animations or videos. The questionnaire showed that the participants gave positive feedback on all the items regarding the multimedia use in Tutorial 1.0, with a mean score of 0.93. High ratings on Question 12, 13, 15, 17, 19 indicated that the participants would rather learn a case in the multimedia format than the text-only format. They believed the use of multimedia increased the authenticity and appeal of the cases, and enhanced their understanding of the cases. (See Table 3.6)

Table 3.6. *Ratings on the Use of Multimedia in Tutorial 1.0*

No	Statement	Sum N=11	Mean
12	Multimedia elements *(e.g. video, audio, images, and animation)* used in the tutorial increased the authenticity of the cases. *(authenticity: the quality of being real or true)*	15	1.36
13	Multimedia elements like the help-aids and examples of student products helped me better understand the concepts presented in the tutorial	13	1.18
14	Some of my design ideas were inspired by studying multimedia elements *(video, image, or animation, etc.)* presented in the tutorial	7	0.64
15	I prefer cases to be presented in text with less multimedia.	13 (reversed)	1.18
16	I like how the cases were presented in an online tutorial.	7	0.64
17	Multimedia elements used in the tutorial made the cases more interesting	11	1.00
18	I think the use of multimedia in the case descriptions was distracting	9 (reversed)	0.82
19	Use of multimedia enhanced my understanding of the cases.	12	1.09
20	Use of multimedia prolonged my process of studying a case.	5 (reversed)	0.45
	Mean score:	10.22	0.93

During the interview, the participants described their learning experience with both the paper-based tutorial and Tutorial 1.0. The common reasons behind participants' preference for Tutorial 1.0 included: (1) it fit their learning style, (2) it seemed more interesting and stimulating, and (3) it activated multiple senses and enhanced information storage and retrieval.

Several participants referred themselves as visual learners and claimed that information came more naturally to them if it was delivered through images, videos, or diagrams. For example, one participant said in the interview that “to me, I feel I retain more information from seeing something, more than just hearing, or getting up and doing things. So, when I look at something, I feel like it comes more to me, than just hearing teachers talk all the time.” Another participant further explained why she didn’t like the paper-based tutorial in the following words:

> I, myself, am more like, videos or graphics kind of person. I am not a great reader… most of the time I will give up when I am doing some tutorial reading tasks. I will skip some paragraphs or things; but this time, I was really involved in it (learning the online tutorial).

Compared to the paper-based tutorial, Tutorial 1.0 was considered to be more colorful, lively, interesting and engaging. One participant believed that the multimedia content “makes the subjects come alive and maintains one’s interest.” Another participant further explained that the presentation of images, animations or videos made the instructional content less “overwhelming” and more “manageable”, thus she was more willing and confident when studying Tutorial 1.0. Several participants also believed that delivering instructional content in multimedia format allowed them to use multiple senses to process information, thus increased the chance of long-term memory.

However, multimedia was not preferred by everyone. One participant expressed her dissatisfaction about the multimedia content during the interview. She didn’t find the images or videos that useful because she felt she knew the content already from the text-description. She also had the notion that multimedia content was for children not adults, as she complained in the interview, “I didn’t need the elementary part on the left. I felt like, you know, I am not a little kid, I can understand from reading of what it is; I don’t need see a picture.” Another issue is the timing of certain animations. Several participants complained that when they were reading the text content in Tutorial 1.0, sometimes emerging captions or highlighted boxes would "pop up", which caused a sense of confusion and surprise.

Mixed findings about built-in interactive elements

Participants seemed to have mixed feelings towards the interactive elements that were built into Tutorial 1.0. As can be seen from the questionnaire result (Table 3.7), the overall ratings on the usefulness of those interactive elements were positive (mean= 0.44). Participants were aware of their presence in Tutorial 1.0 and actively responded to them. The negative ratings on Question 22 and 26 indicated participants considered the interactive elements in Tutorial 1.0 as inadequate to facilitate a two-way communication between them and the tutorial, and provided them with insufficient feedback during the learning process.

Table 3.7. *Participants' Ratings on the Use of Interactive Elements in Tutorial 1.0*

No	Statement	Sum N=11	Mean
21	The tutorial offered me a wide range of hints and help options to help me understand the case.	9	0.82
22	I felt like I was having a conversation with the tutorial during my learning process.	-7	-.064
23	The case narrations included enough interactions to help me reflect on my learning process. *(Interaction can be defined as learner controlled instructional engagement, such as controlling the learning progress, reflecting on the prompt questions, etc.)*	6	0.55
24	I responded to most of interaction cues offered in the tutorial during my learning process. *(an interaction cue is a sign for users to interact with the tutorial)*	9	0.82
25	I developed appropriate design ideas when responding to interaction cues.	5	0.45
26	The tutorial offered me useful feedback on my learning.	-3	-0.27
27	I was able to control my own learning speed during the tutorial.	15	1.36
		34	0.44

The most appreciated interactive elements were those that allowed users to control and adjust their own learning process. The high rating on Question 27 in the questionnaire showed that most participants had no problem controlling their pace of learning. On several occasions during the interview, participants acknowledged the feature of learner control and explained why they saw it as a useful design feature. One participant liked the fact that if she was not familiar with certain concepts or definitions, she could go back and review them before moving on to the next session. She explained, "because sometimes when you look at things you can't really (understand), you are like, 'oh, how does this really relate to the step before?' so you can click and go back there again."

However, it is interesting to note that one participant was having trouble controlling her learning process, as she complained, "there I couldn't control anything; I wanted to hit 'next' when I wanted to hit 'next', and it wasn't letting me bring it (the 'next' button) up until I watched the example... Yeah, I was getting annoyed." Apparently, she didn't know that there were other ways to navigate the tutorial besides the "next" and "back" button, and that she can go to any page of the tutorial by using the navigation control bar at the bottom. Although the design for learner control in the tutorial was considered quite simple and intuitive, more explicit cues or instructions should be provided for those learners with less online learning experience.

Many participants considered the interactive elements in the tutorial as another form of stimulation that made their learning process more interesting and engaging. As one participant pointed out, buttons such as "next" "back" "see an example" broke the tutorial content into *sessions*, and being able to "click through" the tutorial gave her "mental breaks to go through more things in the next session". Another participant also claimed that interactive elements in Tutorial 1.0 made her learning less boring, and explained "you could interact with the tutorial... I got bored from time to time, that (interaction) helps to cut down my boredom." Some interactive elements also engaged participants in active thinking and prompted them to reflect on what they have just learned. One participant explained how the interactive elements in the summary page (e.g. prompt question, text-entry box, rollover feedback) helped her think in the right direction with the following reflective statement:

> Going through the first session of the tutorial, I wasn't thinking like, 'okay, what are the entrepreneurial skills?' like communication, teambuilding... I didn't really think about that when I started to type stuff in… When I clicked on the summary page, that's when it occurred to me, like, "okay…" and I started to think in these terms (in terms of entrepreneurial skills).

Navigation pattern of studying Tutorial1.0

The participants' interaction with Tutorial 1.0 can provide useful information on how to design cases that fit most learners' learning pattern, and thus facilitate the learning process. The pilot test results have revealed several navigation patterns. On a macro-level, there was a pattern for participants to start from the top-left part of the tutorial, with attention shifting to the right and towards the bottom of the tutorial screen. Such pattern is consistent with the natural tendency of reading text for English speakers (Fleming & Levie, 1993). The instructional content of Tutorial 1.0 was organized based on such *top-down left-right* tendency, allowing most participants to intuitively follow the designed learning sequence without any explicit guidance. As one participant described, "I just worked my way across, there is no specific order." Such pattern was confirmed later during interviews where participants described their own approaches of studying the online tutorial. One participant described her navigation pattern in the following words. Her description indicated that besides the *top-down left-right* natural tendency, she also understood the rationale behind the layout structure of Tutorial 1.0, and used such layout structure to organize her learning agenda.

> I probably honestly just started from the top and worked my way down. So I will start from the definition (link), and then work my way down to the tutorial. Mm, for me, I think maybe I need to know some definitions, and skills before I go through (the tutorial)…From there, I would just end up working from left to right (from part one to part three of the tutorial); just for my mind, it feels like it is setting it up from a certain outline, of what you have to do and of what you just do.

On a micro-level, by examining how participants divided their attention when studying an individual tutorial screen, the pilot test revealed that participants actually spent more time on studying text content rather than multimedia content. A general pattern was that participants would first read the text content on the right, and then glanced at the multimedia content on the left. Multimedia content was also likely to get skipped by participants if it was presented without animated visual cues. It was also observed that participants sometimes would divert their attention back and forth between the text and multimedia content, suggesting they were making comparison and connections between abstract concepts and concrete cases in Tutorial 1.0. Such side-by-side layout of the tutorial was appreciated by many participants. As one participant stated, "it is more helpful and beneficial, after reading the whole little paragraphs on the side, and then see what was actually made out of it."

Major findings that inform the field test

Useful design features to be kept in Tutorial 2.0

The pilot testing results revealed that the following design features of Tutorial 1.0 were valued by the participants therefore should be kept in the second version of the case-based online tutorial, Tutorial 2.0. Those design features include:

- Using authentic stories and events from Curiosity Creek as sources for case development. Authenticity increases learners' interest and includes valuable contextual information.
- Including artifacts such as sample products, worksheets, and help-aids in tutorial cases. Artifacts are considered as effective case materials by learners, providing evidence for learning outcome and ready-to-use materials for similar contexts.
- Presenting cases in multimedia format. Multimedia cases provide more stimuli, convey more information, and accommodate for different learning preferences.
- The side-by-side tutorial layout that aligns text content of general instruction with multimedia content of cases. The layout enables learners to constantly compare the general instruction with concrete cases and establish connections between the two.
- Embedding visual cues in multimedia cases to get learners' attention, highlight key information, and emphasize the connection between the text content and multimedia content.
- Including scaffolding features (e.g. prompt questions, highlights, summary page) in the tutorial. Those scaffolding features actively engage learners to reflect on what they have learned from the cases and their overall learning process.
- Including a variety of interactive elements that allow learners control and customize their learning process, such as selecting their own learning sequence, locate information, adjust learning speed, skim or skip certain content.
- Breaking down tutorial content into smaller instructional units based on different phases of entrepreneurship education programs and entrepreneurial skills. Such structure makes the tutorial more relevant to entrepreneurship education and less overwhelming for learners.

Problematic design features to be revised in Tutorial 2.0

The pilot testing results also identified some problems with several design features of Tutorial 1.0, which needed to be revised in Tutorial 2.0. Those problematic design features and proposed revisions are listed in Table 3.8:

Table 3.8. *Problematic Design Features in Tutorial 1.0 and Revising Suggestions*

Problematic Design Feature	Proposed Revision
The existing interactive features of the tutorial do not provide learners with useful feedback during the learning process.	Make the quizzes in the tutorial more interactive and responsive, providing participants with immediate results and guide participants to select the right answer. Provide an assessment rubric as a guide for learners to design and evaluate their own entrepreneurship programs.
Tutorial 1.0 does not provide a sense of two-way communication as that in a face-to-face learning environment.	Create a virtual avatar to play the role of a facilitator in the tutorial. Allow learners to interact with the avatar to receive guidance, hints, or feedback during the learning process to simulate interactions in a face-to-face classroom.
Tutorial content (e.g. general instruction, case stories, sample worksheets, and student works) cannot be downloaded and printed out.	Present all tutorial content in both flash-based media and Word Documents. Worksheets and lesson plans in Word documents can be easily edited and adapted so that they can be used by learners in a similar context.
Presenting instructional contents in both text description and multimedia cases results in redundancy.	The text content will be further reduced, with more information been presented in multimedia cases in terms of emerged captions or lectures made by the avatar.
The quantity, length, and style of multimedia content in the tutorial might not be appropriate for the age group of target learners.	The graphics for the tutorial will be redesigned using the e-learning development tool –Articulate Storyline. Using the style templates in Storyline, the tutorial graphics will be more consistent and have a more professional look.
The animated visual cues can be distracting and confusing for learners.	Provide greater learner control by allowing learners to control the timing and length of the appearance of visual cues.
The dual navigation system (buttons versus navigation bar) proves to be confusing for some learners.	Provide more explicit guidance on how to navigate the tutorial in the form of friendly introduction from the avatar. The primary form of navigation will be achieved by the use of buttons (e.g. next, back, view, replay….), and the navigation bar will be removed or hid.

Problems with data collecting methods

The pilot test also revealed some problems with existing data collecting methods, which need to be addressed in the field test of Tutorial 2.0. First, observation field-notes on how participants interacted with the tutorial are difficult to compile using the traditional *paper-and-pen* method since it is impossible to write down every action that a participant takes. In the field test, participants' interactions with the tutorial content will be digitally captured using *Adobe Captivate*, the screen capture software, with the purpose to accurately restore the learning process. In the field test, participants will also be instructed to move the mouse cursor to the areas they are studying, as the path of cursor movement can provide important data on how participants direct their attentions during the learning process.

Second, the use of instructional design terms should be further reduced in the questionnaire. The use of phrases such as *interaction cues*, *multimedia elements*, or *case narrations* caused confusion among the pilot test participants who are students majoring in instructional design. Those phrases are even more likely to cause confusion among the participants of the field test who will be K-12 teachers with no instructional design background. As a result, the questionnaire was revised using phrases that are more common and comprehendible to the general public. Brief explanations and examples will also be provided to help participants understand specific terms (e.g. scaffolding features, multimedia, and learner control). Because the CBI features of the tutorial have been verified in the pilot test, proving Tutorial 2.0 to be an accurate application of the case-based method was deemed unnecessary in the field test. As a result, distracter questions in the pilot test questionnaire regarding the non-CBI features were removed for the field test questionnaire

Third, the pilot test showed that when an interview was conducted several days after the learning event, participants forgot details regarding the tutorial design features and had to be reminded of those features during the interview. As a result, some of the questions from the interview were imposed and leading. To address this problem in the field test, a short video demonstrating the key features of Tutorial 2.0 was shown to a participant before the interview if the interview was conducted three days later so that participants' memories of the tutorial can be activated. Several new design features were incorporated into Tutorial 2.0 to improve its earlier version, so a few prompt questions regarding those new design features were also added to the interview protocol used in the field test.

Lastly, it was found that the participants in the pilot test were less likely to make drastic changes to their design plan in the second session even if they had some new ideas after studying the case-based online tutorial. As one participant stated in the interview, "after (studying) the tutorial, I realized there were more approaches for designing the program…I just didn't have the time to start it all over again, since I was under pressure and wanted to finish (my design plan) in time." Such reluctance to make changes to the original design plan made it difficult to assess the effect of the case-based tutorial on the learning outcome. As a result, the two design sessions in the pilot test were combined as one for the field test. Participants were told about the instructional design task and brainstormed initial design ideas prior to the field test, and then engaged in design activities after they finished studying Tutorial 2.0.

Phase Four: Field Test–Second Iteration

The pre-dissertation research activities in the first three phases and their key findings are summarized in the previous sections. Starting in Phase Four, the discussion of research methods will shift from pilot works to the actual dissertation work that involved the collection and analysis of empirical data collected from the field test.

Phase Four built on the findings of Phase Three and tested the revised tutorial (Tutorial 2.0) among its target learners – elementary and middle school teachers. Phase Four in this dissertation study is the second iteration of data collection and revision in formative research methodology. Tutorial 2.0 was field-tested to collect empirical data on teachers' interactions with the tutorial, the perceived usefulness of the tutorial features, and the evidence of higher-order learning. A particular focus of Phase Four was on evaluating the revised design features in Tutorial 2.0 and validating the critical theoretical assumptions for designing self-directed online CBI. More specifically, three research questions were investigated in this phase:

- Research question 1: What design features of the case-based tutorial are valued by the learners?
- Research question 2: What design features of the case-based tutorial are not valued by the learners and what are the possible ways to improve them?
- Research question 3: What are the benefits and limitations of applying the case-based method to design self-directed online instruction?

Tutorial 2.0

Based on the pilot test findings, the researcher made a few revisions in Tutorial 2.0 (https://courseware.e-education.psu.edu/cbi/tutorial2/story.html). Unlike Tutorial 1.0 which is hyperlinked to a website, Tutorial 2.0 was developed as a completely self-contained learning module using the e-learning development tool called Articulate Storyline. The tutorial was published into different formats such as shockwave flash object, HTML5, and iOS compatible application, allowing access from computers, tablets, and smartphones. Using the interactive triggers, hotspots, and templates offered by Articulate Storyline, the text content of background knowledge and the definitions of entrepreneurial skills was built into the tutorial and can be revealed to learners through simple click-to-reveal interactions. All instructional materials from the cases such as worksheets, grading rubrics or visual aids can now be downloaded and printed in pdf format when learners click on the *download printable version* button.

As shown in Figure 3.8, a virtual person named Monica was added to the tutorial to act as a facilitator, she would greet learners at the beginning, explain the purpose and learning objectives of the tutorial, provide instruction on how to navigate the tutorial, and insert reflective question(s) at the end of each learning unit. The navigation bar was removed from Tutorial 2.0 to avoid confusion, and the buttons (e.g. PREV, NEXT, Play, Skip, Download) would be the primary navigation control for learners. A new component was the *Menu* panel on the left of the tutorial interface. All of the tutorial slides were listed in a numerical order in the panel thus would allow learners to access any content with ease. The *Menu* panel also served as a progress indicator, showing learners how much of the tutorial has already been completed.

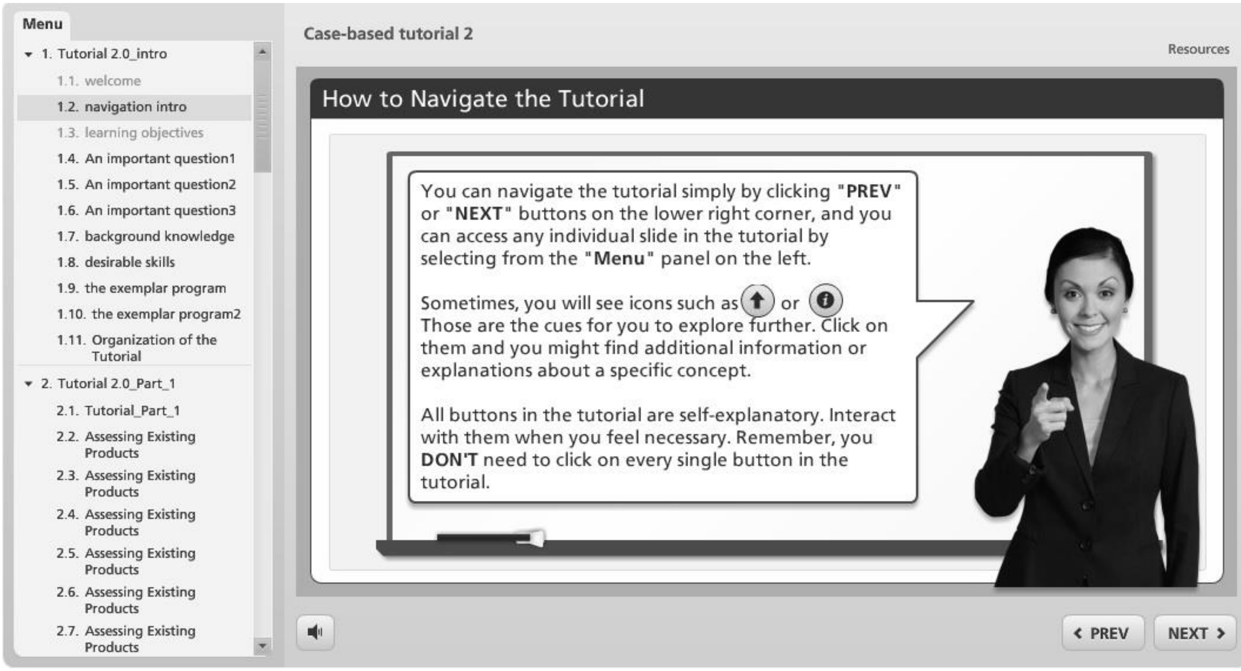


Figure 3.8. The screen capture of an introduction unit in Tutorial 2.0.

Another major revision in Tutorial 2.0 was the design of animated visual cues. Animated visual cues such as emerging captions and highlight boxes no longer appear automatically and need to be triggered by learners with a click on an arrow marker or a button (Figure 3.9). This revision offers learners complete control as to when and how long they want to study the cued content, and is expected to reduce the sense of surprise or distraction due to the sudden appearance of visual cues.

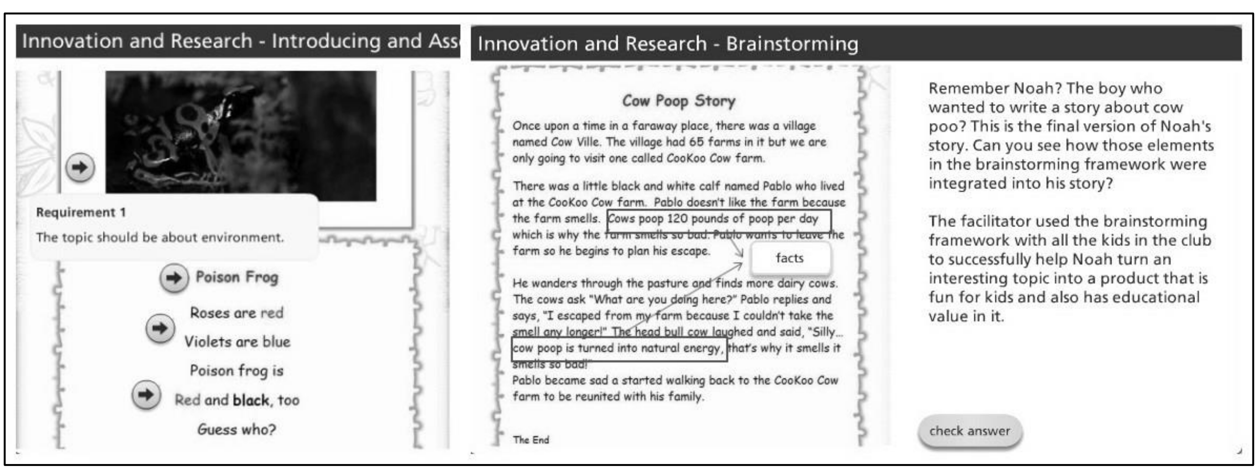


Figure 3.9. User-triggered visual cues in Tutorial 2.0

More prompt questions and problem scenarios were built into Tutorial 2.0 to guide learners to actively reflect on what they have learned from the exemplary cases and how such knowledge can be applied to solve contextualized problems, as shown in Figure 3.10. Like case descriptions, the problem scenarios were also made optional, and would only be revealed to learners upon clicking. Such design aims to reduce the amount of text content presented to learners and provide greater learner control on how much higher-order learning activities one wants to engage.

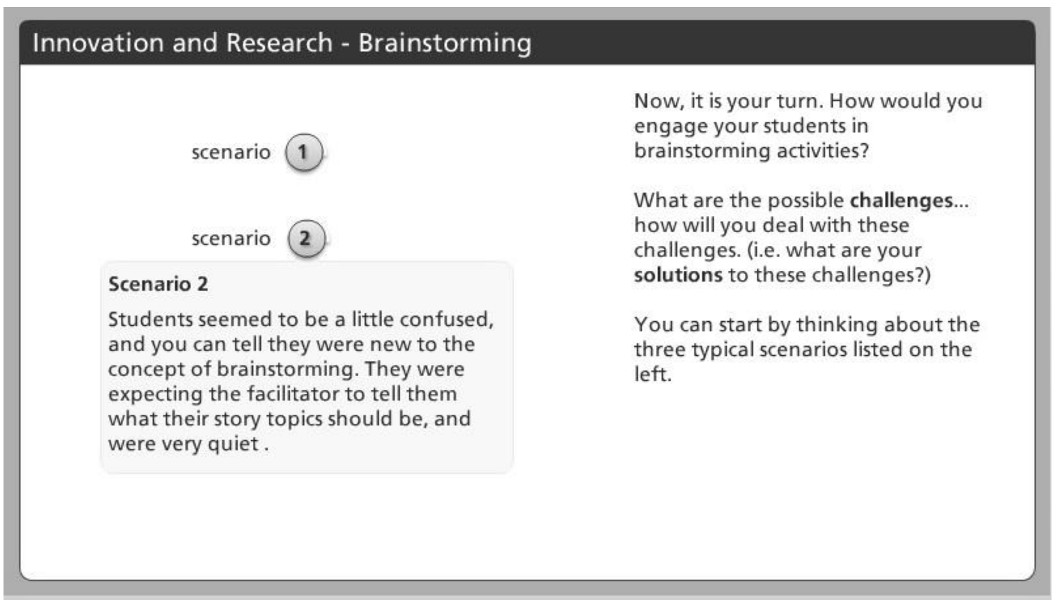


Figure 3.10. An example of prompt questions and problem scenarios in Tutorial 2.0

Tutorial 2.0 still includes a review exercise at the end of each learning unit that prompt learners to reflect what they have learned in terms of entrepreneurial skill development. The review exercise was made more interactive in Tutorial 2.0 by having learners to match a specific entrepreneurial skill with a specific learning activity described in the unit. Unlike the old review exercise in Tutorial 1.0 that requires learners to type their answers in a text-entry box, the revised exercise might be more inviting to learners as it is like a *drag and drop* game without any need to write. More importantly, learner can get immediate feedback once they submit their answer as the wrong answers will be color-coded red and the correct answers will be coded green (Figure 3.11). Such design serves the purpose of review, prompting learners who got the most answers wrong to go back and re-take the unit.

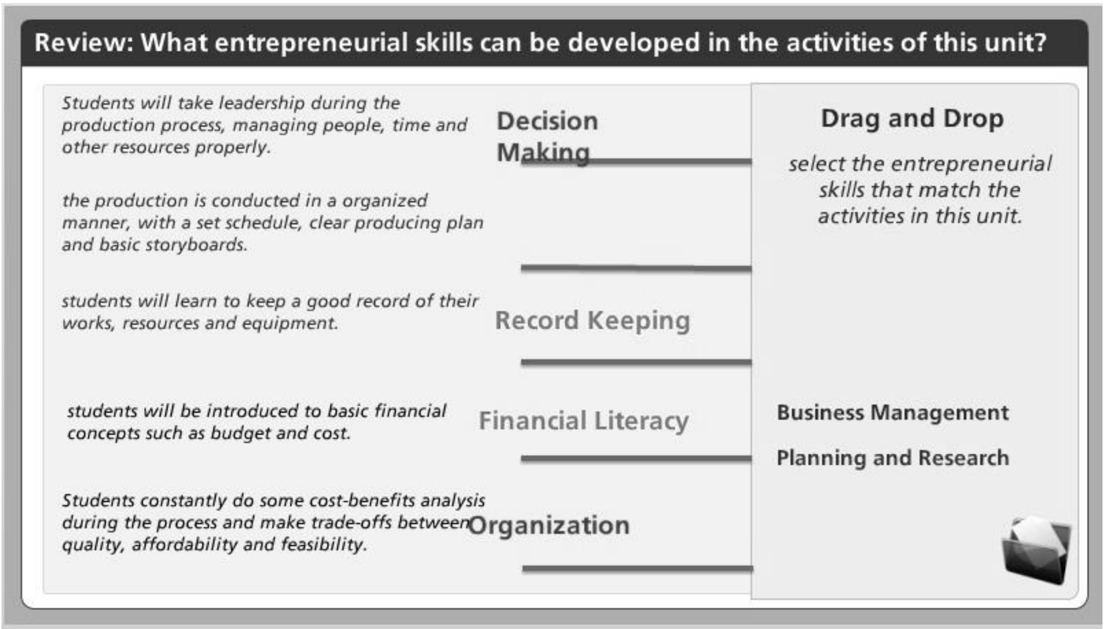


Figure 3.11. The screenshot of a review exercise in Tutorial 2.0

Participants

Participants in Phase Four were nine in-service elementary school or middle school teachers from the United States. The researcher obtained access to the proposed participant pool through his personal contacts, including a senior teacher at a private elementary school and two teachers at public middle schools. There are no specific requirements on demographic characteristics of the participants such as gender, age, and race, since the online tutorial can be freely accessed by any interested teachers.

Formative research draws on qualitative research methods such as case study and formative evaluation with emphasis on analytic evaluation and theory formation, thus is often done with a small sample of participants (Miles & Huberman, 1994; Reigeluth & Frick, 1999;

Willis, 2007; Worthen & Sanders, 1987). There are two main factors that determined the number of participants in this study: workload and data saturation. While more empirical data from more participants usually enhance the trustworthiness of the research findings, they also require more time and efforts for collection and analysis. Considering the amount and richness of data (e.g., interview, design documents, screen recordings…) generated by one participant, nine seems to be a reasonable and feasible sample size for participants in this study. Moreover, after analyzing data from the nine participants, this study has reached the point of *data saturation* (Ritchie, Lewis, & Elam, 2003), where more data does not necessarily lead to new information.

In addition, other dissertation studies in the literature that employed formative research methodology also shed light on the sample size selection in this study. For example, English (1992) conducted a formative research on elaboration theory of instruction for his dissertation and used 10 participants for the first iteration and 3 participants for the second iteration. Herrington (1997) employed what can be considered as formative research methodology to investigate situated learning theory in her dissertation with 6 participants. Watson (2007) conducted a formative research dissertation on the Games for Activating Thematic Engagement (GATE) instructional-design theory with 14 participants. As a result, the researcher felt confident that the 9 participants enrolled in the field test should be adequate to answer the research questions of this dissertation study.

Procedure

The field test was conducted in the 2013 fall semester and took two different formats: face-to-face field test in a computer lab, and virtual field-test where participants studied the tutorial and completed the research activities online. During the field test, the researcher first introduced Tutorial 2.0 and explained the purpose of the field test to the participants, and then distributed several documents to aid the research activity and data collection. These documents include:

1. *A consent form* to obtain the participants' informed consent to participate in the field test and the following research activities (Appendix E).
2. *A handout of an instructional design activity* that the participants are required to complete during the field test (Appendix F). The handout introduces the task of designing an after-school entrepreneurship program for elementary school students and explains the basic requirements for the program. The design task is the same as the one used in the pilot test, with only a few adaptations to make it more applicable for elementary school teachers. For example, the description of the student characteristics has been removed from the handout since the participants are believed to be already familiar with such information.
3. *A paper-based tutorial* that provides the participants with basic information on entrepreneurship education, including definitions of key terms, explanation of entrepreneurial skills, and excerpts from the National Standards of Practice for Entrepreneurship Education (NSPEE). The paper-based tutorial used in the field test contains the same content as the ones that were used in the pilot test.
4. *A learning experience questionnaire* that allows the participants to rate their experience of studying Tutorial 2.0 and its various design features relevant to the case-based method (Appendix G), with a particular focus on the revised design features. The questionnaire was administered and collected at the end of the field test.

The field test took about 120 minutes. The participants spent the first 20 minutes in the field test to read the *instructional design activity handout* and the *paper-based tutorial* to become familiar with the design task and obtain prior knowledge on the basics of entrepreneurship education. Then they were asked to write down their initial design ideas for the given instructional design activity. Next, they were given the web address of Tutorial 2.0 and spent the next 60 minutes exploring and studying the tutorial. The participants were still able to review the *paper-based tutorial* while they were exploring Tutorial 2.0. The learning activities of three selected participants were also digitally captured using the screen capture software *Adobe Captivate*.

For the remaining 40 minutes of the field test, the participants worked on drafting a design plan for the entrepreneurship education program as required in the *instructional design activity handout*. The design plan was to include the outline for the overall program and two or three detailed sample sessions. There were no predetermined templates or formats for the design plans, and the participants were encouraged to choose whatever format that they believed best delivered their design ideas. While working on their design plans, the participants still had access to review the *paper-based tutorial* and Tutorial 2.0. All design plans were collected after the field test as evidence of learning. The *learning experience questionnaires* were given to the participants when they completed the instructional design task and were collected at the end of the field test. The participants who agreed to participate in the follow-up interviews discussed interview logistics (e.g. time, places, and formats) with the researcher before leaving the field test.

Volunteering participants were contacted and interviewed by the researcher within 3 days of the field test to ensure they still had fresh memories of Tutorial 2.0 and field test activities. Semi-structured interviews, also known as *non-schedule standardized interviews* (Denzin, 1989), were used in this phase to prompt participants to describe their learning and designing experiences during the field test, comment on tutorial design features and perceived usefulness, and provide formative feedback on how to improve Tutorial 2.0. Because most participants were not able to meet with the researcher in person, all interviews were conducted over Skype (a voice-over-IP service) or telephone, and were digitally recorded using an audio-capturing software. All interview conversations were manually transcribed by the researcher for data analysis.

Data collection instruments

To address the three research questions raised in Phase Four, four major types of data were collected from the field test, including learner's interactions and learning pattern with Tutorial 2.0, perceived usefulness of the tutorial and its design features, evidence of learning, and formative feedback for improving Tutorial 2.0. The relation between different research data and corresponding data collecting methods and instruments are summarized in Table 3.9. The focus of this section is to describe the data collection instruments prescribed for the field test, and discuss the rationale behind their selection or development.

Table 3.9. *Major Types of Data Collected in the Field Test and Data Collecting Methods and Instruments*

Types of Data	Data Collecting Methods	Data Collection Instruments
Learner's interaction and learning pattern with Tutorial 2.0	• Video recording • In-depth interview	• Screen capturing software (Adobe Captivate) • Semi-structured interview protocol
Perceived usefulness of the tutorial and its design features	• Questionnaire • In-depth interview	• Learning experience questionnaire • Semi-structured interview protocol
Evidence of learning	• In-depth interview • Document Review	• Semi-structured interview protocol • Instructional design plans

Types of Data	Data Collecting Methods	Data Collection Instruments
Formative feedback for improving Tutorial 2.0	• In-depth interview	• Semi-structured interview protocol

Screen capturing software

Research data of how participants studied and interacted with Tutorial 2.0 were collected using *Adobe Captivate*, a screen capturing software. Adobe Captivate allowed the researcher to easily record a participant's computer screen, including website and application windows, mouse cursor movement and clicks, and text input. As a result, Adobe Captivate has provided the researcher with important learning process data such as how much time did a participant spend on a learning unit, how often did a participant respond to the interactive elements, and how did a participant customize their learning sequence. Three participants volunteered to use Adobe Captivate to record their screen activities when studying the tutorial. Those participants were instructed to mark the content they were studying with the mouse cursor so that the cursor movement could also provide data on how participants were directing their attentions during the learning process.

The selection of screen capturing software over researcher observation as the data collecting instrument is largely due to two reasons. First, screen capturing software can collect the learning process data more easily, accurately and thoroughly, as a participant's every interaction with the tutorial can be digitally captured in high-definition and analyzed later. On the contrary, observation notes taken by the researcher are likely to be influenced by subjectivity and miss important details. Second, screen capturing software is less intrusive than researcher observation. It runs in the computer background therefore will not interfere with participants' tutorial learning process, while the presence of a researcher taking observation notes might make participants distracted or uncomfortable.

Learning experience questionnaire

Choi et al (2008) have developed a learning experience survey questionnaire that consists of eight questions with 1-5 Likert Scale. Those questions ask about different aspects of case-based learning experience, such as perceived learning effects, motivation, and preference for CBI. Built upon the questionnaire developed by Choi et al (2008), the *learning experience questionnaire* for the field test includes more questions asking about how participants' learning experience is affected by the case-based design features, the use of multimedia, and the scaffolding features in Tutorial 2.0.

The learning experience questionnaire includes a total of 24 questions with 1-5 Likert Scale, which are listed in Table 3.10. Question 1 asks a participant about the overall learning effect of Tutorial 2.0, and Questions 2 to 6 further examine the learning effect in terms of the tutorial objectives. Questions 7 to 10 ask about the motivational aspect of learning experience. Questions 11 to 14, 15 to 18, and 19 to 23 ask about how participants' learning experience with Tutorial 2.0 are affected by its case-based design features, the use of multimedia, and the scaffolding features, respectively. Question 24 aims to elicit an overall evaluation of the tutorial from the participants.

Table 3.10. *The Learning Experience Questionnaire Used in the Field Test*

No.	Questions
1.	The tutorial teaches me how to design and conduct entrepreneurship programs for elementary school students.
2.	The tutorial increases my knowledge of entrepreneurship and entrepreneurial skills that are relevant to the elementary school setting.
3.	The tutorial improves my skills of designing elementary school activities that engage students in entrepreneurial skills development.
4.	The tutorial teaches me useful techniques that I can use to facilitate elementary-level entrepreneurship programs.
5.	The tutorial improves my skills of identifying or developing instructional materials for elementary-level entrepreneurship programs.

No.	Questions
6.	The tutorial teaches me how to handle the common problems of facilitating an elementary-level entrepreneurship program.
7.	The tutorial makes me more interested in the task of designing an entrepreneurship program for elementary school students.
8.	The tutorial keeps me engaged in the learning process.
9.	The tutorial provides me with meaningful learning experiences.
10.	I prefer the online tutorial to the paper-based tutorial.
11.	The stories and vignettes discussed in the tutorial help me better understand the context of my instructional design task.
12.	The tutorial provides me with useful examples of designing and conducting entrepreneurship programs.
13.	The stories and vignettes in the tutorial are thought-provoking, making me wonder what I would do under similar circumstances.
14.	Some of my design ideas were inspired by studying the stories and vignettes in the tutorial.
15.	The use of multimedia (e.g. video, audio, images, and animation) increases the authenticity of the tutorial stories and vignettes.
16.	The use of multimedia makes me more interested to study the tutorial content.
17.	The use of multimedia helps me better understand the stories and vignettes described in the tutorial.
18.	The use of multimedia provides me with useful information that is not described in the tutorial text content.
19.	The tutorial includes sufficient scaffolding features (e.g. prompt questions, visual cues, hints) to help me reflect on my learning process.
20.	I responded to most of the scaffolding features (e.g. reflect on prompt questions, study cued information, and explore interactive elements).
21.	I developed appropriate design ideas when responding to the tutorial scaffolding features.
22.	The tutorial offered me useful feedback during my learning process.
23.	The tutorial allows me to control my learning process (e.g. the sequence, content and pace of learning)
24.	I would recommend this tutorial to other teachers who want to design and conduct elementary-level entrepreneurship programs.

Semi-structured interview protocol

Reigeluth and Frick (1999) argued that the most useful data for formative research studies usually came from interviews with the participants. They identified several ways interview data can be used to answer research questions in the following statement.

> Both individual and group interviews, or interactions, allow you to probe the reaction and thinking of the participants. They help you to identify strengths and weaknesses in the design instance, but they also allow you to explore improvements for elements in the design instance, to explore consequences of removing elements from, or adding new elements to, the instance, and to explore possible situationalities. (p. 640)

Semi-structured interview is selected as the interview instrumentation for the field test participants. Patton (1990) classified the most frequently used interview formats in educational research into four categories based on their levels of structuredness and flexibility. The definitions of the four interview categories are summarized in Figure 3.12. Semi-structured interview has questions and probes determined in advance, therefore is more structured than the *informal conversational interview* or the i*nterview guide approach*. By allowing respondents to answer the same questions, semi-structured interview increases the comparability of responses thus facilitates future data organization and analysis. Semi-structured interview is also more flexible than the *standardized open-ended interview* as the interviewer can alter the sequence of questions based on the responses of interviewees to increase the naturalness and relevance of questions and answers.

Informal conversational interview	**Interview guide approach**	**Standardized open-ended interview**	**Closed, fixed response interview**
Questions emerge from the immediate context. Question topics and wording are not predetermined.	Question topics are decided in advance in the outline form. Sequence and wording of questions are decided in the course of interview.	Topics, wording, and sequence of questions are determined in advance, seeking open-ended responses from interviewees.	Questions and responses are fixed, allowing interviewees to choose from fixed responses during the interview.

Least structured
Most flexible

Semi-structured interview

Most structured
Least flexible

Figure 3.12. Four categories of interviews classified by Patton (1990)

The complete semi-structured interview protocol can be found in Appendix H. Table 3.11 listed all the questions that were covered during the semi-structured interview and their purposes. The interview attempted to follow the default order of questions as listed in the table, but the sequence of specific questions were often rearranged in the course of interview to allow the conversation to flow naturally and logically. In case a participant's responses to the interview questions are too brief, probes are also included in the interview protocol to have the participant elaborate on specific topics. Possible probes for each open-ended interview question are also listed in Table 3.11. The use of probes was not mandatory, but rather dependent on the participants' responses.

Table 3.11. *Questions, Probes and Rationale for the Semi-Structured Interview in Phase Four*

No.	Questions and Probes	Rationale
1.	Would you please tell me a little bit about yourself? a. How many years have you working as an elementary/middle school teacher? b. What is the highest degree you have earned? Which major did you graduate from? c. Have you designed or conducted any types of informal instruction for children? Such as an after-school program, an enrichment program, a club of special interest? d. How much do you know about the entrepreneurship education before the field test? What do you think of the idea of developing entrepreneurial skills for children?	Ask about demographic information, and working/education background
2.	Have you studied other online tutorials or other forms of self-directed online instruction before this tutorial? a. If yes, how did you like such learning experience, and which do you prefer, online or face-to-face instruction? Please explain. b. If no, is there a reason that kept you away from self-directed online instruction? For what kind of learning task would you consider studying an online tutorial by yourself?	Get to know the participant's prior online learning experience of studying online and their concerns and attitude toward self-directed online instruction
3.	Please describe your overall learning experience with the online tutorial. a. How much time did you spent on the module? b. What was the sequence of your studying the module? Which part did you study first, and why? c. What learning strategies did you employ to complete the tutorial? d. What design features of the tutorial stood out to you? What do you think of them? e. Did you encounter any problems during studying the tutorial? What are they and how did you solve the problems?	Use open-ended, non-leading question to have the participant to respond descriptively and honestly using their own terms and language
4.	What do you think is the purpose of the online tutorial? Do you believe the tutorial has fulfilled such purpose? a. If yes, please explain what features of the tutorial are most useful in fulfilling such purpose, and why? b. If no, what do you believe are the reasons? What features of the tutorial do you think were less useful or inhibiting to fulfill the purpose of the tutorial?	Elicit summative evaluation of the tutorial from the participant

No.	Questions and Probes	Rationale
5.	What do you think of the stories, vignettes and examples in the tutorial? a. In your opinion, why were those stories and vignettes from Curiosity Creek included in the tutorial? b. Can you image what the learning experience with the tutorial would be like if those stories and vignettes were removed from the tutorial? c. All the stories and vignette are based on real events from Curiosity Creek. How do you like studying authentic materials in the tutorial? d. What have you learned from those stories and vignettes? e. How did studying those stories and vignettes affect your design of the entrepreneurship program?	Seek the participant's feedback on the case-based features of the tutorial
6.	What do you think of such multimedia content in the tutorial? a. What do you think of the quality, length and style of the multimedia content? Do you think multimedia content is redundant to the text content? b. Do you enjoy studying the multimedia content? c. What type of multimedia content is the most useful? Why? d. What type of multimedia content is the least useful? Why? e. What type of multimedia content would benefit your learning but was not present in the tutorial? f. Can you image what the learning experience with the tutorial would be like if the multimedia content is replaced by text?	Seek the participant's feedback on cases presented in multimedia format and their unique benefits for learning
7.	Did you notice the different visual cues used in the tutorial, such as emerged captions, arrows, and highlight boxes? What do you think of them? a. Did you pay attention to the cued content? b. Did you think they were distracting for your learning? c. What impact did the presence of visual cues have on your tutorial learning experience? d. Can you imagine what the learning experience will be like without those visual cues?	Ask about the impact of visual cues on the participant's case learning experience, cognitive activity, and learning effect
8.	Did you notice the different interactive elements in the tutorial, such as prompt questions, rollover content, and quizzes? What do you think of them? a. How often did you respond to those interactive elements? b. What do you think of the prompt questions? c. What do you think of rollover content? d. What do you think of the quizzes? e. Did you receive adequate feedback when studying the tutorial? What do you think of the feedback you received? f. Are there any interactive elements that you particularly like or dislike in the tutorial?	Ask about how the participant interacted with the tutorial and how such interaction affected their case learning experience, cognitive activity, and learning effect
9.	What do you think of the navigation control of the tutorial? a. When studying the online tutorial, were you able to control the speed and sequence of learning? b. When studying the online tutorial, can you easily access, revisit, or download instructional content?	Seek the participant's feedback on the scaffolding features that allow learners to control and customize their learning process
10.	What are the two things about the tutorial that you like most?	Ask about the tutorial design features that are valued the most by the participant and explore the reasons behind such valuation

No.	Questions and Probes	Rationale
11.	What are the two things about the tutorial that you want to change?	Ask about the tutorial design features that are not valued and seek feedback for revising those features
12.	What else would you like to share with me about your learning experience with the online tutorial?	Final open-ended question to seek comments and feedback on related areas not covered in the interview

Instructional Design Plan

Participants had either written their instructional design plans on blank papers or typed the design plans using word processing software such as Microsoft Word or Microsoft PowerPoint. There were no predetermined templates or worksheets to help the participants organize their design ideas, and participants were free to choose the most appropriate formats and structures for their instructional design plans. Requesting participants to create instructional design plans would demonstrate how well a participant could design and conduct entrepreneurship education program for elementary school students based on their review of the tutorial. Therefore these plans were considered as an important source for research data on learning evidence.

Design and development cost

In addition, in order to examine the efficiency of the case-based method as an instructional-design theory, the cost for both Tutorial 1.0 and Tutorial 2.0 were also documented and calculated in terms of human time, effort, money, and other required resources, as suggested by Reigeluth and Frick (1999). Both the designer’s reflection and the design documents (e.g., work-plan, design notes, and final design report) were used in this study to determine the design and development cost.

Analytical method

As recommended by Reigeluth and Frick (1999), data analysis in formative research should include three analytical activities: data reduction, data display, and conclusion drawing. Data reduction refers to the process of "selecting, focusing, simplifying, abstracting, and transforming the 'raw' data that appear in written up field notes or transcriptions" (Miles & Huberman, 1984, p.21). Data display builds on the reduced data and provides "an organized, compressed assembly of information that permits conclusion drawing..." (Miles & Huberman, 1994, p.11). The conclusions drawn from the data analysis should identify the strengths and weaknesses in instruction and prescribe specific improvements to both the design instance and the design theory (Reigeluth and Frick, 1999). Data reduction, data display, and conclusion drawing can be achieved through two cycles of qualitative coding process, as suggested by Saldaña (2013). The purpose of First Cycle coding is to "summarize, distill or condense data" (p.4), and the purpose for Second Cycle coding focuses on "classifying, prioritizing, integrating, synthesizing, abstracting, conceptualizing, and theory building" (p.58).

Data reduction-First Cycle of coding

Data reduction in this study was conducted primarily in First Cycle coding, in which the researchers used a variety of coding methods to symbolically assign key words or short phrases to a portion of research data according to its "summative, salient, essence-capturing, and/or evocative attributes" (Saldaña, 2013, p.3). Saldaña (2013) has profiled 25 commonly used coding methods for First Cycle coding and described their purposes, functions and applicability in qualitative analysis. Based on the nature of the three research questions in this phase, seven coding methods were selected for data reduction. The description, application and example codes of each coding method are summarized in Table 3.12. Descriptions are based on the coding manual developed by Saldaña (2013), and example codes are codes generated using the existing data from the pilot test.

Table 3.12. *The Coding Methods Used in First Cycle Coding and Their Descriptions, Applications, and Example Codes*

Method	Description	Application	Example Codes
Attribute Coding	It is the notation of basic descriptive information on setting, demographic attribute, data format, and time frame.	Attribute coding provides important participant and contexts information and assists to manage data collected from multiple participants, sites, and sources.	NAME(pseudonym), AGE, GENDER, YEARS OF TEACHING, TEACHING GRADE, DATA FORMAT
Magnitude Coding	It consists of and adds a supplemental alphanumeric or symbolic code/subcode to a coded datum or category to indicate intensity, frequency, direction, presence, or evaluation.	Magnitude coding will be used in combination with other codes on CBI design features to indicate how frequently an participant interacts with a design feature and how much he/she values such feature	POS=POSITIVE NEG=NEGATIVE NEU=NEUTRAL MIX=MIXED FEELING OFTEN (O) SOMEWHAT(S) NEVER (N)
Structural Coding	It is a question-based coding method that applies a conceptual phrase representing a topic of inquiry to a segment of data in order to address a specific research question.	Structural coding will be used to analyze interview transcripts based on each interview questions. Various tutorial design features supported by the case-based method and web-based technologies will also be possible topics for structural coding.	AUTHENTIC MATERIAL, PROMPT QUESTION, REFLECTIVE OPPORTUNITY, SCAFFOLDING AND EFFECTS, MULTIMEDIA AND EFFECTS
In Vivo Coding	It uses words and short phrases from the actual text of qualitative data as codes. It is also known as “literal coding”, “verbatim coding” or “indigenous coding”.	In Vivo codes use a participant’s own words from interview to describe and evaluate their learning experience, so that the researcher’s interpretations and conclusions are grounded in data.	POP-UP STUFF (referring to the emerged captions) SMALL CHUNKS (referring to the individual instructional units) EXAMPLE (referring to a case event)
Value Coding	It is the application of codes that reflect a participant’s values, attitudes, and beliefs, representing his or her perspectives or world views.	Value coding is selected to address the research questions on what design features are valued or not valued by learners. Some value codes are determined a priori (e.g. CBI features), and some are constructed during coding of data.	Values: MULTIPLE PRESENTATION, CONTEXT, LINKING THEORY TO PRACTICE Attitudes: FUN, OVERWHELMING Beliefs: LEARNED FROM CASE
Evaluation Coding	It is the application of codes to qualitative data that assigns judgments about merit, worth, or significance of programs or policy.	Evaluation coding is based on both the judgment of the researcher and evaluative comments from the participants. It will be used with other coding methods (e.g. In Vivo, value, magnitude) to address research questions that are evaluative in nature.	ANIMATED VISUAL CUES + DIRECT ATTENTION - “DISTRACTING AND CONFUSING” REC (recommendation): INITIATED BY CLICKING

Method	Description	Application	Example Codes
Versus Coding	It identifies and applies dichotomous or binary codes to a segment of data, in direction conflict with each other.	Versus codes highlight participants' sometimes different or contradicting views on the tutorial design features or their learning experiences. They can also indicate conflicting research data from pilot test and field test.	ENGAGING VS. DISTRACTING, FUN VS. RELEVANCE, CONTEXTUALIZED VS. TIME CONSUMING, MORE INTERACTION VS. LESS INTERACTION

The following is an example of how the seven First Cycle coding methods are applied to an interview transcript excerpt. The specific coding methods related to the codes are indicated in the square brackets. Sometimes several coding methods are used to code one piece of datum.

DATA FORMAT: INTERVIEW	[Attribute Code]
NAME: Laura	[Attribute Code]
GENDER: FEMALE	[Attribute Code]
YEARS OF TEACHING: 2	[Attribute Code]
TEACHING GRADE: GRADE 3	[Attribute Code]

[Researcher: Did you encounter some of the problems when you studying the tutorial? Like something that was confusing, and caused surprise…]	
Participant: Well, the only thing that I thought was	
weird[1] was, when I was reading on the tutorial; and	[1]"WEIRD" [In Vivo Code] [Value Code]
later the picture on the side, you guys would have	
talking bubbles[2] … I would be reading and the talking	[2]"TALKING BUBBLES" [In Vivo Code]
bubbles would start to appear[3], so I couldn't keep up	[3]PROBLEM OF VISUAL CUES [Structural Code]
with reading what I was trying to read on the side[4]	[4] - BAD TIMING -DISTRACTING
(laugh), so I had to go back, because I noticed there	[Magnitude Code][Evaluation Code]
was a "play" (button) on the bottom, so I would	
pause[5] it and go back a little bit. And then, so I could	[5]REC: ABLE TO PAUSE [Evaluation Code]
read those (talking bubbles); because I want to see	

what they were saying, but I wanted to finish reading the information first[6].

[6]CUED CONTENT VS. CURRENT CONTENT
[Versus Code]

[Researcher: Mm, I was wondering, like, what are the two features about this tutorial that you like the most?]

Participant: Like the most? The first one is that I like how it is broken down into different sections[7], like "innovation and research", so all that information was in one section. So I knew what the different skills[8] you need to know were broken down, so I knew where they fell. Uh, the other thing I like is that, at the end of each section of the tutorial, they had a question[9] about your thoughts, and then, if you need help with an answer, you would click[10] underneath and it would pop up on the side[11], saying like…(didn't finish the sentence) and throughout the tutorial, these were the things that…

[7] VALUED FEATURE: "SECTIONS"
[Structural Code][In Vivo Code][Value Code]

[8]ORGANIZED BY SKILLS
[Structural Code]

[9]VALUED FEATURE: REVIEW QUESTIONS
[Structural Code][Value Code]

[10]INTERACTION
[Structural Code]

[11]FEEDBACK
[Structural Code]

Data display-Second Cycle of coding

The primary purpose of data display is to conceptually and theoretically categorize the reduced data in a way that provides answers, evidences, or insights to the formative research questions (Reigeluth & Frick, 1999). In this study, the purpose of data display was realized through Second Cycle coding, which reorganized and reconfigured First Cycle codes to develop "a smaller and more select list of broader categories, themes, concepts, and/or assertions"

(Saldaña, 2013, p.207). Pattern Coding and Elaborate Coding are the two coding methods that were used in Second Cycle coding for data display.

Pattern Coding is the process of grouping related codes into "a more meaningful and parsimonious unit of analysis" with the purpose to synthesize "explanatory or inferential codes that identify an emergent theme, configuration, or explanation" (Miles & Huberman, 1994; p.69). First, the researcher reviewed all the First Cycle codes and assess their internal relationships. The researcher then grouped those First Cycle codes into fewer categories based on their commonality and assigned Pattern Codes to the various categories. Lastly, Pattern Codes were used as stimulus to develop themes that identified the strengths and weaknesses of the tutorial, explained interrelationships between the tutorial design features and perceived usefulness, and explored theoretical constructs and assumptions of online CBI.

Using data from pilot test for example, several participants have discussed the weaknesses of Tutorial 1.0 in their interviews. The following are the First Cycle codes identified from the related data corpus. The types of codes are listed in the square brackets and the source data for the codes are briefly summarized in the round brackets.

1. SAME CONTENT [evaluation code] (Participants complain sometimes the same content is presented in both multimedia and text format)
2. "I DON'T NEED" [In Vivo code](Participants indicate their preference for tutorial content format and consider the content in other formats less useful)
3. DISTRACTING VISUAL CUES [structural code, evaluation code](Participants complain that sometimes the emergence of visual cues is very distracting)

4. “ANNOYING TALKING BUBBLES” [In Vivo code, value code] (One participant describes how she is annoyed by the emerged captions in the tutorial)
5. “FEELS REPETITIVE” [In Vivo code] (One participant complains how his learning experience with the tutorial seems to be repetitive)
6. CUED CONTENT VS. CURRENT CONTENT [versus code] (Participants describe the dilemma between continuing to study the current content and starting to study the cued content)
7. “CAN’T SKIP” [In Vivo code] (One participant describes that he cannot skip a video he doesn’t want to watch and move on to the next part of the tutorial)

After analytic comparison and reflection, those codes would be categorized into two Pattern Codes: REDUNDANT CONTENT (code 1, 2, 5, 7) and CONFUSING CONTENT (code 3, 4, 6, 7). Depending on the nature of research questions, the two pattern codes can be further combined into one code: PROBLEMATIC CONTENT. A possible explanatory theme statement based on the Pattern Code REDUNDANT CONTENT can be stated as *presenting case content in both multimedia and text format without the option to select and skip results in redundant learning experience*. This theme statement can be further expanded to include evidence that support the claim and possible revising ideas to solve the problem.

The other coding method used for data display is Elaborative Coding. According to Auerbach and Silverstein (2003), Elaborative Coding is a top-down coding method that begins coding with a list of preconceived theoretical constructs from a previous study, with the purpose to refine those theoretical constructs in the current study. Elaborative Coding is appropriate for formative research because formative research often includes at least two complete studies – pilot test and field test. Using theoretical constructs from the pilot test as Elaborative Codes, the analysis in the field test elaborated on the major findings from the previous study with the purpose to confirm, strengthen, revise, or refute the previous findings.

Based on the major findings of the pilot test study, possible theoretical constructs for Elaborative Coding in this phase can potentially be classified into three major categories: Useful Design Features, Problematic Design Features, and Revised Features, as can be seen from Table 3.13. Those constructs were used to guide the selection, organization, and examination of the First Cycle codes and the related data. Elaborative Codes were also used to identify themes from the field test data that were consistent or contradicting with the pilot test findings, and were used to explore the reasons behind such consistency or contradiction.

Table 3.13. *Possible Theoretical Constructs from the Pilot Test Study for Elaborative Coding*

Categories	Major Findings from the Pilot Test Study	Theoretical Constructs for Elaborative Coding
Useful Design Features	• Use authentic stories and events from Curiosity Creek as sources for case development. • Include artifacts such as sample products, worksheets, and help-aids in tutorial cases. • Present cases in multimedia format • Use the side-by-side tutorial layout that aligns text content of general instruction with multimedia content of cases • Embed visual cues in multimedia cases to get learners' attention, highlight key information, and emphasize the connection between contents. • Include scaffolding features (e.g. prompt questions, highlights, summary page) in the tutorial. • Include a variety of interactive elements that allow learners control and customize their learning process • Break down tutorial content into smaller instructional units based on entrepreneurial skills	• Authentic materials • Artifacts • Multimedia content • Layout of the tutorial • Use of visual cues • Scaffolding • Interaction with the tutorial • Tutorial structure

Categories	Major Findings from the Pilot Test Study	Theoretical Constructs for Elaborative Coding
Problematic Design Features	• The existing interactive features of the tutorial do not provide learners with useful feedback. • Tutorial does not provide a sense of two-way communication as that in a face-to-face learning environment. • Tutorial content cannot be downloaded and printed out. • Presenting instructional contents in multiple media formats results in redundancy. • The quantity, length, and style of multimedia content in the tutorial might not be appropriate for the age group of target learners. • The animated visual cues can be distracting and confusing. • The dual navigation system proves to be confusing for some learners.	• Feedback • Two-way communication • Downloadable content • Redundant content • Age appropriateness • Animated visual cues • Ease of navigation
Revised Features	• Provide problem solving opportunities and feedback in both text and multimedia. • Create a virtual instructor avatar to provide guidance, feedback and scaffolding. • Include downloadable PDFs in the tutorial. • Further reduce the amount of text, and replace them with multimedia content. • Use better graphics that are professional and consistent. • Include interactive elements to allow learners control the timing of visual cues and the length of display.	• Higher-order learning opportunities • Feedback • Virtual instructor • Downloadable content • Text VS multimedia • Graphic design • Visual Cues • Learner control

Analysis of teachers' instructional design plans

The analysis of teachers' instructional design plans collected from the field test is different from the analysis of interview transcripts. While the various coding techniques discussed in the previous sections are still applicable here, the design plan analysis focuses on identifying evidence of learning by comparing teachers' design ideas of entrepreneurship program before and after studying the tutorial. More specifically, the following questions guided the analysis of design plans in this study:

- In a teacher's design plan, what are the program theme, structure, format, learning activities, methods of assessment, and required resources and instructional materials?
- How does a teacher's final design plan differ from his/her initial design thoughts? Which content was added, revised, or deleted?

- What similarities can be identified between a teacher's designed program and the exemplar program in the tutorial? Are those similarities results of learning?

Conclusion drawing

Based on the codes identified from both the First Cycle and the Second Cycle coding, the researcher has established several categories to allow more conceptual and generalizable conclusions to be drawn from the data. Figure 3.13 shows the outline the researcher used to organize the categories. The outline is based on the research questions and the underling hierarchical order between categories. By analyzing the relationship between different categories and subcategories, several conclusions were drawn from the data that identified the strengths and weaknesses of Tutorial 2.0 and provided tentative improvements to the case-based method theory in the self-directed online learning context.

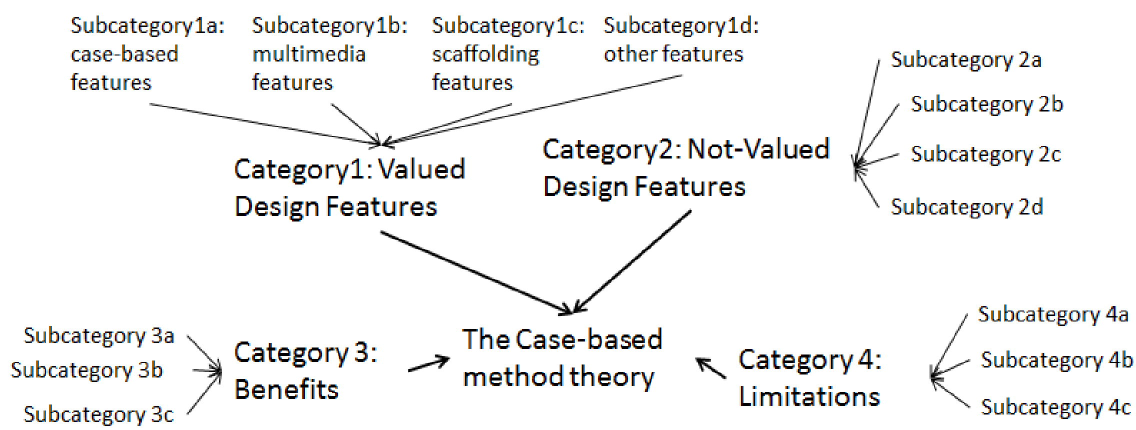


Figure 3.13. The outline used to establish and arrange categories in data analysis

Phase Five: Refine the Theory of the Case-Based Method

In this phase, recommendations for refining the theory of the case-based method were made based on both empirical data analyzed in the previous four phases and the personal reflection of the researcher. The research focus in this phase shifted from the instructional design instance (the case-based online tutorial) to the instructional-design theory (the case-based method) with the purpose to evaluate and improve the theory. By examining the theoretical assumptions behind both the working and non-working tutorial design features, this phase aimed to propose a set of improvements to the case-based method theory to make it more applicable to the online setting. More specifically, Phase Five attempts to answer the following research question:

- Research Question 4: What possible improvements can be made to the case-based method in the context of self-directed online instruction?

Methodological Issues

Establishment of Trustworthiness

Formative research rejects the positivist paradigm of inquiry that sees truth as existing entities with fixed properties and relations that can be consistently and objectively measured. Instead, formative research believes that truth is contemporary, contextualized, and a matter of degree, determined by its real effects to a practical solution (Dewey, 1999; Fox, 2006; Reigeluth & An, 2006). As a result, traditional methodological concerns rooted in positivist epistemology such as validity and reliability are considered as inapplicable to this dissertation study and are not discussed in this chapter. However, there should still be indicators that differentiate well-designed inquiry from poorly-designed inquiry for research in any paradigms. Since this study employs primarily qualitative data collection and analysis methods, the term *trustworthiness,* a commonly used terminology for evaluating qualitative research (Creswell & Miller, 2001; Davies & Dodd, 2002; Lincoln & Guba, 1985; Seale, 1999; Stenbacka, 2001), was borrowed here to evaluate the quality and rigor of this dissertation study.

Lincoln and Guba (1985) emphasize the importance of trustworthiness for a research report so that the credibility of the research inquiry can be defended and sufficient confidence can be placed in the transferability of its findings. Acknowledging the importance of sustaining trustworthiness in qualitative data collection and analysis, this study employs several procedures to ensure that the research findings are credible, and are likely to be applied in similar contexts. The procedures of establishing trustworthiness in this study are listed and explained in Table 3.14, with descriptions of how they were implemented during the actual process of data collection and analysis.

Table 3.14. *Procedures of Establishing Trustworthiness and Their Implementation in the Dissertation Study*

Procedures	Explanations	Implementation in the current study
Triangulation	Triangulate data by collecting data from different instruments, multiple participants and different sources. (Guba, 1981; LeCompte & Preissle, 1993; Miles & Huberman, 1994; Reigeluth & Frick, 1999)	Different forms of data (e.g. ratings, comments, documents, screen recording) were collected from 9 in-service teachers and were analyzed using various methods (e.g. descriptive statistics, coding, document analysis).
Expert/Peer scrutiny	Scrutiny of data collection, analysis, and interpretation by experts and peers to refine the research methods and strengthen the research arguments. (Guba, 1981; Reigeluth & Frick, 1999; Saldaña, 2013; Shenton, 2004)	Dissertation proposal were reviewed by three committee members (established scholars in the field of IDT). Research design and preliminary data were presented in the AECT conference to elicit feedback and critique from audiences. About 15 percent of the interview data was coded by another PhD student to assess the *intercoder agreement* and *interpretive convergence*.
Negative cases	Attention to contradictory evidence and negative cases during data analysis to allow new themes and theories to emerge and develop. (Lincoln & Guba, 1985; Miles & Huberman, 1994; Saldaña, 2013; Silverman, 2000)	Identification and careful analysis of negative cases that contradict with the hypotheses or existing themes. Special attention paid to the different and conflicting findings between the pilot test and field test. Design features that were not working or valued were also reported.

Procedures	Explanations	Implementation in the current study
Member check	Member check with the participants to have them confirm the researcher's interpretation of their words reflect what they actually intended. (Lincoln & Guba, 1985; Miles & Huberman, 1994; Reigeluth & Frick, 1999)	Participants were asked to further explain their questionnaire responses during the interview. Participants' comments and feedback were summarized and the gist were sent back to the individual to confirm the accuracy of the summary/interpretation.
Reflective commentary	Use of the researcher's reflective commentary to constantly evaluate the research project and deal with the emerging patterns and theories. (Lincoln & Guba, 1985; Saldaña, 2013; Shenton, 2004)	The reflective commentary was included in the analytic memos for the two cycles of coding, including subjectivity analysis, reflection on the codes, categories and themes, reflection on the limits and problems of the study.

It is important to note that the purpose of these procedures is not to make the findings more "objective" so that other researchers who follow the same procedures can produce the same results. This study was conducted in a naturalistic setting without manipulation and control of variables; therefore all findings should be considered as context-specific. However, by taking the aforementioned procedures, this study aims to ensure that its research design and methods are appropriate for the research questions, its analysis and conclusions are consistent and grounded in data, and its description of contextual factors is sufficient to allow its findings to be properly interpreted. Using Schofield's (1990) words, the goal of ensuring trustworthiness is "not to produce a standardized set of results...Rather it is to produce a coherent and illuminating description of and perspective on a situation that is based on and consistent with detailed study of that situation" (p.203).

Transferability of the Research Findings

Transferability in qualitative research refers to the degree to which readers can transfer or apply the results of the study to other contexts and situations they are familiar with (Lincoln & Guba, 1985). It is a concept comparable to generalizability (or external validity) for quantitative research. Transferability is largely dependent on the similarity between the research context and other possible contexts where the research findings might apply (Guba 1981). Instead of making generalizable claims, it invites readers to make their own connections between elements of a study and their own understanding or personal experience of a given context (Reigeluth & Frick, 1999; Shenton, 2004; Stake, 2005). Transferability was emphasized in this study so that the findings from a single design instance can contribute to the general design knowledge of the case-based method theory. Following the suggestions made by researchers such as Guba (1981), Merriam (1998), and Reigeluth and Frick (1999), and this study took two major procedures to enhance the transferability of its findings.

The first procedure is to provide a rich description of research situationalities, including learner characteristics, the learning environment, the nature and purpose of the online tutorial, documentation of the tutorial design and implementation, the trade-offs and compromises made during research, and the subjectivity of the researcher/designer. The provision of such situationalities would allow readers to make their own judgments about the similarity and relevance between the research situation and other possible situations, and select the research findings that are applicable and transferrable in those new situations.

The other procedure is to conduct iteration studies with the design instance, with a variation of certain situational or theoretical elements. Iteration is the underlying logic for multiple-case studies (Yin, 2009), aiming to predict similar or contrasting results for anticipatable theoretical reasons. Iteration is critical for formative research to accumulate sufficient evidence that warrant revisions to the instructional-design theory (Reigeluth & Frick, 1999). Particularly in this study, iteration has been realized through conducting the pilot test and the field test, which can be considered as two complete studies in slightly different contexts and with different participants. Improvements to the case-based method theory were proposed based on the comparison and contrast of the findings of those two studies.

Summary of the Methodology

In summary, this chapter justified the selection of formative research as the dissertation research methodology, and has laid out five critical phases in the research design. The first three phases were completed prior to the dissertation, and presented key findings from the CBI literature review, tutorial prototype design, and the tutorial pilot test. These key findings have prepared the foundation for this dissertation, as they informed the tutorial revision to be field-tested in Phase Four and provided the initial design assumptions to be validated in Phase Five. As a result, this chapter summarized the pre-dissertation research activities in the first three phases to set the context and rationale for the dissertation, it then specified the procedures and instruments used in the field test to collect empirical data (Phase Four) and the data analysis methods for theory formation (Phase Five). This chapter ended with a discussion on methodological issues regarding trustworthiness and transferability of formative research.

Based on the research procedure, instruments, and analysis methods discussed in Chapter 3, the dissertation study implemented the tutorial in the field test with its target learners, and collected both summative and formative evaluation data such as learners' overall opinions of tutorial learning experience, perceived value of various tutorial design features (including revised and newly added design features), and the context-specific benefits and limitations of applying the case-based method in design. The empirical findings from the field test are reported in the following chapter – Chapter 4.

CHAPTER 4: FINDINGS

Introduction

Chapter 4 presents empirical findings regarding the case-based online tutorial from its second iteration of formative evaluation (field test). As a result, this chapter focuses on the presentation, synthesis, and interpretation of the field test data with the purpose of validating the theoretical assumptions that guide the design and revision of the design instance of self-directed online CBI. More specifically, this chapter seeks to provide answers to the following three research questions:

Q1. What design features of the case-based tutorial are valued by the learners?

Q2. What design features of the case-based tutorial are not valued by the learners and what are the possible ways to improve them?

Q3. What are the benefits and limitations of applying the case-based method to design self-directed online instruction?

Consequently, this chapter is organized in the order of these three research questions and presents findings in the following three major areas: valued CBI design features, not-valued CBI design features, and preferrability of applying the case-based method to designing self-directed online instruction. The term “tutorial” in this chapter, if not specified otherwise, refers to Tutorial 2.0, the revised case-based online tutorial tested in the field test.

In general, the field test went as planned, and followed the procedure and methods specified in Chapter 3: the participants were first introduced to the task of creating a design plan for an informal entrepreneurship education program for younger students (grade 5-8), and then spent an hour studying and evaluating the tutorial before completing their design plans. The formative feedback regarding the tutorial design features were collected primarily through in-depth interviews, and other data collection methods such as questionnaire, video-recording, document analysis were also employed to collect data on participants' summative opinions, learning interactions and patterns, and evidence of learning.

Field Test Participants

The field test participants are the target users of the case-based online tutorial — teachers working in the elementary or middle school settings who are interested in conducting informal educational programs to develop entrepreneurial competencies for children. A total of 9 in-service teachers were selected to participate in the field test. While all of the participants are elementary or middle school teachers in the United States, they teach in different schools and vary in their educational backgrounds, teaching experience, informal program facilitating experience, and online learning experience. The basic information of each participant is summarized in Table 4.1. All personal identifiable information such as school names are removed from our analysis, and only pseudo names are used in this study.

Table 4.1. *Basic Information of Field Test Participants*

Name	Age	Region	Degree	Grade Level	Teaching Experience	Informal Program Facilitation	Online Learning
Carrie	30s	AZ	B.Ed in sci & elem Ed; M.Ed	2nd -3rd	3 years in ESL; 6 years in elementary	after school tutoring, informal	extensive
Debbie	30s	TX	B.Ed in Elem Ed; M.Ed	4-6th	5 years in ESL; 3 years in elementary	cultural enrichment program	moderate
Janet	50s	NY	BA in English; M.Ed	5th	15 years in elementary	summer programs in the nature of theatres	none
Katie	30s	CA	B.Ed, M.Ed in crrclm & Istrct in sci Ed	6-8th	6 years in middle school	none	moderate
Kelly	30s	NY	B.Ed; M.Ed	7th ; junior high	13 years of teaching experience	run a nutrition program in the community	extensive

Name	Age	Region	Degree	Grade Level	Teaching Experience	Informal Program Facilitation	Online Learning
Maria	50s	NY	BS in Sci & Ed; M.Ed	6th	27 years in elementary	an after-school French program	moderate
Melanie	30s	FL	B.Ed in elem Ed; MS in ESL	1-6th ESL	8 years in ESL	English oriented summer camp in Poland	moderate
Molly	50s	NY	BA in British Lit; MS in Ed leadership	7-8th	30 years of teaching experience	after-school photography and creative writing programs	none
Zach	30s	MI	B.Ed	5-8th	3 years in China, 3 years in Michigan	enrichment programs on social studies, literature, and science	moderate

As shown in Table 4.1, this group of participants are predominantly female teachers with Zach being the only male teacher. Three teachers (Janet, Maria, and Molly) are in their 50s and the rest of group are in their 30s. Senior teachers have more years of teaching experience, but younger teachers tend to have more online learning experience and feel more comfortable studying online. Most of the teachers have experience of facilitating informal educational programs such as after-school programs, themed summer camps, or other enrichment programs, with exception of one (Katie). All teachers have Bachelor's and/or Master's degree in education-related fields, and all of them are Caucasian.

The concept of engaging students in entrepreneurship education program from a younger age was well received by all the teachers, as they agreed that the entrepreneurial competencies such as creative thinking, management, digital and financial literacy are essential life skills and would benefit students beyond their school years. However, those essential competencies are currently not emphasized in elementary and middle school curriculum, and thus after-school or enrichment programs are a good venue to develop those competencies. For instance, several teachers made comments such as the following:

> I think it is a great idea. It reaches to real life, and teaches them a lot of basic things they could get at their elementary years, and they would move along in the older years, making them more ready for the real-life situations of entrepreneurship. Even though the students are still in their elementary school years, I think they will benefit...they will be learning a lot of small things and be gathering small things that they would not otherwise know when they were older. (Interview with Janet)

> I think those skills (entrepreneurial skills) are excellent for students to have. As too much education sometimes is just memorization...and there is a place for that (memorization) too. But I always try to reach those higher level skills and I think entrepreneurship is a cool way to do that. (Interview with Zach)

Learning Experience Questionnaire Results

At the end of the field test, all teachers were invited to complete a Learning Experience Questionnaire (see Appendix G) where they rated 24 statements regarding their learning experience with the case-based online tutorial from *Strongly Disagree (1)* to *Strongly Agree (5)*. The questionnaire results are summarized in Table 4.2, which reflects teachers' overall opinion of the tutorial. In general, teachers believe the tutorial has realized its instructional goal of teaching educators how to design and conduct entrepreneurship program for younger students (Statement No.1-6), and would recommend the tutorial to other teachers (Statement No.24). Teachers recognized the various benefits of studying contextualized case stories in the tutorial, including a better understanding of the design context, access to useful examples, opportunities of reflection, and inspiration of design ideas (Statement No.11-14). Teachers also preferred those cases to be presented in multimedia formats for enhanced authenticity and better comprehension of case content (Statement No.15-18). Teachers interacted with most of the tutorial scaffolding features during the field test and generally agreed that those features benefited their learning process in terms of promoting reflection, inspiring design ideas, and improving learner control (Statement 19-21, No. 23). However, about one third of the teachers remained neutral on whether the scaffolding features offered them useful feedback (Statement No.22). In addition, most teachers agreed that the case-based online tutorial made them more interested in the design task, more engaged in learning, and unanimously agreed that the tutorial provided them with meaningful learning experience (Statement 7-9).

Table 4.2. *Field Test Participants' Responses to the Learning Experience Questionnaire*

No.	Statement	SD (1)	D (2)	N (3)	A (4)	SA* (5)	Mean	Std. dev
1.	The tutorial teaches me how to design and conduct entrepreneurship programs for elementary school students.				33%	67%	4.67	0.50
2.	The tutorial increases my knowledge of entrepreneurship and entrepreneurial skills that are relevant to the elementary school setting.				11%	89%	4.89	0.33
3.	The tutorial improves my skills of designing elementary school activities that engage students in entrepreneurial skills development.				33%	67%	4.67	0.50
4.	The tutorial teaches me useful techniques that I can use to facilitate elementary-level entrepreneurship programs.			11%	33%	56%	4.44	0.73
5.	The tutorial improves my skills of identifying or developing instructional materials for elementary-level entrepreneurship programs.			22%	33%	44%	4.22	0.83
6.	The tutorial teaches me how to handle the common problems of facilitating an elementary-level entrepreneurship program.		11%	11%	56%	22%	3.89	0.93
7.	The tutorial makes me more interested in the task of designing an entrepreneurship program for elementary school students.			11%		89%	4.78	0.67
8.	The tutorial keeps me engaged in the learning process.				33%	67%	4.67	0.50
9.	The tutorial provides me with meaningful learning experiences.				44%	56%	4.56	0.53
10.	I prefer the online tutorial to the paper-based tutorial.			11%	22%	67%	4.56	0.73
11.	The stories and vignettes discussed in the tutorial help me better understand the context of my instructional design task.				33%	67%	4.67	0.50

No.	Statement	SD (1)	D (2)	N (3)	A (4)	SA* (5)	Mean	Std. dev
12.	The tutorial provides me with useful examples of designing and conducting entrepreneurship programs.				56%	44%	4.44	0.53
13.	The stories and vignettes in the tutorial are thought-provoking, making me wonder what I would do under similar circumstances.			22%	44%	33%	4.11	0.78
14.	Some of my design ideas were inspired by studying the stories and vignettes in the tutorial.			11%	22%	67%	4.56	0.73
15.	The use of multimedia (e.g. video, audio, images, and animation) increases the authenticity of the tutorial stories and vignettes.				22%	78%	4.78	0.44
16.	The use of multimedia makes me more interested to study the tutorial content.				22%	78%	4.78	0.44
17.	The use of multimedia helps me better understand the stories and vignettes described in the tutorial.				22%	78%	4.78	0.44
18.	The use of multimedia provides me with useful information that is not described in the tutorial text content.			22%	33%	44%	4.22	0.83
19.	The tutorial includes sufficient scaffolding features (e.g. prompt questions, visual cues, hints) to help me reflect on my learning process.				33%	67%	4.67	0.50
20.	I responded to most of the scaffolding features (e.g. reflect on prompt questions, study cued information, and explore interactive elements).			11%	67%	22%	4.11	0.60
21.	I developed appropriate design ideas when responding to the tutorial scaffolding features.			11%	67%	22%	4.11	0.60
22.	The tutorial offered me useful feedback during my learning process.			33%	67%		3.67	0.50
23.	The tutorial allows me to control my learning process (e.g. the sequence, content and pace of learning)				11%	89%	4.89	0.33
24.	I would recommend this tutorial to other teachers who want to design and conduct elementary-level entrepreneurship programs.				11%	89%	4.89	0.33

*SD, D, N, A, SA are abbreviations for Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree respectively.

The questionnaire results provide an overview of the teachers' perception of the case-based online tutorial, including its overall effectiveness and perceived usefulness of its major design features such as contextualized cases, multimedia use, scaffolding design, and learner control. The quantitative questionnaire results present a simplified view of the teachers' tutorial learning experience, and also informed the qualitative coding process that occurred in the later stage. For example, questionnaire items that received high or low ratings became a priori codes in this study for structural and evaluation coding and analysis (Saldaña, 2013). In addition, when triangulated with other qualitative data collected from the field test (e.g., interview transcripts, design documents), the questionnaire results also enhance the trustworthiness of the research findings by presenting evaluation data in a different form and from a different instrument.

Valued Design Features

The empirical findings described in this section provide answers to Research Question 1: *What design features of the case-based tutorial are valued by the learners?* The interview transcripts with the field test participants are the primary data source, and three major types of design features have been identified as highly valued by the participants, including: contextualized case stories, variety of content, and self-directing design. Those design features, together with the various design decisions that enabled them, are discussed in detail in this section.

Contextualized Case Stories

Consistent with the Learning Experience Questionnaire results (Statement No. 11, 12, 13, 14), the teachers also spoke highly of the contextualized case stories in the interviews. Case stories, often mentioned as *examples* by the teachers during the interview, were frequently referred to as the tutorial's unique design feature, and many teachers elaborated why they liked such design feature and how they benefited from it when studying the tutorial. More specifically, several themes relevant to the case stories in the tutorial were emerged during our analysis, including: *authenticity to infuse confidence*, *contextualized examples to demonstrate activities and techniques, Connecting theory with practice*, *interactive scaffolding to promote reflection*, and *cases to intrigue and engage*.

Authentic stories to infuse confidence

Designing and facilitating entrepreneurship program for children turns out to be an intimidating task for some teachers initially, as they admitted that they had limited prior knowledge of entrepreneurship education during the interview, and a few expressed their concern that elementary school or middle school students might be too young for some of the entrepreneurial activities. For example, one teacher commented, “I didn't have any ideas of doing an entrepreneurship program. I wouldn't even think of doing it before learning the tutorial.” Another teacher also expressed her concern about the characteristics of the target students, saying, “I like the concept of teaching children entrepreneurial skills, I really do, but when I thought about my kids, I was not totally convinced they were able to carry out something really entrepreneurial.” In other words, it seems that some teachers were uncertain about the design task in the beginning: they were afraid they might lack the skills, knowledge, and resources to implement such an entrepreneurship program, and were not sure this program would be something their students could do.

However, the teachers became more confident of designing entrepreneurship programs for elementary school students after studying the tutorial, and many teachers contributed such increase of confidence to their exposure to the real, authentic case stories presented in the tutorial. The use of photos, video footage, real instructional materials, actual student works all add to the credibility of cases stories, and such credibility was greatly appreciated by the teachers. A credible case story provided proof that an activity or technique has been successfully implemented in the past, it also allowed a teacher to fully evaluate its contextual factors before applying what they learned from the case to their own context. For example, when asked about the perceived authenticity of the tutorial cases, one teacher felt the cases were "absolutely believable", and argued that:

> I can definitely recognize the school and those activities, and I think the kids are very likely to act the ways as they did in those examples so I am actually interested to see how the teacher responded in the example. I don't think those examples were staged or fabricated, no, definitely they seem very real to me. (Interview with Molly)

Other teachers expressed similar point of view, and further pointed out that the sense of authenticity helped them relate the case story to their own classrooms. Evidences from the interview include:

> The authentic materials just make good examples for teachers, or whoever that gonna take on the tasks. By showing the pictures of classroom and the actual products of students, making you know those things are not fake or theoretical and can be actually carried out in your own classroom. (Interview with Kelly)

> I guess this is my experience with teaching that there were so many times that we had consulted with whoever talking to us about how it should be going in our classroom, and how the students should be doing something. But then, when you actually see the students doing that, it makes it more credible. Those examples make the tutorial credible because it is not just "do this with your kids" or "try this in your program", but "this is what is actually going on in this program that this school used". (Interview with Carrie)

By observing a real after-school entrepreneurship program (Curiosity Creek Club) being successfully implemented in an elementary school, the teachers started to believe the design task that they were given in the field test was a realistic and doable project, and they became more willing to learn how to approach the design task once they felt the task was actually feasible and manageable. The way case stories infused confidence in the teachers is best described by Molly with the following statement:

> And that (the examples) show you that it is very doable, you know, that you actually can do this, and that it was done, somebody else did. You also understand why it is better by actually seeing it unfold in practice. Sometimes I looked at something and think, mm, I don't believe it, but then you see a teacher using the technique in class, and I realized, oh, this is how it was done, and that makes sense now... So I think it (studying examples) is useful. (Interview with Molly)

Contextualized examples to demonstrate activities and techniques

The review of literature reveals that an important purpose of CBI is to use cases as exemplars to demonstrate desired principles, theories, behaviors, and instructional techniques (Merseth, 1996; Sykes & Bird, 1992). Based on our interview with the teachers, the case design in the tutorial has fulfilled such purpose. The design decision of using concrete examples to demonstrate how an activity or a technique was implemented in a specific context has helped the teachers gain a better understanding of it, and also provided a step-by-step guidance on how to apply or adapt such activity or technique to a similar context. Most commonly, the teachers would study the tutorial cases as "best practice of teaching" where they observed and tried to follow the case examples. One teacher described such learning experience as in the following:

> And I also felt like I was going through steps when studying the tutorial, and doing the same things that they were doing. So it helps me understand the purpose of this kind of program, and what are the things you can do to run the program… what I found to be most useful for me is that I got to see how an activity was implemented and what the key steps of implementation were. I felt I can relate to that when I was thinking of my own design. (Interview with Janet)

More specifically, several teachers explained how they adapted activities demonstrated in the case stories and integrated them in their own designs of the entrepreneurship program. The rich contextual information in a case such as school resources or student characteristics would enable a teacher to evaluate the similarity between the case context and his/her own context, helping the teacher decide whether or not the activity is transferrable to the new setting. The detailed description of the activity process and the inclusion of authentic instructional materials also made it easy for the teachers to follow the case examples in their own designs. For example, one teacher explained how she liked an activity demonstrated in the tutorial and decided to include the same activity in her own design:

> I liked how those kids in the tutorial had this event to showcase their movies to the little ones and to their teachers and parents…I thought about presenting the final products in my class, but I never thought about showing them to a broad audience inside or even outside school. Engaging my students in such science fair events across schools will be really benefiting, having them sell their ideas and products, and maybe competing with other schools…it will be an awesome experience for my kids and I know they will love it…so I steal this idea and put it in my design. (Interview with Debbie)

The design decision to include all case stories from one exemplary program (Curiosity Creek Club) was also appreciated by many teachers, as those cases together provided a much in-depth demonstration, and helped the teachers see the "bigger picture" of how different elements in the program were connected or interacted with each other. The bigger picture allows a teacher to understand the purpose of the activity or techniques in relation to other elements in a program, and thus makes it easier for the teachers to make adjustments or adaptations based on the variances of contextual factors. The following comments are from two teachers who tried to explain why they liked the fact that all the cases in the tutorial are from one program instead of many:

> It is important to include the whole spectrum of events so it is not pieces everywhere from different sources, as it would then be difficult to understand how those different bits fit together. For example, after studying those different activities in the tutorial, it is easier for me to make decisions to adapt the program to fit my design. I might replace the video production part with, say, picture book making, but I will keep the brainstorming and storyboard part, and the post exhibition event, as I understand how those activities were connected to serve a single purpose. (Interview with Katie)

> I think the tutorial shows a perfect example that how story writing activity can be used for later video filming, and I think the video filming part wouldn't be so great if students didn't have a well scripted, clearly laid out story to begin with. Looking only at the filming part would make much less sense if it was taken out of the context. (Interview with Janet)

Connecting theory with practice

A unique benefit of using cases in instruction is to "bridge the vast chasm between principle and practice" (Shulman, 1992, p.1), and such benefit has been recognized by many teachers when they studied the tutorial. Since all participants in the field test are in-service teachers with years of teaching experience, *practicality* emerged as an important criterion for them to evaluate the usefulness of the tutorial. In general, the teachers agreed that the cases helped them better understand the abstract theories and concepts introduced in the tutorial by pairing those theories and concepts with their actual implementations in teaching practice. For example, one teacher explained how she initially misunderstood certain concepts described in the tutorial and how studying the case stories of applications gave her a better understanding of those concepts:

> At first, I was a little hesitant about the certain skills discussed in the earlier part of the tutorial, such as business skills or project management. I thought you were talking about things like

> investment, profit, or conflict intervention, and I am not sure my students are ready for these things yet… The tutorial made me realize that business skills can be as simple as creating something valuable for other people, and management skills can be, er, managing your backpack to put everything back to where they belong. Now I see those skills are quite appropriate and rather necessary for my students. (Interview with Debbie)

Several teachers also argued that the tutorial would be much less useful to them without the "practical details" in the cases since those details are usually what they took away from the tutorial. The practical details mentioned by the teachers include step-by-step lesson plans, downloadable resources used in the program, or student responses/feedback. Those practical details were greatly appreciated by the teachers, providing them with viable examples, useful tools, and valuable lessons for applying those theories or concepts in their own program design. As one teacher explained in the interview:

> I liked the examples that it (the tutorial) gave, as I can see how different activities were carried out in an actual classrooms, including very practical information such as what kind of worksheet should a teacher bring to the class and how to use it in teaching, what are some of the issues the teacher might encounter… I could see how those things discussed in the tutorial, like brainstorming, the facts and research, the worksheets, were implemented in helping the kid coming up with this story. Those were the things that I took away from the tutorial... (Interview with Carrie)

Interactive scaffolding to promote reflection

Promoting reflective opportunities is considered as an essential activity of CBI (Kleinfeld, 1992b; Jonassen & Hernandez-Serrano, 2002; Richert, 1991; Tippins et al. 2002). To support this activity, various interactive scaffolding features were embedded in the tutorial to promote learner reflection, and those scaffolding features can be categorized into two types:

visual cues (e.g. emerging captions, prompt questions, and highlights) and review quizzes. The detailed description of those scaffolding features can be found in Chapter 3.

The cases in the tutorial seem to be quite effective in promoting learner reflection. When the teachers described their tutorial learning experience, there has been frequent references to their reflective actions such as evaluating the pros and cons of an instructional activity, comparing the exemplar program with similar programs in their schools, synthesizing teaching principles from concrete examples, and proposing suggestions for improving the exemplar program. For instance, Katie admitted she was constantly assessing the feasibility and desirability of the tutorial activities and comparing those activities to an existing entrepreneurship program in her school called *Buzz town*. The anecdote of a facilitator guiding a student to write a story about cow poo also prompted Carrie to synthesize an important teaching principle - *facilitators should try to connect the instructional projects and activities with students' backgrounds*. Janet, Debbie, and Kelly also discussed ways to further improve the exemplar program based on their teaching experience. In summary, the teachers were not merely following the case examples, and higher-order thinking frequently occurred during their case learning process. The analysis further revealed that the aforementioned reflective actions were often triggered, and sometimes guided by the teachers' interactions with visual cues and review quizzes, albeit in different ways.

Visual cues

Visual cues played an important role in directing the teachers' attention to key points, emphasizing the connection between different contents, and providing constant stimulants for learning and exploring. For example, a teacher explained how visual cues helped her identify the key ideas from the tutorial and made her reflect upon the purposes and connections among those key ideas:

> Because when you read a paragraph, you can read the whole paragraph and miss some key ideas, or misunderstand what the paragraph is saying. Because with that little box of text, that is the only thing you focused on... But with pop-ups (i.e. emerged captions or highlights), they grab your attention, and make you think harder: why are they in pop-ups? And what is the connection between those pop-ups and the text or images? I guess it just adds more stimulation to the study. For me, without those interactions, I might just keep reading the text but I think I will miss many key things. Since I didn't stop and think. (Interview with Kelly)

A more specific example of reflection triggered by visual cues was given by Debbie during her interview. When she studied the unit about assessing existing products, she clicked all four arrow markers on an image showing a facilitator guiding students to evaluate previous video products. The arrow markers point to key information within the image and provide additional explanations accordingly, including available tools and resources, student responses, and facilitating methods. Debbie explained how interacting with those arrow markers made her examine the case content more carefully and think more critically. Without the arrow markers, Debbie confessed she might simply glance at the image and move on to the next slide and lost the opportunities of reflection:

> The shining arrows (i.e. arrow markers) made me take a better look of the picture and I found some interesting details: It is in a classroom instead of a computer lab. Classroom might actually be a better choice since students might easily get distracted on individual computers and the big screen projection feels more like watching a movie…the additional information about technology resources is also helpful, as I feel nowadays most schools will have those equipment. However, I am a little curious about the video editing software used… (Interview with Debbie)

Review quizzes

The review quizzes engaged the teachers in the interactive activity of dragging and matching target entrepreneurial competencies with the appropriate learning activities at the end of each instructional unit with the purpose of providing the teachers with the opportunities to stop and reflect. The review quizzes were also designed to offer the teachers immediate feedback regarding their previous learning before proceeding to the next unit. The component of review quiz was highly valued by the teachers in the field test, but for different reasons. Some teachers pointed out the "fun" part of doing those reviews, considering them to be "a little fun way to review materials by having to move stuff around" and "the little breaks during the study where you can take a breath". Other teachers believed passing the quizzes gave them a sense of "affirmation" and "completion", showing that they have done well and make them more confident when moving to the next unit, as Molly argued:

> I found them (review quizzes) very useful...Because, you know, all those teachers are very competitive people, we want to make sure that we understand and get this stuff so we can pass the quiz! That is like a gold star (laugh)...Oh yeah, we like quizzes. You know we are teachers but we are still kids at heart, we like to show that we have learned something, like, YES! I got it right! (Interview with Molly)

The reflective action of self-assessment was implied during the interview when the teachers discussed their interactions with the review quizzes. Since the review quizzes highlight the connection between the case content to desired entrepreneurial skills, when a teacher got the correct answer, the review quiz provided useful reinforcement of learning. In case of a teacher getting a wrong answer, the review quiz prompted them to reexamine the definition of specific entrepreneurial skills and re-analyze the previous case stories more critically in terms of those skills. For example, a teacher described how taking the review quizzes made her revisit case examples and gain a better understanding of certain entrepreneurial skills:

> The first one I got one of the answers wrong, and I have to re-read it and think about it, and really ponder. I guess, once I have seen all of the skills...first I thought one of them was maybe marketing, or problem solving, but we haven't gotten to that yet. But once I saw the example of marketing, I realize, oh yeah, the first one was clearly not marketing, this is what marketing means, or this is what critical thinking means. (Interview with Melanie)

It is interesting to note that the inclusion of the review quizzes in the tutorial itself also made the teachers reflect upon the value of the evaluation component in instructional design. A few teachers even suggested the inclusion of similar assessment activities in their entrepreneurship program designs and discussed the value of self-assessment and reflection as result of those activities. For example, Maria discussed how the review quizzes prompted her to think about the importance of self-assessment for both adults and children:

> I was just reading information and looking at videos, but at that point (review quizzes) I would stop and self-assess myself. I think that is really important, that is important for adults as well as for kids, that you can't just give information to them, you have to stop and give them time to reflect that and then to give some information back to make sure that they understand what they are doing. (Interview with Maria)

Cases to intrigue and engage

The field test reveals that the most valued cases are also the cases that got people's interest and kept them engaged in learning. It is apparent that some cases in the tutorial are more memorable than the others, as the teachers mentioned them more frequently during the interviews and spoke highly of them. Those popular cases include the case about making a cow poo story (mentioned by 6 teachers), the case about the showcasing the products in science fair (mentioned by 4 teachers), the case about assessing existing products (mentioned by 3 teachers), the case about helping students to manage their equipment (mentioned by 3 teachers). It is highly desirable to include interesting tutorial cases to gain teachers' attention immediately, as those cases are more likely to keep them engaged during the learning process, as one teacher explained:

> I think keeping teachers engaged, those teachers on very busy schedule, is very important, probably the most important thing. If you get teachers engaged, they will buy in to it and will probably use it in the classroom. I am just telling from my experience of the workshops with other teachers, you know what, there are often things that I will never use simply because I don't like it. If teachers like it, chances are they will use it. I like the tutorial, and I am not even a computer person but I really like it. (Interview with Molly)

While it is always important to write the case in a clear and concise way and present the case in the right format and sequence, the case content alone sometimes can be the biggest indicator of success among its learners, possibly because people love interesting stories and interesting stories can be an inviting way to prompt them into engaging with the case content in contextual ways. Take the case of the cow poo story for example, it presents a story that is considered by many teachers as "interesting", "funny", and "hilarious". These characterizations may suggest a reason for teachers to study it in greater depth. As Melanie described it, "It was funny, like the kid with the poop story (laugh), you know, help me imagine how this would actually go in a classroom and visualize it. Yeah, just fun." Maria also commented on the case story, "I have my personal interest in it, and I am interested to watch it even more."

In addition, the teachers were also attracted to cases that allow interactions, contain interesting graphics or videos, and afford easy-to-adapt, practical materials. Compared to the case examples that are only presented in plain text and still images, field observations and the screen recordings both reveal that teachers spent considerably more time studying case stories with interactive elements, doing things like playing a story puzzle created by a student, exploring content hidden by arrow markers, or examining additional linked resources. Such a finding is further supported by teachers' interviews. For example, one teacher discussed how interactive multimedia cases made her more interested in studying the tutorial:

> I thought it made you interested in looking at the different learning activities, and made you pay attention a bit more, like where can I click on this page to get more information, maybe I will view the videos here, or oh there was a worksheet that I can download, that made the tutorial really interesting. (Interview with Katie)

Variety of Content

The case-based online tutorial is consisted of a variety of content, including videos, images, animations, worksheets, and external resources. The integration of different content supported the case development and presentation in different ways, and was highly valued by the teachers in the field test. According to the Learning Experience Questionnaire, all teachers agreed that the multimedia content in the tutorial increased the authenticity of the case stories, made them more interested in the tutorial, and helped them better understand the case content. Most teachers (77%) also believed they have learned useful information from different types of content other than text. In addition, Carrie and Zach compared the tutorial with other online materials they had studied and stated that the tutorial was different, as the other online instructions were "just text with a couple of graphics thrown in". Molly also expressed her approval of the variety of content presented in the tutorial, as she explained in the interview:

> I like the variety, you know, because you don't get bored with it. There is information, there is question, there is video, you know, and examples...I like the variety of things inside the tutorial,

> that wasn't just reading, but also there was visuals, and you were interacting with the tutorial, you were answering questions...I really like that, like the variety. (Interview with Molly)

Based on the different instructional purposes, this section categorizes the tutorial content into three major types: multimedia content, background information, and downloadable resources. The perceived value of each content type is discussed in this section primarily based on the interviews with the field test teachers. The major findings and their supporting evidence are presented in below:

Multimedia content

The multimedia content in the tutorial refers to the non-text based content, which is primarily images, videos, interactive elements, and a few animations. The teachers enjoyed studying the multimedia content, and have given the following reasons for such preference:

- Multimedia content provides the teachers with visual stimulations and mental breaks.
- Multimedia content accommodates most teachers' learning preference.
- Multimedia content supports comprehension of text-based content.
- Multimedia content presents richer contextual information than text.
- Multimedia content increases the authenticity of the case stories.

Visual stimulation

The most recognized value of multimedia content seems to be the visual stimulation it provided to the teachers during the learning process. The teachers used words such as "interesting", "fun", "colorful", and "engaging" to describe their first impressions of the tutorial, and have contributed such impressions to the extensive use of videos, images, animations, and interactive elements. Many teachers compared the tutorial with text-heavy books or websites, and asserted they much preferred to study the multimedia tutorial. For example, Carrie argued that she would not choose to study the tutorial if it was heavily text-based in the following comment: “I think it would be less interesting if I study a tutorial without videos or images, such tutorial doesn't appeal to me and I don't think I would sit down and dig into it if I was on my own.” Another example of visual stimulation was given by Kelly when she described her interaction with the review quizzes, as she commented, “at one point, I was like, I was getting a little tired of reading, but once I got to that quiz part, I was like I woke up and read it and made sure I focused on what I got right.”

The interaction with multimedia content also provided teachers with mental breaks during the hour-long study, allowing them to “sit back and relax a bit” and “feel refreshed” before continuing to study the next unit. As Katie explained in her interview, “I guess you could put the same thing in text, but the way it (multimedia content) let you interact also kept you engaged, and feel less overwhelmed with text.” According to Zach, occasional mental breaks during self-directed learning are essential for learners like himself:

> For me, it would be more difficult to really engage with it (the tutorial) during the entire hour. And I am not a passionate reader like some of the people are, too. So read for an hour straight would be really... I would need something to break it up. (Interview with Zach)

By having a teacher take occasional breaks such as watching a short video or participating in an interactive activity, the multimedia content in the tutorial helped break down the tedious learning process and kept the teachers interested and engaged. For example, several teachers mentioned an interactive story puzzle included in a tutorial case. The story puzzle was created by a student in the Curiosity Creek exemplar program, and the tutorial enabled the teachers to actually play with the puzzle during their learning. Such learning experience was greatly appreciated by the teachers, as Carrie said “it is neat that I could actually play with the puzzle, it is not only clarifying but also quite fun!” Debbie also believed such interactions were like short breaks in a test, helping her “catch her breath” from time to time so she can “see through to the end of it”.

Learning preference

Several teachers considered themselves as visual learners and contributed their affection for multimedia content to such learning preference. For example, Carrie claimed she had a preference for visual learning, and said, “I am a very visual learner, so the more I see different variety of the ways I see it or observe it, it helps me learn better.” Molly also identified herself as a visual learner and explained why she liked the images in the tutorial and how the images assisted her learning:

> For me? I am more of a visual learner, so images for me is good. I like the text, but then, the images make the text come alive…If I read something and I am not sure that I quite understand what you mean, if I can see it, then I say, okay, now I understand. So I think images reinforce what I have learned. (Interview with Molly)

Other teachers pointed out that videos have been frequently used in teacher education to showcase exemplary teaching practice, therefore teachers in general are used to studying video content and feel comfortable doing it. For example, Maria expressed her preference for video content as a teacher in the following comment: “Yes, I like the videos, because I am a teacher and I like to see the videos with the kids, and how you actually apply what is described in a video to the development of entrepreneurial skills.” Another teacher Molly made a similar comment, saying that “I really like the video clips in the tutorial, because that, you know, especially as an educator, it is good to see something in theory but it is better to see it in practice."

Supporting comprehension

Consistent with what the literature suggests, the multimedia content in the tutorial proved to be very effective in helping the teachers comprehend activities or techniques introduced in the case stories by providing supplementary case content and/or showcasing their applications in practice. For example, Melanie admitted that the details of students putting up posters and showing videos to kindergartners helped her gain a better understanding of the science fair activity, but such details were usually presented in images rather than in text descriptions. Kelly argued that video is better than text in presenting examples because video "goes to the ears and eyes", and thus made her understand better and stay focused. Katie discussed how an animated conversation between a facilitator and students helped clarify the abstract concept of brainstorming:

> So, I read about the principles of doing brainstorming and, some worksheets, but it is still all of a blur in my mind, since all of those stuff are still very abstract and theoretical, that I bet I wouldn't remember the next day (laugh). Then I saw the conversation bubbles between the teacher and the students, showing how brainstorming was done in a real example, it just became so much clearer to me. I even went back to review the principles. (Interview with Katie)

In addition, Zach also considered interactive visual cues to be highly effective in highlighting key content in the tutorial and presenting the big picture, and explained how he used those visual cues as the highlighting notes to understand the text content:

> Sometimes I felt when I clicked on those pop-up text first, it helped me understand the current page much quicker, as those pop-ups were like the gist or highlights. For example, I remembered

> reading a student's story about cow poop, I didn't read the whole story but by looking at the highlights, I think I got the big ideas. So those pop-ups were actually very instructive. (Interview with Zach)

Contextual information

Contextual information of the case examples (e.g., learning environment, student demography and characteristics, personnel and technology resources) was considered by many teachers as important and useful. The inclusion of such information made tutorial cases more vivid and trustworthy, and also helped the teachers analyze the differences and similarities between the case context and their own contexts, and thus determine the transferability and adaptability of a specific case example.

Compared to textual narratives, the multimedia content in the tutorial offered the teachers a more direct, concise, intuitive, and effective way of receiving contextual information. For instance, the long, tedious description of the trivia about the program setting can easily be replaced with an actual picture or video recording of the classroom. The teachers recognized the value of multimedia for delivering contextualized case content, as one teacher said in her interview:

> I am not sure you can learn the same thing just from the text. As a teacher, it is important to me to see the class environment and students to understand what are the possible activities that I can carry out, as you need to differentiate your teaching. So, those contextual information I got from the multimedia really helped. I think my learning experience would be much different without seeing those images or videos. (Interview with Katie)

Sense of authenticity

The Learning Experience Questionnaire results revealed that the teachers unanimously agreed (22% agreed and 78% strongly agreed) that the use of multimedia like videos and images greatly enhanced the authenticity of case stories (as shown in Table 2). Such finding was further elaborated by some teachers during their interviews. For example, Debbie argued that the extensive use of real photos in the tutorial convinced her of the legitimacy of the case examples and made her more interested in studying them:

> Whenever I heard about some new pedagogy or teaching techniques, I was like, “yeah, that sounds great, but will it actually work with my students?” I can be very skeptical sometimes, you know (laugh). So it is important for me to see proof of it is actually working. I guessed I liked those photos in the tutorial because of that, the very first impression that those stuff are real, they are not faked, and they actually worked…I guess you can do that with text, but, it might not be the best, as you know, a picture is worth a thousand words. (Interview with Debbie)

The authentic details in multimedia content also increase the credibility of the case examples, making the teachers more confident that what worked in those examples might also work in their own schools. For example, the actual photos of Curiosity Creek students filming videos in a group convinced Melanie that the videography project was within the capacity level of 5th and 6th graders, as she explained, “At first I think videography might be a little complex for 5th and 6th graders, but by actually seeing them working in team, I felt, yeah, it might actually work”. Other examples given by the teachers include: the final story puzzles and movie products demonstrated possible standards to be expected from the students; the animated student-facilitator interactions testified the effectiveness of certain facilitating techniques in dealing with possible student responses and disruptive behaviors; the photos of the science fair showed its scale and format, and the resources that went into such event.

Background information

The teachers liked the fact that background information of entrepreneurship education and entrepreneurial skills was included in the beginning of the tutorial, which provided sufficient prior knowledge to understand the learning objectives, terminologies, and examples described in the tutorial. The teachers found such design feature particularly useful and effective since most of them knew little about entrepreneurship education prior to the field test and had no time to conduct their own research to gather the necessary background information. For example, Maria expressed her appreciation for the inclusion of various definitions of entrepreneurship, and acknowledged that she had referred to those definitions to gain a better understanding of the tutorial content:

> I also like, oh, if you didn't understand something, you had definitions that you could refer to, which I did use for a couple of the definitions. Even for the word "entrepreneur", you think that is a word you know, but I feel I needed a better definition of it and I like the definition you did. (Interview with Maria)

Katie also liked the brief overview of entrepreneurship at the beginning of the tutorial, and found such “introductory knowledge” useful in helping her understand the key concepts behind the case activities and making her connect entrepreneurship to her past teaching experience:

> Well, I also think it is a good feature that the tutorial offered me the introductory knowledge on entrepreneurship in the very beginning… I have never systematically studied this topic, such as the definitions of entrepreneurial skills, or what qualifies as entrepreneurial development...So I found the introductory part quite useful: Not only it helped me better understand this tutorial, like the service-learning concept, and essential skills such as creative thinking or teamwork, it also

> made me rethink of my experience with JA Buzz Town (an entrepreneurial program in Katie's school), like, from a more academic perspective. (Interview with Katie)

The teachers also appreciated the design decision of integrating all background information inside the tutorial rather than linking it to external resources. The integrated information (e.g. necessity of entrepreneurship education for children, desirable entrepreneurial skills) has been pre-screened and edited, therefore is more concise and fitting to the tutorial objectives. On the contrary, the process of filtering and examining external online resources can be very time-consuming and unproductive. As Carrie explained, an online tutorial should be different from an online course, since teachers do not have much time to do extra research or explore different websites when studying an online tutorial and would expect to receive all key content from one place. Debbie further argued that important content should always be "self-contained" in the tutorial since external links are likely to become invalid after a prolonged period of time.

Downloadable resources

The variety of downloadable resources such as worksheets, help-aids, and evaluation forms is another design feature highly valued by the teachers. Several teachers even kept copies of some resources to take away from the field test as they believed they might be able to use them in future occasions. Downloadable resources offer evidence of previously successful implementations of activities or techniques described in the tutorial, and also provide a tangible foundation for the teachers to replicate or adjust those activities or techniques to their own contexts. As a result, many teachers believed that those resources made their design task more feasible and less intimidating, as Carrie explained in the interview:

> There were the worksheets that I can download and actually use with my students so I didn't have to take all this information and say, okay, now where do I find print-outs, where do I find the visual aids...The actual information was all there. So I have been informed and I was also being shown where I can go and get this other information or I can just use those worksheets that were used in the exemplar school. It just made the whole concept of creating your own program less scary and actually doable (Interview with Carrie).

Another teacher Zach further pointed out that it was cost-effective for him to be able to download materials directly from the tutorial rather than searching aimlessly on the internet or starting from scratch. He also acknowledged the practicality and usefulness of those downloads and admitted he would definitely refer to them if he was actually going to conduct an after-school program:

> I did notice those worksheets and I think they would be useful in the real setting where I was actually...had I really been thinking about setting up this program. Because I know for my own classroom I would search online for a lot of things so if there is any time that I can download something or borrow something form other source, I will do it. I think it will be very cost-effective as you only need to adapt it to fit your own setting rather than build it from scratch. It is also nice to have something to start with, making setting up a program less intimidating… (Interview with Zach)

Self-Directing Design

The teachers' learning experience with the tutorial was completely self-directed since no interaction with the researcher was allowed during the field test. However, such self-directed learning process turned out to be quite smooth with no major usability problems reported by the teachers. Based on analysis results of the interview data and recorded navigation videos, this study has identified two design features that supported the self-directed learning of the tutorial: *clear outline structure* and *adequate learner control*.

Outline structure

The outline structure of the tutorial offered the teachers a default order to navigate its content. To examine how the teachers interacted with the tutorial, three teachers (Carrie, Katie, and Melanie) volunteered to have their screens captured when studying the tutorial so that their learning behaviors could be recorded in videos. The analysis of those recorded videos revealed a navigation pattern that is consistent with the pattern self-reported by many teachers in the interview: The teachers would simply follow the default outline structure of the tutorial and go through the tutorial content by clicking the “next” button. Many teachers used their own words to describe such pattern, and the following are a few examples:

> I just clicked through the whole tutorial. I know I could change the learning order if I want to, but I just enjoyed the learning so far so I just followed the default order. (Interview with Janet)

> I went through everything in the numbered the order. I just kept clicking next. I didn't read every word of everything and I didn't watch all of the videos, but I went through each page. (Interview with Melanie)

> Oh, I just did the tutorial very sequentially, you know, as it went. Once in a while I will jump to the end to see what the end game is, but I think I went very sequentially…Yes. I like to work at the stationary order (laugh). (Interview with Molly)

The teachers liked the outline structure of the tutorial and felt its chronological order was easy to follow and depicted a clear picture of the exemplar program. The three parts of the tutorial (*Innovation and Research*, *Production and Management*, *Publish and Marketing*) highlight three important phases of the exemplar program and also showcase a desirable sequence of instructional activities for the teachers to follow in their own design of the entrepreneurship programs. For example, Carrie agreed that the tutorial structure was “well-directed" and "easy-to-follow" and "moved in the sequential pattern of how you would go through a program like this". She further explained how the tutorial structure benefited her learning and influenced her design in the following comment:

> I will not, probably will not design the same program as the one shown in the tutorial, but definitely using the same, er, like the sequential flow they showed me, like, starting with the innovation and research, then going to the production and management, and then publishing and marketing. I will follow those three steps and tailor it to what the needs are at the school that I am working, with the students and their grade level...I will probably change them a little, but the structure and format might be very similar. (Interview with Carrie)

Other teachers have expressed similar opinions: the tutorial's structure has provided them with a clear, intuitive, and optimal order to study the exemplar program and also has informed the structure and format of their program designs. For example, Maria argued that showing the steps from the beginning of brainstorming to the very end of the final product could be a very effective way of helping people understand the exemplar program. Katie also admitted she would probably design her entrepreneurship education program using the same outline as she saw from the tutorial:

> I feel that I keep saying that, but I was really, I loved the outline of it (the tutorial): how it went from the beginning, you know, this is what you will do with the class, and then, through each part of the program...I just like how it is so easy to follow that way, and it helped me realize, "oh, I can do this exact the same pattern", and I should probably be doing this the exact same pattern with my kids, and we would be able to do a great program of entrepreneurship. (Interview with Katie)

Learner Control

High degree of learner control is a design feature that was highly valued by many learners during the pilot test. As a result, the revised tutorial kept this design feature and included a few improvements to further enhance its learner control before the field test. Major improvements for learner control are listed in below:

- Adding a menu panel that lists all tutorial pages in numerical order to allow easy access
- Enabling learners to control the timing and length of visual cue appearance
- Making all case examples optional to study and highlighting the option of skip

In general, the teachers believed that the tutorial provided them with a great amount of learner control. The Learning Experience Questionnaire results (Table 4.2) revealed that all teachers agreed (11% agree and 89% strongly agree) they had sufficient control over their learning process and could easily change the sequence, content, and pace of learning. The teachers' comments in the interview supported such finding, as many teachers discussed how they were able to study the tutorial in their own ways without encountering any problems. For example, Carrie spoke highly of the learner control design in the tutorial and commented, "I didn't recall there were any problems during studying the tutorial." Kelly agreed with Carrie and further elaborated, "I think it was all good. I can go next, go back, and click on the hyperlinks. Yeah, no problem." Zach considered the learner control afforded by the tutorial as one of its distinguishing feature and claimed: "I think this tutorial is much better than a lot of the other online learning I have done, giving me more learning control."

The menu panel

The addition of the menu panel, or as many teacher referred to as "the table of content", is a revision that was welcomed by the teachers. Many teachers chose to glance through the list in the menu panel before digging into the tutorial content in order to get an overall idea of what is inside the tutorial. A few teachers also used the menu panel to freely access any individual tutorial page when they decided to review a specific topic. As Carrie explained in the interview, "If I wanted to go back to a specific example or story, I would use the table of content in the menu, which took me to a specific page in the tutorial." Zach also commented, "Table of contents on the end allows you to jump forward or backward easily, which is nice."

By listing all the content topics in the menu and differentiating *studied content* from *unread content*, the tutorial also served as a progress indicator for many teachers, showing what parts still need to be studied during the remaining time. For example, Zach explained how he used the menu feature when studying the tutorial:

> I guess it is nice to know it (the menu) is there, maybe it could be something that can be hidden or can be options to hide it possibly. But it did give me some indication about where I was during the study. Like, towards the end as I went on, I did kind of look at that bar and see how I was doing. When you told me that I was given an hour to do it… now thinking about it, I did kind of use that to pace myself, to see if I was progressing too quickly or too slowly. (Interview with Zach)

Visual cue control

The pilot test showed that visual cues in Tutorial 1.0 have caused problems for some learners. Animated cues would appear suddenly and distract learner's learning process, and cued content sometimes disappeared too fast, causing confusions. As a result, visual cues in Tutorial 2.0 were revised to be triggered by the learners and a cued content will always display until it is closed by the learners. In other words, the teachers had complete control as to when and how long they want to study the cued content in the field test.

Contrary to the pilot test results, the teachers' experience with the visual cues has been mostly positive during the field test. The teachers still noticed those visual cues and believed they were useful for highlighting key information and providing additional content. However, since visual cues no longer appeared automatically in the tutorial, the teachers now can decide when is the best time to respond to them based on their individual learning process. As a result, there were no more complaints in the field test about visual cues causing distraction or confusion. The teachers can also decide whether or not they want to respond to a visual cue or view a cued content, rather than passively studying all of them. The following example was given by a teacher explaining how she interacted with the visual cues in the tutorial:

> I am looking at 2-4, innovation and research. I got this picture of a classroom, and then the arrows. I guess I don't need to read what kind of resources are needed but would rather take a look at this picture and I think I actually get a better idea. Some of information that popped up were similar to what is on the right in the text, but not every teacher has to read every single word, so, if they don't want to read every caption, every pop-up, that is okay. I clicked on most of the arrows, but not every single one. (Interview with Melanie)

Optional case examples

All case examples were made optional in the tutorial: A learner can choose to study a case example by clicking the “example” button, or skip the example by clicking the “skip button”, as shown in Figure 4.1. Even though many teachers chose to study all the content in the tutorial, they still preferred to have an option to select their own instructional content, as explained by Molly in her interview:

> I like that you have options that allow me to click on the stuff I want to explore, but I don't need to click on everything, but I can still get, I think, a full picture of what you are trying to accomplish in the tutorial. I don't want to waste my time on something I already know or been forced to learn something I don't care, if that happens a lot, I might give up the tutorial all at once. Making things optional is good, so you can dig in and take just what you need, and you can't really complain about that. (Interview with Molly)

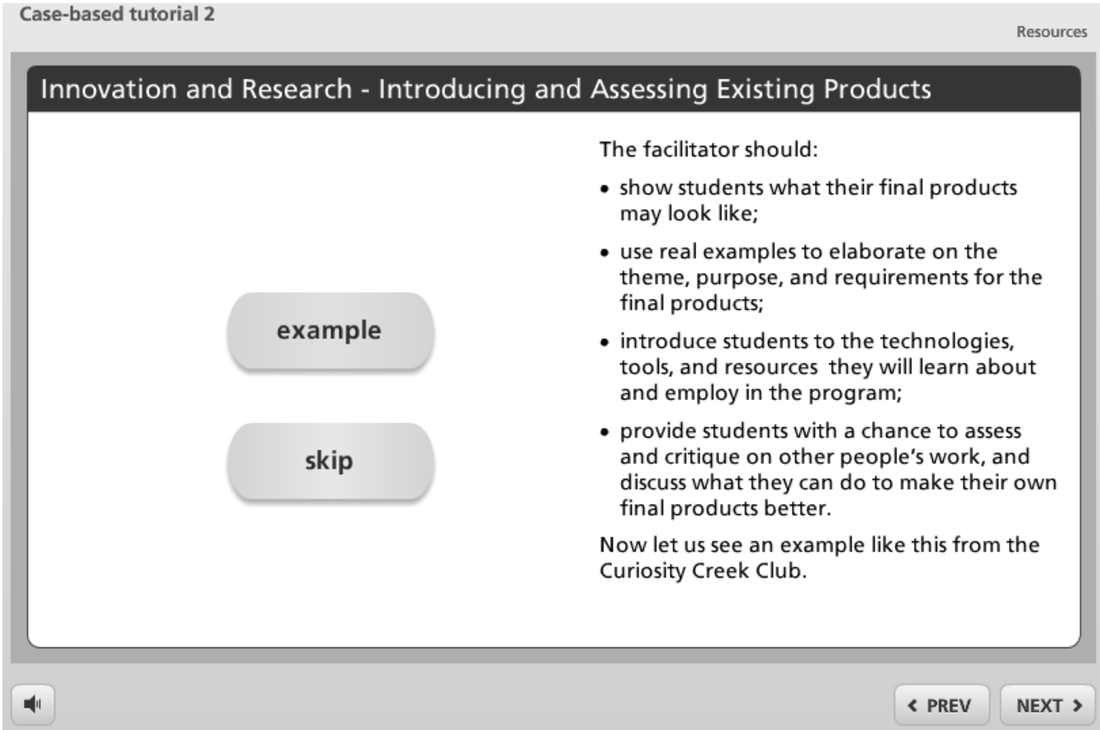


Figure 4.1. A screen capture of Tutorial 2.0 showing the example and skip buttons

Several teachers admitted they had exercised such design feature and skipped certain case examples, and argued that doing so helped them spend more time on content that was most useful for them. For example, Kelly changed her tutorial learning strategy halfway through her learning process and decided to skip some obvious examples if she can guess what they were about. Debbie stated she would only pick one example to study if multiple examples were offered for one topic. Zach further discussed the benefit of skipping or skimming in the following comment:

> If it was a concept that I had previous experience and was pretty familiar with, I kind of skip it. I didn't skip a lot completely as there are only a few things that I completely skipped and then I will skim over. If that is something that I am less familiar with I would spend more time on it. I found this strategy quite useful since I only got like an hour...so I felt I got the most from the tutorial, got some great ideas and examples, and I don't feel like I missed anything. (Interview with Zach)

Section Summary

In summary, this section has identified three major types of tutorial design features that are highly valued by the teachers, including contextualized case stories, variety of instructional content, and self-directed design. Those design features have played an important role in the field test in engaging and motivating teachers, promoting higher-order thinking, providing practical information and resources for design, and customizing individual learning process. However, not all design features in the tutorial are valued by the teachers, and some revisions were proposed to be added to the future versions of the tutorial to enhance self-directed CBI. Those not-valued design features and proposed future improvements are discussed in the following section.

Not-Valued Design Features

The empirical findings described in this section provide answers to Research Question 2: *What design features of the case-based tutorial are not valued by the learners and what are the possible ways to improve them?* Not-valued design features discussed in this section refer to the features in the tutorial that were rarely utilized by its learners and/or received negative or mediocre reviews. The analysis of the interview data has identified three specific tutorial design features that were not valued by the teachers: the virtual instructor avatar, too much text content, and monotonous review quiz. In addition, the teachers also proposed a few new design features to be added to the tutorial in its future revision.

The Virtual Instructor Avatar

Based on the pilot test results, several revisions were made to the tutorial with the purpose of improving its mechanism of providing timely guidance and feedback. One major revision is to add a virtual instructor avatar “Monica” to simulate instructor facilitation as seen in the face-to-face classroom settings. Monica would act as a facilitator who greets the tutorial learners, presents an overview of the tutorial goals and objectives, and provides guidance and feedback when necessary.

However, the teachers were not quite convinced of such design and found it rather confusing and distracting. As Melanie confessed in her interview, she was a bit baffled about the role of Monica and felt this character was not properly introduced in the beginning, did not show up consistently in the tutorial, and did not look like an elementary school teacher:

> Mm, I don't know. I think at the beginning when she introduced herself, I expected to see more of her: Is she the one teaching me all those stuff? Is she my teacher? I mean, she pop back up and asked a few thought questions later on, but …I guess maybe you can make it more clear in the beginning, like, why is she there, is she the one who teaches me how to do this? Is she supposed to be the one who is the classroom facilitator in the example? It doesn't seem that way because she is all dressed like a business woman rather than an elementary school teacher. (Interview with Melanie)

In addition, the teachers were frustrated that they were not able to actually interact with the virtual avatar, therefore the graphic of Monica seemed to be purely decorative and thus was not very useful. For example, Carrie admitted she stopped paying much attention to the avatar after a while and focused more on the content instead, and sometimes felt the avatar image took up too much screen space and became distracting. Debbie also expressed her disappointment that she cannot really "communicate" with Monica and suggested to include a simple "question selection" feature in the future that enables learner to choose from a list of questions to ask Monica, and thus will add a little interactivity to the learning process. The prompt questions asked by the virtual avatar also failed to capture the teachers' attentions, as Zach described:

> I didn't take a lot of time to think of those (prompt questions). No. I am not sure why, maybe I just wanted to jump into the tutorial stories. And I felt, in a sense, I knew about the tutorial goals and what the nature of those questions were so I didn't study them very carefully. (Interview with Zach)

Too Much Text Content

From Tutorial 1.0 to Tutorial 2.0, about 25% of text content has been replaced by multimedia content. However, the teachers in the field test were still unsatisfactory with the amount of text content and wanted it to be further reduced. While it is important to learn some background knowledge about entrepreneurship education before studying the case stories, some teachers felt there was too much reading at the beginning of the tutorial that might discourage learners from further studying it. As Maria pointed out, “At the beginning, there was a lot of readings and a lot of definitions, and I think somebody who might not be interested in this subject matter might give up at that point.” However, Maria also admitted it might not be easy to solve this problem since there is a lot of information to learn at the beginning.

The teachers also preferred more multimedia content to be included in the case development and argued that studying text content can become boring, repetitive, and tiresome after a while. For example, Kelly felt the tutorial was a bit long, and reading started to feel repetitive as “there was too much as the same materials.” Janet preferred to see more case stories in the video format because video is more effective in presenting contextual information, more fun to study, and allows easy control such as pause, fast-forward, and rewind. Molly also suggested that the text-based instruction of how to use the tutorial should be replaced by a user-friendly “pre-video” since video demonstration is more effective and easy to understand than text description.

Monotonous and Easy Review Quiz

While the review quiz at the end of each tutorial unit was perceived as a useful learning component for conducting self-assessment and promoting higher-order thinking, several teachers also pointed out the problems associated with its design: the review quiz lacks variation in its format, is not challenging enough, and becomes repetitive and boring after a while. In fact, the interview data and the screen capture videos both indicate that the teachers tended to spend more time on the first few review quizzes and skim or skip the rest of them.

The most common complaint regarding the review quiz is its invariable format. The review quiz itself is a nice learning component to have: it takes the form of a *drag and drop* game where a learner matches entrepreneurial skills with the right learning activities; it provides teachers with mental breaks between tutorial content and adds interactivity to the learning process. The problem lies in the fact that the same format repeats eight times in the tutorial and starts to lose the teachers' attention and interest half way through the tutorial. For example, Melanie admitted she was not paying too much attention to the review quizzes by the end of the tutorial and skimmed through a few of them due to its repetitiveness and lack of variation:

> But by the end, it (the review quiz) was getting a little bit repetitive, and it was getting easier too, so, I kind of skimmed over them at the end…I would probably change the format on a few of them, just because it is the same thing eight or so times. It seems a little bit...by the end, it was pretty predictable…I mean, if you did it in a more challenging way, it would be more meaningful and I would reflect more. (Interview with Melanie)

Another complaint about the review quiz is that it is not challenging enough for the teachers. Katie and Melanie noticed that sometimes the description of a learning activity included the same word or phrase that defines an entrepreneurial skill, and thus revealed the correct answer too easily. Zac found that correct and wrong answers would be indicated by different colors (green and red respectively) by the system therefore he was able to test out the right answer without thinking too much. As a result, Zach suggested the tutorial should include more challenging review exercises that require more efforts of higher-order thinking:

> The first few times I did and I thought about it (the review quiz) carefully. But then, I noticed that as soon as I dragged the right word and it would turn green. Once I figured that out, then I stopped to think. So most of the attention was at the beginning… I would make the review, the self-check review, maybe a little more challenging… I like the review to force me to think a little bit when I am reviewing the content. (Interview with Zach)

Proposed Future Improvements

The teachers also proposed a few improvements to be added to the tutorial in its future revisions. Those improvements are:

- Adding a final assessment component at the end of the tutorial to help learners reflect on what they have learned;
- Including more cases that document failures or setbacks of instruction to promote discussion, debate, and reflection;
- Using the responsive web design (RWD) approach to allow optimal viewing experience of the tutorial on different devices;
- Adding personal contact to the tutorial to allow learners to seek further information and advice.

Final assessment component

In addition to the existing review quizzes, several teachers also suggested to include a final assessment component to the tutorial to have learners review the most critical content and reflect on their overall learning experience. The final assessment component is expected to be different from the review quizzes, as it should assess learners on all tutorial content based on the learning objectives and take a more open-ended format to provoke a greater degree of higher-order thinking. For example, Maria suggested a form of final assessment, which requests learners to review and analyze all 10-12 entrepreneurial skills described in the tutorial and select the top three skills they consider as the most important for their contexts and explain the reasons. Maria seemed to consider such assessment as a wrap-up reflective opportunity for learners, which does not necessarily need to be reviewed or graded by others. Another form of final assessment was proposed by Molly, who preferred to include a checklist at the end of the tutorial to have learners check which contents are useful to them:

> Let me see... mm, maybe, how about in the end, a teacher evaluation of the tutorial? Like, when you are done with the tutorial, maybe provide a checklist for teachers to select, what are the things that you will use in your classroom? Like a little check list that will say: this is useful, this is useful, and this is useful, check, check, check. Or something like, if you are going to pass this tutorial on to a peer, what are some things that you thought were useful to pass on...just to get them to think about the tutorial. (Interview with Molly)

Cases that document failures or setbacks

When asked about the possible improvements to the tutorial in the interview, several teachers believed they would benefit from studying a few cases that document the failures or setbacks of the exemplar program, so they could learn from those lessons and avoid similar mistakes in their designs of the entrepreneurship program. For example, Janet admitted the importance of following “good examples” but also acknowledged the unique value of analyzing problems, failures, and mistakes in teaching, since unexpected situations are bound to happen when working with children and learners need to be informed and prepared:

> Also, maybe adding some examples of things that didn't go so well in Curiosity Creek, you know, a few things will always go wrong if you are dealing with children, so, as a learner, I want to see how the facilitator handled those unexpected situations. This is also valuable for learners, especially those who have little teaching experience with children. (Interview with Janet).

In addition, narrative accounts of failure or setback are expected to provide learners with more opportunities of discussion, debate, and reflection. As argued by some teachers, this type of cases can prompt learners to discuss the reasons behind a failure, debate about the best method to solve a problem, and reflect upon the ways to prevent similar mistakes. For example, Debbie made the following suggestion in her interview:

> I don’t know, I feel all those examples might be too perfect in the tutorial…Not that I don’t believe those examples, it is just that, I guess it is probably better if the tutorial include one or two examples that are not so perfect, which will be a nice change during the learning to figure out what went wrong and how to fix it, instead of simply reading and reading. I personally probably will pay more attention to those examples. (Interview with Debbie)

Adaptable screen size

The size of the tutorial interface is 800 by 450 pixels, which provides good viewing experience on desktop or laptop screens whose resolutions are between 800×600 pixels and 1366×768 pixels. However, for screens that are too small or too large, the display of the tutorial content might cause problems for its learners. For example, Melanie mentioned that the tutorial interface looked really small on her large desktop screen, leaving a lot of white spaces, and suggested, “I like everything to be a little bigger, and easier to see. So I think if you just expand the box to the whole screen. That will make everything bigger.” On the contrary, Zach initially tried to study the tutorial using the browser on his iPhone but found it was very inconvenient to do so since he had to scroll frequently to be able to see all the content.

Consequently, teachers like Melanie and Zach had implied their wishes to add a feature that makes the tutorial interface “adaptable” to allow optimal viewing experience on different devices, including computers, tablets, and mobile phones. One possible technological solution to realize such function is responsive web design, which is already supported by some of the latest e-learning developing tools such as Adobe Captivate. As a result, it is desirable and also feasible to make the tutorial adaptable and responsive in the future revisions.

Personal contact information

Another component that was considered missing in the tutorial is the personal contact information. The teachers were quite interested in the exemplar program and wished to be able to learn more from the program facilitators. Some teachers had questions about the use of certain worksheets; some wanted to access a detailed lesson plan for a specific session, some were worried about the video production part and wanted more guidance and advice in this area. As a result, many teachers would prefer the tutorial to provide personal contact information such as a telephone number, an e-mail address, or a bulletin board system to have their questions answered by the program facilitators. This wish was articulated by Carrie in the following comment:

> I would wish they would also provide a contact for technical issues or any questions that teacher might have about the entrepreneurship program…So, like providing a number or e-mail in the tutorial so teachers can get in touch with someone in the Curiosity Creek and asking questions like, "I got this tutorial, I loved the things you did in your school, would you please e-mail me, or can I e-mail you if I have any questions, or something like that." (Interview with Carrie)

The concept of having a personal contact for self-directed learning is not a new one, as many commercial tutorials for high-stake exams (e.g. driver’s license or SAT practice test) would have a dedicated live representative or at least the e-mail support. However, for this specific tutorial, it is unrealistic to employ a dedicated teacher answer questions over phone or e-mail years after facilitating the exemplar program. The teacher might not have time or incentive to provide long-term peer-to-peer support, or might have changed her contact information. As a result, other forms of support such as an FAQ (frequently asked questions) section might be a more feasible alternative.

Section Summary

To sum up, only a few design features in the tutorial received negative or mixed reviews from the field test participants, suggesting an overall quite positive user experience with the tutorial. Various improvements were made to the tutorial and seem to have fixed many problematic features identified from the pilot test, such as distracting visual cues, “childish” graphics and style, confusing navigation design, insufficient learner control, and inability to download or print. In addition, the field test also identified several possible improvements to be included in the future versions of the tutorial. While it is important to examine the perceived value of various tutorial features, it is also important to investigate the actual effects, efficiency, and appeal of the tutorial design in order to determine the benefits and limitations of the case-based method as the instructional-design theory in this specific context. The empirical results of the investigation are discussed in the following section.

Preferrability of the Case-Based Method

This section seeks to answer Research Question 3: *What are the benefits and limitations of applying the case-based method to design self-directed online instruction?* Based on the formative research methodology proposed by Reigeluth and Frick (1999), this study examines the benefits and limitations of the case-based method in terms of its *preferrability* and presents empirical findings in the following three aspects of the tutorial: *effectiveness* measured by the learning outcomes, *efficiency* measured by the cost of efforts, time, and other resources, and *appeal* measured by the attitude of the learners. Consequently, three major types of qualitative data were collected and analyzed to answer this research question, including: the design plans collected from the field test, interview with the teachers, and reflection and commentary on the tutorial design process.

Effectiveness

By examining the teachers' designs of entrepreneurship programs before and after studying the tutorial, this study investigates the effects of the tutorial on teachers' learning outcomes, which is measured by the differences between the initial and final design plans drafted by the teachers. The analysis of the submitted design plans has revealed four noticeable effects of the tutorial, which are listed below:

- The tutorial's skill-based learning objectives informed the teachers to design their weekly activities focusing on specific entrepreneurial skills;
- The theme, format, and schedule of the exemplar program have been used as a template for designing other entrepreneurship programs;
- The instructional activities, techniques, and materials described in the tutorial cases were adapted and included in the final design plans;
- The case stories and examples have inspired new design ideas from the teachers.

Skill-based learning objectives

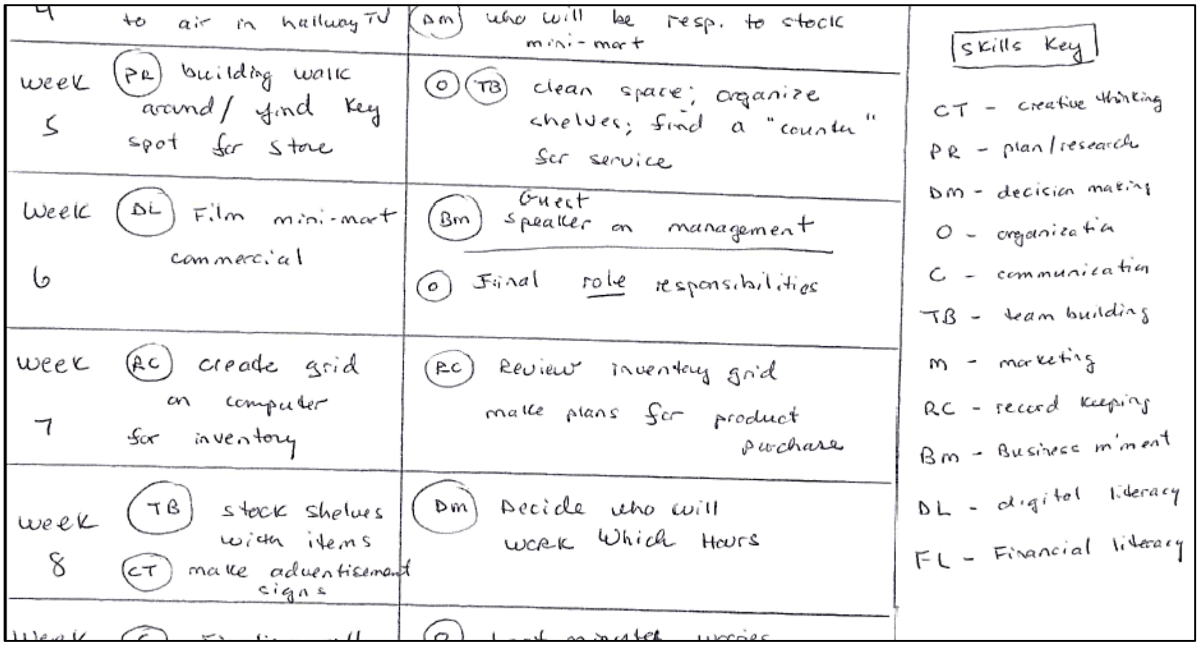
The tutorial sets its learning objectives in terms of desirable entrepreneurial skills for children and emphasizes the connection between case examples and target skills. It is apparent that such skill-based learning objectives have influenced the teachers' designs as many teachers chose to include the exact same entrepreneurial skills as the learning objectives for their programs and aligned their weekly program activities with the skills of their choice.

Take Melanie's design plans for example, the initial design was organized by different topics of entrepreneurship such as *understanding the key concepts of business* (week one), l*earning how to write a business proposal* (week 3), or *visiting local small businesses* (week 12). After studying the tutorial, she discarded her original design plan and started to organize her 12-week program based on the 11 entrepreneurial skills she learned from the tutorial. As a result, Melanie's final design plan aligns each week's activity with one or two entrepreneurial skills, as shown in Figure 4.2:

Weekly activity	skills
• Week 1: having students brainstorm ideas for innovative products	• Creative thinking
• Week 2: students form their own groups and work on the selected projects	• Teamwork, communication
• Week 3: helping students to research the project topics online, create storyboard and detailed development plans	• Management, research skills
• Week 4: hands-on learning experience with technologies (creating website, flyer print-outs, short videos…)	• Digital literacy
• Week 5: working in groups, presentation of the progress	• Communication, digital literacy

Figure 4.2. A screenshot of Melanie's final design plan

Another example can be seen in Molly's final design plan, where she took the 11 entrepreneurial skills from the tutorial and assigned a key to each skill, as shown in Figure 4.3. She then outlined her entrepreneurship program by appointing skill keys to different program activities so that the whole program keeps its focus on its learning objectives – entrepreneurial skills development. Molly's final design plan clearly resembles what she saw in the tutorial.



4	to air in hallway TV	(DM) who will be resp. to stock mini-mart
week 5	(PR) building walk around / find key spot for store	(O) (TB) clean space; organize shelves; find a "counter" for service
Week 6	(DL) Film mini-mart commercial	(BM) Guest speaker on management (O) Final role responsibilities
week 7	(RC) create grid on computer for inventory	(RC) Review inventory grid make plans for product purchase
week 8	(TB) stock shelves with items (CT) make advertisement signs	(DM) Decide who will work which hours

Skills Key

CT - creative thinking
PR - plan/research
DM - decision making
O - organization
C - communication
TB - team building
M - marketing
RC - record keeping
BM - Business m'ment
DL - digital literacy
FL - Financial literacy

Figure 4.3. A screenshot of Molly's final design plan

Program theme, format, and schedule

The analysis of the design plans shows that five teachers (Debbie, Katie, Kelly, Melanie, Zach) have revised their initial designs of entrepreneurship programs to emulate the theme, format and schedule of the exemplar program of Curiosity Creek, which seems to provide those teachers with a template for their own designs. This finding is consistent with what the teachers said in the interviews that they found the theme of Curiosity Creek appropriate for children, and format and schedule desirable to follow.

Katie's design plans provide a good example that shows how her learning experience with the tutorial has changed the theme, format, and schedule of her initial design. As shown in Figure 4.4, Katie initially designed her entrepreneurship program to focus heavily on business and cover topics such as entrepreneurship definition, business models, loans, taxes, check-writing, and business layout. The theme of her initial design was too formal for an after-school program and the weekly topics were clearly beyond the age of the target students.

However, after studying the tutorial, Katie made many revisions to her initial plan (Figure 4.4): the new program theme is no longer fixated on business topics but rather based on a children's literature book called *The Mysteries of Harris Burdick*; the format of the program sessions is more hands-on and learner-centered as students will work in groups and engage in various writing, filming, editing, and presentation activities throughout the program; the schedule of her new program is also very similar to that in Curiosity Creek: it starts with assessing existing products, to brainstorming ideas, to story writing and video production, and ends with a publishing event. It is apparent that Katie used Curiosity Creek as a template to design her own program during the field test.

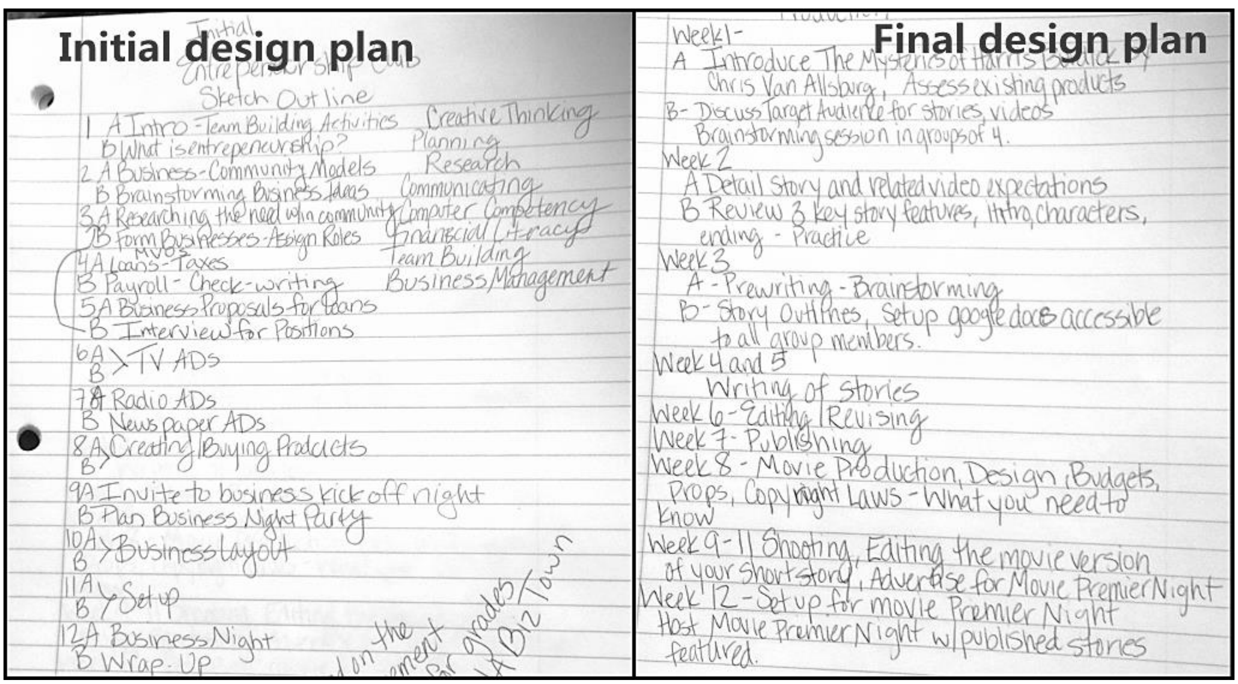


Figure 4.4. The comparison between Katie's initial and final design plans

Instructional activities, techniques, and materials

After studying the tutorial, many teachers started to add new instructional activities, techniques, and materials to their initial design ideas. Those additions were usually very similar to what was demonstrated in the tutorial cases, sometimes identical. It is evident that the teachers attempted to follow the case examples and apply what they have learned from the tutorial to their own design practices. For example, the instructional activity of *promoting final products at science fair* was quite popular among the teachers and was emulated in many design plans. Different names were used to describe such activity, including “movie premiere” (Katie), “advertising event” (Maria), “culminating event” (Debbie), “store opening” (Molly), “marketing fair” (Zach), and “advertising party” (Melanie). Like the science fair promotion case in the tutorial, all of those activities created by the teachers involve demonstrating value-embedded products to its target users in a professional, business manner. The other commonly emulated and adapted case activities include: *assessing existing products*, *brainstorming*, *video production*, and *copyright discussion*.

There are also many instances where the teachers made annotations on their initial or final design plans about using the same facilitating techniques or instructional materials as demonstrated in the tutorial cases. For example, Figure 4.5 shows part of Carrie’s initial design plan where the black texts were written before studying the tutorial and grey texts were annotations added afterwards. Besides adding new activities such as *assessing existing products*, *gathering information online*, and *copyright discussion*, Carrie also made notes about the desirable techniques to facilitate the brainstorming session, such as “quantity over quality” and “formatted and written down.” It is apparent that she learned those two techniques from the brainstorming case in the tutorial. In addition, Carrie also specified in her design that the “User Analysis Worksheet” should be used for the Week 2 activities and the “Questions &Resources Worksheet” should be used for the Week 5-6 activities. Both worksheets were included in the tutorial as part of the case examples, and can be downloaded and printed out.

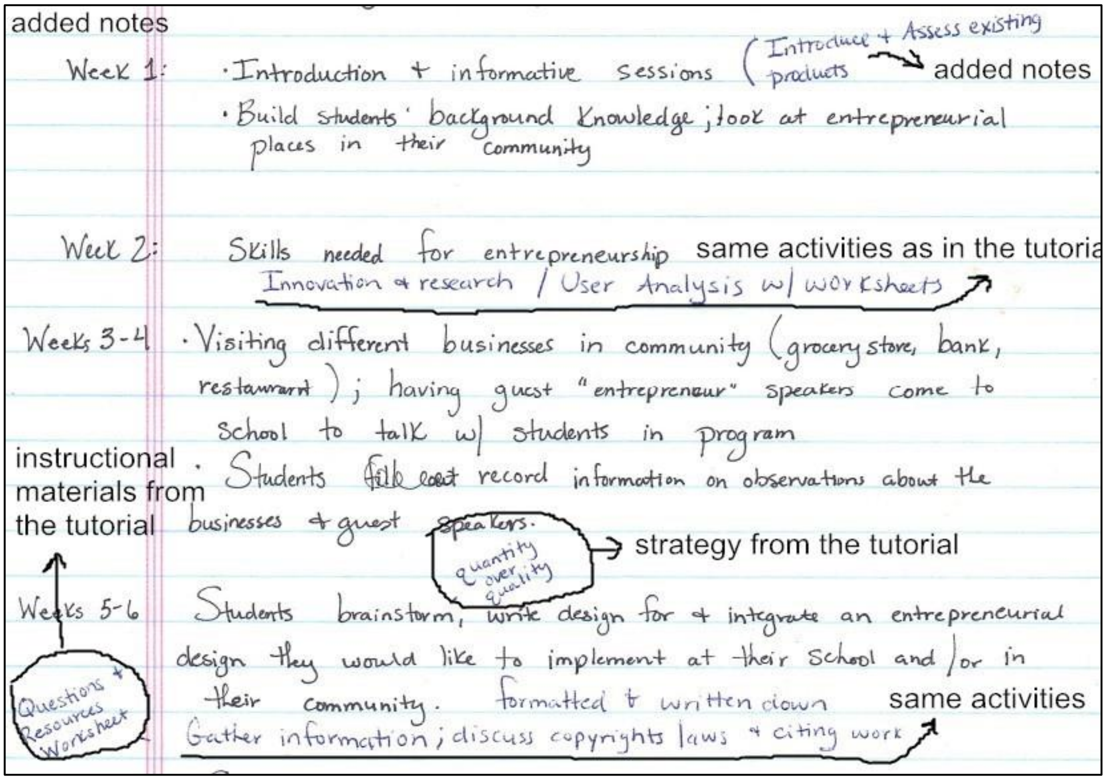


Figure 4.5. A screenshot of Carrie's initial design

Design ideas

The tutorial cases also seem to inspire ideas from the teachers about designing entrepreneurship programs, and supporting evidence can be found in both the interviews and the design plans. For example, the tutorial case of *gathering information online* prompted Melanie to add a new research component and a few content subjects to her initially designed entrepreneurship program. In her initial design, Melanie planned to have her students run a lemonade stand with the purpose of teaching them basic monetary concepts such as cost and budgets. In her final design, Melanie has integrated content subjects such as nutrition and geography in her lemonade stand project, and required students to do research in the school library or online as a result. Melanie admitted in her interview that this new design decision was informed by some of the tutorial examples:

> Even for my original idea of lemonade stand, after studying some of the examples in the tutorial, I now think I can even design it to be more meaningful and integrate some content subjects into the activity, like, doing research on nutrients in lemonade, or finding the best location and time to sell lemonade, something like that. I think, what I took from the tutorial is that, it is useful to help or guide students to plan, research and carry out the plan. (Interview with Melanie)

Another example of idea inspiration can be found in Katie's final design plan, where she explored several new design ideas, including: (1) a new theme for her entrepreneurship program based on a children's literature book, (2) a series of new activities centered on creative writing and video production, (3) a movie premiere event. Katie later admitted in her interview that those new design ideas were inspired by the theme of the exemplar program and its service-learning concept:

> Well, just the overall concept that you didn't necessarily have to specifically teach entrepreneurial skills to kids in this model. That is a big thing I learned. I guess I have never realized that train of thoughts or line of thinking...In my original thought, it needed to be like somebody actually sell something and make profits, that kind of thing. The tutorial made me understand there were other viable options we can explore, and now it makes perfect sense to me now. (Interview with Katie)

Due to the time constraint of the field test, not all newly-generated design ideas got integrated in the design plans, and some ideas did not emerge until a few days after. For example, both Kelly and Molly had passionately discussed the design idea of having students making video commercials for school events, although they did not have time to elaborate on this idea in their final design plans. Kelly pointed out the tutorial reminded her of a project in her school, and Molly praised the tutorial for getting her "creative juice" flowing since this idea struck her two days after the field test:

> Yesterday when I was walking, I just had an idea that I like to have my kids to make some religious commercials because I teach at a Catholic school, and we have a TV in our main hallway that constantly runs stuff, I like my kids to make some stuff that relate to whatever the religious season is, like advent is coming up. So that already got my creative juice flowing about what I like to do in my own classroom. (Interview with Molly)

Efficiency

The section presents the basic facts regarding the cost of efforts, time, and other resources for designing and developing the tutorial, with the purpose of evaluating how efficient it is to apply the case-based method to designing self-directed online instruction. Contrary to what Schulman (1992) suggested that cases were expensive and time-consuming to produce, the study shows that the case-based method can be a rather efficient design theory for creating online instructions if the following two conditions are met: (1) at least one designer has participated in the case events and thus has acquired plenty of rich, first-hand experience and knowledge of the cases; (2) the design team already has access to the various materials from the case events that can be easily built into the case development.

The costs of creating the tutorial, both its first and second versions, are summarized in Table 4.3. The detailed documentation of the design and development process of Tutorial 1.0 can be found in a design article published prior to this dissertation (Luo & Koszalka, 2011). As shown in Table 4.3, the total amount of time spent on developing Tutorial 1.0 was about 70 hours, and a large portion of such time (40 hours) was invested on the initial analysis and prototyping. Once the development plan was finalized, the actual developing process was quite smooth and took only about 30 hours, as all tutorial cases were based on the same template and layout as in the prototype. Since there was no need to select or write new cases, the revision of the tutorial took much less time (15 hours). Although there were several newly added or revised design features in Tutorial 2.0 (e.g. the virtual avatar, skills tags, clickable visual cues, review quizzes, menu panel), those features were easy to realize using Articulate Storyline, the new e-learning authoring tool.

The resources required for developing the tutorial were also quite basic: Tutorial 1.0 was created by two graduate students using Adobe Captivate. The only cost for development was time and software purchase. Tutorial 2.0 was revised by only one person, and the only change in resources was a different e-learning authoring tool. The most valuable resource in the development process was access to the exemplar program and its various materials such as the lesson plans, videos and images of activities, worksheets and help-aids, student projects, and the principle investigators who designed the program. Some of those materials were later selected to be built into the case development. Obtaining this access was easy since the tutorial designer was one of the facilitators who supported the exemplar program.

Table 4.3. *Cost of Efforts, Time, and Resources for Creating the Tutorial*

Phases of Design	Major Efforts	Time*	Resources
Information gathering	• Obtain and examine client's requirements • Literature review and information searching on entrepreneurship education	10 hr.	• Designer (1) • Access to library database
Initial analysis	• Needs analysis • Draft learning objectives	5 hr.	• Designer (1)
Initial prototype	• Identify key design features of the tutorial • Establish tutorial layout or template • Create a sample instructional unit using the layout/template	5 hr.	• Designer (1) Developer (1) • Storyboarding tool • E-learning authoring tool (Adobe Captivate)
Prototype revision	• Tryout the prototype in small groups • Establish CBI as the guiding design theory • Revise the outline, layout, and template • Re-create a sample unit based on the new layout/template	15 hr.	• Designer (1) Developer (1) • Access to case materials • Storyboarding tool • E-learning authoring tool (Adobe Captivate)
Final Development plan	• Research consensus with the client • Finalize the key design decisions (e.g. layout, template, content, activities, authoring tool) • Draft a detailed final development plan	5 hr.	• Designer (1) • Storyboarding tool

Phases of Design	Major Efforts	Time*	Resources
Mass development (Tutorial 1.0)	• Select and edit case stories • Create instructional content • Realize instructional functions • Assemble all instructional units into one package • Testing and troubleshooting	30 hr.	• Designer (1) Developer (1) • Access to case materials • Video production support • E-learning authoring tool (Adobe Captivate)
Tutorial revision (Tutorial 2.0)	• Transfer content to the new platform • Add new design features and graphics • Testing and troubleshooting • Finalize the tutorial and export it online	15 hr.	• Designer (1) • E-learning authoring tool (Articulate Storyline)

*Time measurement is approximate.

Appeal

As defined by Reigeluth and Frick (1999), appeal of an instructional-design theory is an "issue of how enjoyable the resulting designs are for all people associated with them" (p.635), and this issue should be independent from effectiveness and efficiency. Since the teachers are the main stakeholders of the tutorial, appeal in this study is measured by how enjoyable the teachers felt about their tutorial learning experience.

The Learning Experience Questionnaire results (as shown in Table 4.2) indicate that the teachers in general enjoyed their learning experience with the tutorial, as all of them agreed that the tutorial offered them meaningful learning experience (Question No.9, 44% agree and 56% strongly agree) and kept them engaged in the learning process (Question No.8, 33% agree and 67% strongly agree). The fact that the teachers unanimously would recommend the tutorial to their peers (Question No.22, 11% agree and 89% strongly agree) also supports the assumption that the tutorial is appealing to its target learners.

The teachers also discussed their impressions of the tutorial in their interviews, and the general impression was that the tutorial is interesting, different, engaging, and was fun to learn. For example, Maria believed it was interesting to see the exemplar program unfold in the tutorial from the very beginning and was willing to study more cases from the program. Carrie was attracted by the colorfulness of the tutorial and really enjoyed studying cases in multimedia format. Kelly was excited about the built-in interactions in the tutorial since the visual cues were "flashy and interesting" and the review quizzes provided her with "a little fun way to review materials by having to move stuff around". Some cases in the tutorial such as the "cow poo story" and the "Itty-Bitty-Kitty" video were fun to learn and even made teachers laugh during the field test. As a result, Katie summarized her feeling for the tutorial by saying, "I really like it. You told me the learning activity would be fun and I agree with you completely." Zach agreed with Katie and further claimed, "It was probably the best online tutorial I have taken."

Limitations of Self-Directed Online CBI

While the empirical evidence regarding the preferrability of the case-based method are largely positive, the study also identified a few limitations of applying this method to designing self-directed online instruction, including: longer study time, excessive imitation and replication, lack of quality feedback, and too much emphasis on a single exemplar. However, it is important to note that the discussion of online CBI limitations in this section is based on the case-based tutorial and should not be over-generalized.

Longer study time and redundancy

It is important for CBI to present rich, narrative, contextualized, or sometimes trivial details in its cases with the purpose of capturing the complexity of a teaching practice and inciting educational discussions (Barnes et al., 1994; Merseth, 1996). However, sometimes doing so results in heavier workload for the learners and a much longer study time. The average amount of time that the teachers spent on studying the tutorial is about an hour, and the time can be even longer if a teacher chooses to study all the cases, watch all the videos, and examine all the downloadable materials. One hour of undivided attention to study online materials was challenging for a few teachers, who confessed in the interview that they probably would not persevere to the end if it was not for research purposes. For example Kelly believed the tutorial was “a bit too long” for self-study and Melanie argued some cases can be further condensed in the tutorial.

Mixed finding were reported regarding the redundancy of tutorial content. It was found that the teachers who attempted to customize their learning process (e.g. Katie, Molly, Maria, Zach) did not complaint about the redundancy as they would skip those cases they already knew and focused on things that held their interests. However, for teachers who simply followed the default sequence of the tutorial, the sense of redundancy was a common complaint. For example, Janet pointed out that certain case activities such as *team formation* is common knowledge for teachers therefore there is no need to show multiple examples or worksheets for one activity. Kelly also complained that studying the tutorial felt repetitive after a while, and said, “I thought at some point it seems like I was reading the same materials…I guess there was too much of the same materials.”

Excessive imitation and replication

While it was a desirable learning outcome for learners to follow the case examples and model the best practices in CBI (Doyle, 1990; Merseth, 1996; Shulman, 1992; Sykes & Bird, 1992), it is also important not to restrain learner’s creativity and imagination with existing cases. However, the analysis of the teachers’ design plans has identified several instances where imitation and replication was prevalent while originality was lacking. For example, Kelly designed her entrepreneurship program based on the theme of movie making, which is very similar to the theme of the exemplar program. She also followed the same schedule as in the exemplar program without addressing the possible differences in her context. Some teachers also replicated certain case events and activities in their own designs with slight or no variations, despite the fact that there might be better alternatives for the same purposes. In Katie's design, for example, since her program is based on a children's book that focuses on creative writing, a more appropriate marketing and publishing event might be the actual publication of her students' collected essays, rather than the movie premiere as described in her final design. Excessive imitation and replication by teachers was not an isolated incidence, as similar themes and activities were evident in many other teachers' design plans.

Lack of quality feedback

A few design features such as the virtual avatar and review quizzes were integrated in the self-directed tutorial with the purpose of providing learners with timely and meaningful feedback without the facilitation of a real instructor. However, the effects of those design features seem to be rather limited, as lack of quality feedback and guidance was still a common complaint among the teachers. For example, Melanie wished she had a real teacher to ask questions of when studying the tutorial so that she could get further information or confirmation about certain cases, "if she was here I would ask her questions, you know, more details about what she did with her students." However, Melanie admitted it might be unrealistic to expect self-directed instruction to provide the same kind of feedback as in face-to-face classroom, as she said, "Because it is a tutorial, not a person, and I wouldn't expect the tutorial to answer me back in the same way as a person."

Too much emphasis on a single exemplar

The tutorial is based on a single exemplar program – Curiosity Creek. While the design team's in-depth knowledge and first-hand experience with the program made it easy to create rich cases, too much emphasis on a single exemplar program fails to capture the complexity of the phenomenon in different contexts and is likely to cause over-generalization from the learners. The excessive imitation of the exemplar program in a few teachers' design plans can be viewed as evidence of over-generalization: the model of Curiosity Creek was sometimes applied to a new setting without necessary modifications to address the different contextual factors such as program themes, student demography, available resources, and possible restraints. For instance, as mentioned before, teachers like Kelly and Katie all followed the model of Curiosity Creek in their designs and came up with similar entrepreneurship programs with movie making themes, but none of them discussed the potential different contextual factors in their designs and made adaptions accordingly.

When asked about the possible improvements to the next version of the tutorial, several teachers recommended the tutorial to expand its scope to include more cases from different programs so that they could make useful comparisons, learn more relevant examples, or simply keep them as future reference resources. This recommendation can be seen in the following comments:

> I know what you mean. I think I might want to see a few different examples. I like to see the detailed examples, say like, look at one in detail, but I also like to see a few other ones, maybe not in as much detail, but just to get a comparison. (Interview with Kelly)

> I think some people might look at something and say, "Oh, this is not for me and I will never use it". But if they had a variety of things to look at, they might find something that they could apply to what they do (Interview with Molly).

> Well, it certainly didn't hurt to see more examples, maybe you could add some more links to somebody else's program, but I like to see the different steps they took with the same program and to see those steps in much more detail. (Interview with Melanie)

The teachers' complaints about the absence of other program examples and their excessive imitation of tutorial cases might also indicate a misunderstanding of the tutorial goal: the tutorial was never meant to be used as merely an archive for instructional activities or techniques, but rather aims to infuse the idea that entrepreneurial skills can be presented in ways other than teaching a business 101 class, and fun activities where kids create valuable products can be used to develop those entrepreneurial or other essential skills. As a result, the introduction section might need to be revised in the future tutorial to emphasize this goal and help learners make the best of the tutorial cases.

Section Summary

Overall, the empirical findings in this section support the effectiveness of the tutorial, which had several positive impacts on the teachers' learning outcomes, as evidenced by the comparison between their initial and final design plans. The tutorial seemed to prompt the teachers design their programs based on skill-oriented objectives, provide them with a desirable program theme, format, and schedule to follow, and offer them plenty of exemplar instructional activities, techniques, and materials that are practical and readily implementable. There are also evidence of new design ideas inspired by the tutorial cases. The case-based method also proves to be an efficient way for tutorial design and development, and the overall online CBI learning experience is quite appealing to the teachers. However, despite the various benefits, the case-based method as an instructional-design theory is not without limitations for the online setting, and this section has listed a few potential problems of self-directed online CBI based on the teachers' feedback.

Summary of the Findings

Based on the field test data, this chapter presents the empirical findings regarding the case-based online tutorial, including the teachers' overall opinions of their tutorial learning experience, perceived value of various tutorial design features, and the context-specific benefits and limitations of the case-based method as the instructional-design theory.

The Learning Experience Questionnaire results show that the tutorial was well received by the teachers, who believed it has realized its instructional goals of teaching educators how to design entrepreneurship program for children, and would unanimously recommend the tutorial to other teachers. Specifically, several tutorial features have received mostly positive ratings from the teachers, including authentic and engaging case stories, the multimedia case content, embedded scaffolding features, and learner control. These findings are further supported by the in-depth interviews with the teachers, where they elaborated on why those design features were perceived as valuable and useful for their learning.

The teachers highly valued the contextualized case stories presented in the tutorial, more specifically, they liked how the cases were based on real stories and included authentic artifacts such as student projects and worksheets, infusing a sense of credibility and confidence. The teachers also appreciated the fact that the cases included plenty of contextual information and practical details, helping them evaluate the transferability and feasibility of the activities or techniques described in tutorial. Another widely recognized design decision is the built-in interactive scaffolding features such as visual cues and review quizzes, which were perceived to promote higher-order thinking such as reflection and self-assessment. It is also found that the most valued cases are those telling interesting stories that got learner's interest and kept them engaged.

The variety of content presented in the tutorial is another unique design feature valued by the teachers. Multimedia (e.g. videos, images, animations, interactive elements) is found to be a desirable format for case presentation as it provided the teachers with visual stimulation and mental breaks, accommodated different learning preferences, supported the comprehension of text-based content, presented richer contextual information and added a sense of authenticity. In addition, the background information on entrepreneurship education and the variety of downloadable resources embedded in the tutorial were also perceived as useful design features, offering the teachers prior knowledge to understand the case content and providing useful, easy-to-adapt tools for their own designs.

Although the tutorial is completely self-directed, two design features have made the teacher's self-learning process smooth and problem-free. One design feature is the outline structure of the tutorial, which organizes its case stories in a chronological order and provides the teachers with a clear, intuitive, and optimal sequence to study the case content. Another design feature is the learner control that allows the teachers to customize many aspects of their learning process (e.g. pace, sequence, content).

However, the field test also revealed a few design features that received poor or mixed reviews from the teachers. For example, the virtual avatar in the tutorial was criticized for its rather limited instructional functions and unnecessary confusion and distraction. The amount of text-based case content needs to be further reduced, and the review quizzes need more variation in its format. Moreover, many revising suggestions were proposed by the teachers to address the need for design features that were absent in the tutorial, including: a final evaluation component, more negative cases, adaptable screen size, and the inclusion of personal contact information.

The findings also support the preferrability of the case-based method as an instructional-design theory for self-directed online instruction. In addition to the various perceived benefits described by the teachers in their interviews, the document analysis also revealed several positive effects of the tutorial on teachers' learning outcomes, proving the overall effectiveness of the tutorial. Moreover, the case-based method turned out to be a rather efficient way to create the tutorial, and provided the teachers with a quite enjoyable and appealing online learning experience. However, the case-based method is not without limitations in this specific context, as a few problems associated with the tutorial design were also identified in this chapter, including longer study time and redundancy, excessive imitation and replication from the learners, lack of quality feedback, and too much emphasis on a single case.

CHAPTER 5: DISCUSSION AND CONCLUSION

Introduction

This dissertation study contributes to the CBI scholarship by formatively evaluating a design instance of CBI (i.e., the case-based online tutorial) in the online learning environment, with the purpose of validating and refining the theory of case-based method in the context of self-directed online instruction. Following the formative research methodology, this study introduces the research problem and the case-based method design theory in Chapter 1, synthesizes a set of theoretical design assumptions for self-directed online CBI in Chapter 2, describes the formative research process and pilot-test findings in Chapter 3, and presents the empirical findings from the field test in Chapter 4. In Chapter 5, the dissertation study seeks to provide answers to the four research questions, and the focus is on results interpretation and theory improvement. By comparing and analyzing the empirical evidence from two iterations of tutorial design, evaluation, and revision, this concluding chapter also reviews the validity of the 13 theoretical assumptions that guided the tutorial design (as described in Table 2.2), and consequently proposes a set of new or modified design assumptions as tentative revisions to the case-based method. In addition, the limitations of the study and recommendations for future research are also discussed in this chapter.

Subjectivity Statement

Before discussing the research findings in this study, it is important to briefly state my subjectivity first in this study since subjectivity such as personal beliefs, bias, or histories is intimately involved in the research design and finding interpretation (Peshkin, 1988).

As a social scientist, I believe truth and knowledge are contemporary, contextual, and to-a-degree, and the selection of research methods should be based on the research inquiry. As a result, I am inclined to neither positivist nor constructivist paradigm of inquiry, and would embrace both quantitative and qualitative methods for different research questions. In addition, I firmly believe findings from educational research should have practical implications to inform educational practice.

As an educator, I do not believe technology itself can improve learning, but rather it offers many affordances that help create a learning environment that allows assumptions of learning or instructional theories to be implemented. Therefore, it is more important to understand the integral relationship between technology and pedagogy in a specific context, and the best question to ask is not “does it work”, but rather “how does it work, for whom, in what context, and why.”

As the researcher of this particular study, I was involved in the design and implementation of the exemplar program – Curiosity Creek for about two years, and I was the leading designer and developer of the case-based online tutorial. I have my personal bias that many educational resources on the internet are unsatisfactory as they tend to be abstract, general, fragmented, and fail to provide important contextual information when needed, and there need to be more case-based online instructional materials like the tutorial investigated in this study.

In reflection, my subjectivity has influenced my selection of research topic (i.e., investigation of the context-specific, technology-supported instructional design theory), research methodology (i.e., formative research methodology that originates from functional-contextualism paradigm of inquiry), research goal (i.e., refined theory to inform online instructional design), and the interpretation of research findings that are described in the following sections. Therefore, it is important to keep my subjectivity statement in mind when making meaning of the research findings and discussions in this dissertation study.

Research Question 1: Answers and Discussion

Research Question 1 asks: *What design features of the case-based tutorial are valued by the learners?* Both the pilot test and the field test have reported empirical findings that support various perceived benefits of these valued design features, including: facilitating case comprehension, supporting case demonstration, assisting case navigation, promoting higher-order thinking, enhancing the appeal of learning. It is important to note that those benefits are not mutually exclusive as some design features were reported to have more than one benefits to the tutorial learning experience. The valued design features and their perceived benefits for self-directed online CBI are summarized in Table 5.1, and are further discussed in this section

Table 5.1. *Design Features in the Tutorial that are Highly Valued by the Learners*

Highly Valued Design Features	Pilot Test	Field Test	Perceived Benefits
1. Authentic stories and examples from a single exemplar program	yes	yes	• Facilitate comprehension • Enhance appeal
2. In-depth description of instructional activities and techniques	yes	yes	• Support demonstration,
3. Use of multimedia to present case stories and examples	yes	yes	• Facilitate comprehension • Support demonstration • Enhance appeal
4. Use of artifacts (e.g. student works, worksheets) in case development	yes	yes	• Support demonstration
5. Background information about entrepreneurship education	yes	yes	• Facilitate comprehension
6. Breaking down tutorial content into smaller instructional unit based on chronological sequence	yes	yes	• Assist navigation • Enhance appeal

Highly Valued Design Features	Pilot Test	Field Test	Perceived Benefits
7. Use of visual cues such as emerging captions, prompt questions and highlights (user-triggered)	n/a*	yes	• Facilitate comprehension • Promote higher-order thinking
8. Interactive review quizzes with instant feedback	n/a	yes	• Promote higher-order thinking
9. Downloadable and printable resources	n/a	yes	• Support demonstration
10. The menu panel serving as the table of content for the tutorial	n/a	yes	• Assist navigation
11. Side-by-side layout aligning text instruction with multimedia cases	yes	n/m**	• Facilitate comprehension

*n/a stands for *not available*; **n/m stands for *not mentioned*

Design Feature No.1 through No.6 were highly valued by participants from both the pilot test and field test. Design Feature No.7 through No.10 are new features in Tutorial 2.0, and thus were only available to the field test participants. However, the addition of those new design features in Tutorial 2.0 were based on the critical feedback from the pilot test. Although the case content in Tutorial 1.0 and Tutorial 2.0 both have the same side-by-side layout, this layout design (Design Feature No.11) was highly favored and frequently commented on during the pilot test, but did not incite any discussion from the field test participants.

Design Features that Facilitate Case Comprehension

As shown in Table 5.1, a total of five design features (No.1, 3, 5, 7, 11) are valued by the tutorial learners due to the perceived benefits of facilitating comprehension: the learners felt those design features enabled them to have a better understanding of the case stories and examples described in the tutorial.

Both pilot test and field test participants appreciated the fact that all cases in the tutorial are from the exemplar program of Curiosity Creek Club (Design Feature No.1). For pilot test participants who had limited elementary school teaching experience, the in-depth description of Curiosity Creek Club offered them useful contextual information such as student characteristics, typical classroom setting, and school resources, which provides a foundation for understanding the specific teaching activities or strategies introduced in the cases. In contrast, all of the field test participants were in-service K-12 teachers. While they were familiar with the elementary or middle school settings and thus relied less on the contextual information presented in Curiosity Creek Club, they preferred the tutorial's focus on one exemplar program since it provides a bigger picture that highlights the connection of different cases and enables them to have a better understanding of the purpose of a specific instructional activity or strategy. Otherwise, a single case would make less sense if taken out of the whole spectrum of events.

Consistent with the existing CBI literature (Beck et al., 2002; Choi et al., 2008; Carter, 1993; CTGV, 1990), the findings of this study also support the use of multimedia (Design Feature No.3) as a valuable design feature that captures the authenticity and complexity of case contexts, and improves the comprehension of case stories. Learning style is a frequently cited reason for better comprehension of multimedia cases, as participants from both the pilot test and the field test would often consider themselves as "visual learners," and the superiority of the audiovisual dual encoding mechanism afforded by multimedia was implied in both tests. For example, several pilot test participants felt that information came more naturally to them if delivered through images or videos, and the field test participants made similar comments, praising multimedia use for making text come alive as it "goes to the eyes and ears." In addition, it is also mutually agreed that multimedia is a better form than text to provide sufficient contextual details and trivia, which are essential for learners to conduct analysis and evaluation, and thus better understand the case problem.

Another design feature to facilitate case comprehension is to provide learners with supportive background information prior to studying the cases, and make such information easily accessible during the learning process (Design Feature No.5). Since entrepreneurship education for children is a new field for most tutorial learners, the inclusion of background knowledge such as key term definitions and entrepreneurial skill descriptions turned out to be a simple but much needed design feature for the learners. The screen recordings also indicated this was a frequently used design feature as the learners would spend time studying the background information section before proceeding to the cases, and would occasionally revisit the entrepreneurial skill descriptions during the remainder of the learning process. The learners expressed their gratitude for the opportunity to study the basics about entrepreneurship before delving into the cases, and admitted doing so help them gain a better understanding of the cases in relation to entrepreneurship education. This design feature is consistent with what Van Merriënboer proposed in his 4C-ID instructional model: Supportive information should be included as a critical component for complex learning as it connects learners' prior knowledge with their work on the learning tasks, and allows learners to "work fruitfully on non-recurrent aspects of learning tasks and to genuinely learn from those tasks". (Van Merriënboer, Clark, & De Croock, 2002, p.46)

Two other design features reported to help learners gain a better understanding of case content are the use of visual cues (Design Feature No.7) and the side-by-side case layout (Design Feature No.11). The visual cues were found to be quite effective in attracting the learners' attention to the cued content therefore can be used to highlight key information or important relationships in a case. The visual cues added a level of interactions to engage the learners in spending more time examining the cases and sometimes they allowed the learners to quickly grasp the gist of case content and understand the key concepts much faster. However, the pilot test shows that the visual cues also could be rather distracting and confusing if they popped up or disappeared unexpectedly. Therefore it was important to re-design the visual cues so that they allowed easy learner control. Their appearance and display time should be triggered by the learner.

The pilot test participants also appreciated the side-by-side layout design that sets the text-based general instruction on the right side and the multimedia-based case content on the left side. Such layout was initially designed to emphasize the connection between the abstract concepts and the concrete case examples, and was found helpful and beneficial by many pilot test participants. It was observed that that pilot test participants would divert their attention back and forth between the text instruction and the multimedia case, suggesting they were attempting to understand how the abstract concepts of entrepreneurship education were applied to the case context. It is important to note that it was the visual connection and comparison that enhanced participants' cognitive learning, therefore other layouts that emphasize the connection might accomplish the same results, and they are not necessarily side-by-side. Interestingly, field test participants did not make any comments regarding such layout design. However, the lack of comment is very likely due to the fact that the side-by-side layout was intuitive enough and came naturally to the learners. As Norman (1988) pointed out in his book *The Design of Everyday Things*, design with good usability is sometimes invisible to users as it is often naturally interpreted (Norman, 1988).

Design Features that Support Case Demonstration

An important pedagogical purpose of CBI in teacher education is to provide concrete examples that demonstrate the desirable principles, theories, or instructional techniques in order to theorize, prescribe, or model the best teaching practice (Doyle, 1990; Merseth, 1996; Sykes & Bird, 1992). Many cases in the tutorial are designed for such demonstrating purpose since it is assumed that the tutorial learners lack the knowledge and experience in entrepreneurship education therefore would benefit from studying cases showcasing the best practice. The pilot test and field test have revealed three design features that were valued by the learners for supporting case demonstration, including in-depth description of instructional activities and techniques (Design Feature No.2), use of multimedia (Design Feature No.3), and use of various artifacts (Design Feature No.4). In the field test, artifacts such as worksheets, help aids, and evaluation forms were made easily downloadable and printable (Design Feature No. 9) for learners to be used in their own settings.

While the in-depth description of exemplary activities or techniques often results in longer study time, the empirical evidence suggest that the learners prefer the tutorial cases to be more detailed rather than general. The learners appreciated the practical details included in the case descriptions as they provide tangible, sometimes step-by-step guidance on how to implement a case activity or technique. They also enjoyed learning about students' responses, reactions, or learning outcomes in those cases as such information offers useful insights on the effectiveness and potential issues of a case activity or technique. In addition, the rich description of case context also helped the learners to decide whether the exemplary activity or technique can be implemented in their own contexts or if adaptions were needed. To sum up, the learners believed that the in-depth case description is what differentiates the tutorial from other online instructional resources, providing them with sufficient practical details to apply what they learned from the tutorial to their own design and development practice.

It is not surprising that the use of multimedia and artifacts aided in the case demonstration. The superiority of multimedia for case demonstration has been proven in the literature, and the most commonly cited benefits include: higher-level of engagement (Bencze, Hewitt, & Pedretti, 2001; Friel & Carboni, 2002), increased authenticity (CTGV, 1990; Baddeley, 1990), better captured ambiguity and complexity (Beck et al., 2002; Choi et al., 2008), dual-coding cognitive mode (Mayer & Sims, 1994), and the flexibility of interpretation (Beck et al., 2002). The empirical evidence in this study also supports the superiority of multimedia cases with similar reasons: Many learners reported that they enjoyed studying the real pictures and videos from the exemplar program since they provided learners with vivid vicarious experience, useful contextual details for interpretation and application, and an enhanced sense of confidence that the same can be done in their own contexts.

The use of artifacts such as worksheets, help aids, or evaluation forms further supports the demonstration of best practices as they are a facilitating technique by themselves and are an integral part of certain instructional activities described in the tutorial cases. In the field test, such artifacts were made to be easily downloaded and printed out by the tutorial leaners, and have become valuable resources for learners to replicate the demonstrated activities or techniques in their own contexts. Student projects and products such as written stories, poetry puzzles, and final movies are another form of artifacts in the tutorial, which can be considered as evidence of students' learning outcome. The consequence and learning outcome are an important aspect of instruction since they demonstrate how students reacted to a proposed teaching practice and indicate its effectiveness or issues, therefore should be included in case demonstration when possible. In other words, when using cases to demonstrate a best teaching practice, it is desirable to also include evidence showing the proposed practice worked. Even if the teaching practice failed to work, artifacts such as student assignments or projects can also offer valuable opportunities for critical analysis and discussion.

Design Features that Assist Case Navigation

Learners in CBI are likely to suffer from problems such as information overload, misunderstanding, and confusion due to the open-ended and exploratory nature of case-based learning (Christensen & Hansen, 1987; Lee et al., 2009; Williams, 1992), and this problem can be even worse in self-directed online CBI without instructor facilitation. As a result, design features that ease the case navigation and reduce the potential confusion are essential for self-directed online CBI. Thanks to two design features (content chunking and the menu panel), this study has reported mostly positive findings regarding case navigation, as all learners agreed or strongly agreed that the tutorial allowed them to control different aspects of learning such as the sequence, content, and pace (Table 3.7 and Table 4.2), and reported no major problems navigating the tutorial content.

Chunking tutorial content into smaller instructional units based on chronological order (Design Feature No.6) is a frequently mentioned design feature that contributes to the ease of case navigation. Many learners simply followed the default learning sequence and went through cases in the order of three important phases of the exemplar program: *Innovation and Research*, *Production and Management*, *Publish and Marketing*. The learners considered such order to be intuitive, clear, and easy-to-follow, which highlights the sequential relationship among different cases and provides a desirable program format and schedule to be followed in their own designs. Chunked content also makes it easier for the learners to skim, skip, or revisit a specific part of the case, which allows for greater learner control and more customized learning experience. This finding is consistent with what CBI literature suggests: Chunking case content into smaller units (e.g. video clips, text descriptions, images) and presenting cases in a non-linear way through hyperlinking allows cases to be indexed in a more flexible way and enables learners with different learning preferences to approach CBI differently (Baker 2009; Boling, 2007; Horvath & Lehrer, 2000; Jonassen & Reeves, 1996; Lacey & Merseth, 1993).

Another design feature that assists case navigation is the menu panel that provides hyperlinks to all instructional units in the tutorial (Design Feature No.10). This is a new feature added to Tutorial 2.0 to replace the initial design of the navigation bar, since the presence of both navigation bar and navigation buttons (e.g. Next, Back) caused confusion for a few pilot test learners. Like the navigation bar, the menu panel can be used as a form of Master Control that enables learners to access any content in the tutorial at any time, but it is more precise and less distracting: The menu panel lists all instructional units in a numerical order for more accurate reference and is less distracting as it can be easily hidden. Moreover, some learners used the menu panel as the table of content, which offers them an overview of the tutorial content so that they know what to expect and can pick the interesting cases to study first. In addition, one learner explained how he used the menu panel as an indicator of his learning progress because the *studied content* and *unread content* are marked differently. As a result of all those aforementioned benefits, the menu panel can be a small but quite useful design feature in self-directed online CBI that helps learners to make better decision on how to selectively study the instructional content and navigate through its different cases.

Design Features that Promote Higher-Order Thinking

An important pedagogical purpose of CBI is to provide learners with sufficient reflective opportunities that enhance deeper learning and develop learners' higher-order thinking skills (Doyle, 1990; Merseth, 1996; Shulman, 1992; Sykes & Bird, 1992). The tutorial was designed to fulfill such pedagogical purpose. Rather than simply having learners emulate the examples from the exemplar program, the tutorial seeks to develop learners' intellectual skills for designing entrepreneurship programs for different contexts by engaging them in various of higher-order thinking activities such as analysis, interpretation, evaluation, and reflection. Positive findings were reported regarding this aspect of learning, and two design features were identified to have effectively promoted learners' higher-order thinking: the use of various visual cues (Design Feature No.7) and the inclusion of interactive review quizzes (Design Feature No.8).

The presence of visual cues sends out a clear signal that urges learners to stop and think. They added variation and stimulation to the learning process and prevented learners from skimming through the tutorial cases without critically or analytically reflecting on the key points in the case stories. The pilot test results proved the effectiveness of visual cues in attracting learners' attention, but also revealed a critical design flaw that resulted in disruption and confusion in learning. Tutorial 2.0 fixed such flaw by making all visual cues user-triggered and the feedback received from the field test became collectively positive as a result. The visual cues in the tutorial promoted learners' higher-order thinking in the following ways: directing attention to key content and contextual details for further analysis, offering additional explanations to assist the interpretation of a case story, providing prompt questions to promote reflection, highlighting connection between multimedia cases and the general instruction. Many learners agreed their tutorial learning experience would be much different without those visual cues.

The inclusion of review quizzes in the tutorial is based on the assumption that assessment should be an integral part of any effective instruction. Such assumption is supported by the generic ISD model of ADDIE (Molenda, 2003) and other widely acknowledged instructional design models or theories such as Dick and Carey model (Dick & Carey, 1990), Kemp model (Morrison, Ross, & Kemp, 2004), Smith and Ragan model (Smith & Ragan, 1999), and Gagné's Principles of Instructional Design (Gagné, Briggs, & Wager, 1992). The review quiz at the end of each tutorial unit required the learners to critically and analytically review the activities and techniques introduced in this unit and reflect upon the connection between the case stories and the tutorial's learning objectives – entrepreneurial skills development for children. Along with provoking higher-order thinking, the learners also identified a few additional benefits of the review quiz such as provision of mental breaks during the learning, reinforcement of learning objectives, and a sense of affirmation and completion. Those additional benefits are consistent with what the Assessment Reform Group (ARG) identified as principles of effective assessment design: assessment should aim to increase learner motivation, focus on learning goals, and have an emotional impact (Broadfoot et al., 2002).

Design Features that Enhance the Appeal of CBI

The appeal of instruction is especially important for the self-directed online learning context: failure to attract learners' interests is likely to result in the early termination of the learning efforts. Compared to the traditional lecture-based instruction, CBI is often perceived to be a more appealing and engaging form of instruction (Barnes et al., 1994; Shulman, 1992; Wasserman, 1994; Williams, 1992), and the literature has reported many benefits of CBI on the emotional and attitudinal aspects of learning, including stronger motivation to learn (Berg et al., 2004; Herreid, 1994), enhanced emotional involvement (Angeli, 2004; Kang & Lundeberg, 2010), and increased self-confidence (Cherubini, 2009; Lundeberg et al., 2003). The results of this study are consistent with the CBI literature, as the learners felt the tutorial offered them different online learning experience that was engaging, interesting, and highly enjoyable. More specifically, three design features were perceived to have greatly enhanced the appeal of the tutorial, including the use of authentic stories and examples (Design Feature No. 1), the use of multimedia (Design Feature No.3), and the chunking of tutorial content (No.6).

According to Christensen and Hansen (1994), cases are “a selection of reality” or “a slice of life” (p.71) and authenticity should be a desirable characteristic of an effective case. The empirical evidence in this study proves the appeal of authentic cases as the learners from both the pilot test and the field test enjoyed studying the genuine stories and examples from a real exemplar program. While the initial purpose of using authentic materials in the tutorial was to provide contextual details to capture the situational complexity of the cases, the results suggest that the added sense of authenticity also increased the credibility of the cases and made learners more interested in studying them. As one learner (Debbie) explained, she enjoyed studying the tutorial because her first impression was that “those stuff are real, they are not faked, and they actually work.” Apart from learners’ inclination to study genuine stories, authentic cases also worked as testimonies testifying the feasibility and effectiveness of a teaching practice described in the tutorial, and convinced the learners that the same can be done in similar contexts.

It is interesting to note that many learners considered themselves as visual learners and appreciated the fact plenty of visually stimulating content was included in the tutorial. In the pilot test, learners were required to study a paper-based tutorial before the online tutorial. When comparing the two types of learning experience, the learners expressed overwhelming preference for the online tutorial. The use of videos, images, and animations left learners with a first impression that the tutorial was colorful, funny, and interesting, and also made their one-hour learning experience appear less intimidating and more manageable. In the field test, new multimedia elements was added to Tutorial 2.0, such as user-triggered visual cues, “drag-and-match” review quiz, downloadable worksheets, and playable story puzzles. Those elements successfully disrupted learners’ monotonous reading mode when studying the tutorial and engaged them in more hands-on, exploratory activities, and thus making their learning process more interactive and engaging.

Another frequently mentioned design feature that made the tutorial learning process more enjoyable is the chunking of the instructional content. Learners from both the pilot test and the field test expressed their appreciation of the tutorial being broken into smaller instructional units. Going through the tutorial unit by unit provided the learners with mental breaks and a sense of achievement along the way, making the hour-long learning task less overwhelming and intimidating. In addition, smaller instructional units also made it easy for the learners to choose and pick the part they wanted to study therefore reinforced the feeling of learner control. As discussed previously, almost all learners appreciated being able to control their learning process in order to accommodate their personal needs.

Section Summary

Eleven learner-valued tutorial design features are discussed in this section, which provides a tentative answer to Research Question 1. Consistent with the existing CBI literature, this study reports positive findings regarding the use of authentic material, rich description, multimedia content, and assessment component in CBI. Furthermore, this study also revealed additional valuable design features for self-directed online CBI, including: provision of background information, inclusion of artifacts and downloadable resources, the side-by-side layout to display case content, use of visual cues as instructional scaffold, chunking of instructional content and adding a menu panel as the table of contents.

As shown in Figure 5.1, the eleven valued design features are perceived to bring five major types of benefits to the CBI learning experience (i.e. facilitate case comprehension, support case demonstration, assist case navigation, promote higher-order thinking, and enhance the appeal), and can be further synthesized into three main design principles for creating self-directed online CBI, which are: using contextualized case stories, including a variety of content, and supporting self-directed learning. Moreover, a few design features are themselves closely related, with some features benefiting the others.

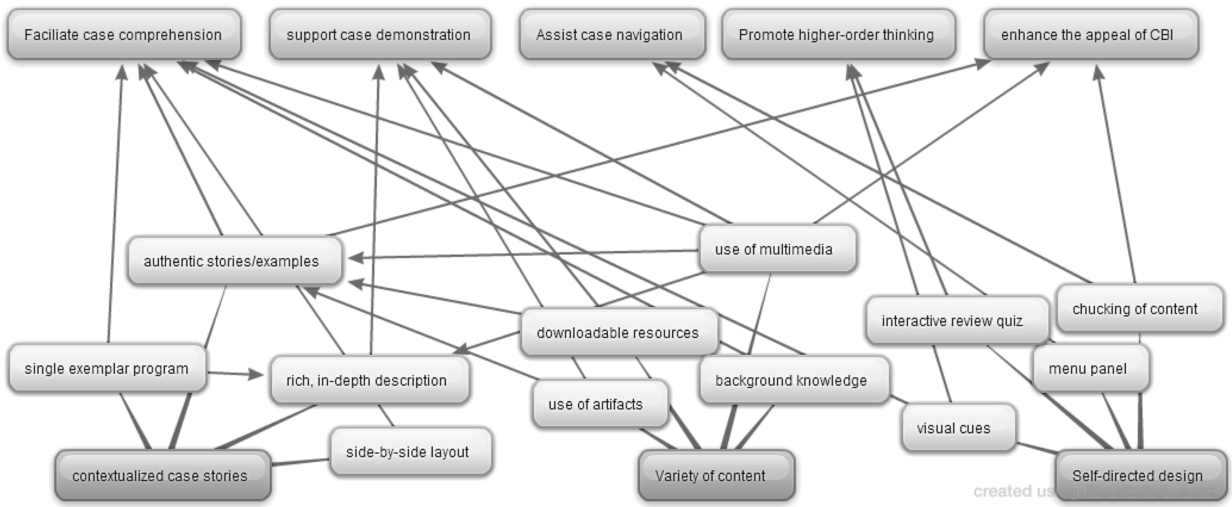


Figure 5.1. The valued design features in the tutorial and their perceived benefits for self-directed online CBI

Research Question 2: Answers and Discussion

Research Question 2 asks: *What design features of the case-based tutorial are not valued by the learners and what are the possible ways to improve them?* The pilot test has identified several design features that were perceived as problematic by the learners. While many of those problematic design features were fixed in Tutorial 2.0, a few problems persisted due to the restraints of the instructional context and technology, and call for innovative solutions in future revisions. With the purpose of answering Research Question 2, this section summarizes the problematic design features identified in both the pilot test and the field test, and explores the potential reasons behind learners' disapproval of those design features. In addition, the challenges facing the design of self-directed online CBI are also discussed in this section based on learners' evaluative feedback and the designer's reflections.

Design Features that Are Confusing

Since the tutorial is completely self-directed without the facilitation of an instructor, design features that can potentially cause confusion for self-directed learning have received poor opinions from the learners. Three main design features that caused confusion include:

- Visual cues in Tutorial 1.0 whose appearance is not user-triggered
- The dual-navigation system in Tutorial 1.0 that allows learners to use both the navigation buttons and the navigation bar.
- The virtual avatar that was introduced in Tutorial 2.0 to simulate face-to-face interaction.

While many pilot test learners acknowledged the positive effects of visual cues to attract their attention and promote higher-order thinking, they also expressed their dissatisfaction that the sudden appearance of visual cues during the learning process was distracting and sometimes confusing. Leaners tried to focus and understand a paragraph of text, and their attention would be disrupted by an emerging visual cue somewhere else on the screen. Before they decided whether or not to switch their attention to the cued content, the visual cues sometimes disappeared, leaving the learners confused and feeling like they had missed something important. The uncertainty about the timing of visual cues also made learners feel anxious and made it difficult for them to concentrate during the learning process. A solution was to make the appearance and disappearance of visual cues user-triggered, as seen in Tutorial 2.0. Learners' positive feedback from the field test suggested this modification was an effective solution.

The presence of both the navigation buttons (e.g. Next, Back, Skip) and the navigation bar also turned out to be a confusing design feature in Tutorial 1.0. The navigation bar was included in Tutorial 1.0 as a form of Master Control that allowed learners to go through the tutorial content slide by slide in case there were problems with navigation buttons (e.g., an invalid hyperlink). However, using the navigation bar did not necessarily offer learners the best learning sequence since it did not allow learners to customize their learning process by skipping or hyperlinking to additional case information. Unfortunately, some learners in the pilot test used the navigation bar as the primary navigation tool or in combination with the navigation buttons, which was problematic to studying the tutorial cases. A better alternative was implemented that included removing the navigation bar and adding a menu panel in Tutorial 2.0. This navigation option was rated high by the field test learners with many perceived benefits for navigation, as discussed in the previous section.

Another confusing design feature was the virtual avatar “Monica.” She was added to Tutorial 2.0 as a virtual facilitator to offer learners timely guidance and feedback on their learning process. This design feature aimed to simulate face-to-face interactions between instructor and learners in a self-directed online setting. However, this design failed to substantially increase the interactivity of the tutorial as the interactive options offered by the avatar were rather limited, and became repetitive after a while. Because of the limited graphic resources, the participants suggested that the avatar Monica looked like a business woman rather than a teacher in the tutorial. As a result, learners were sometimes confused about the purpose and role of Monica and found her existence rather distracting as she would pop up unexpectedly and took up too much screen space. It is still a tantalizing idea to simulate the instructor-learner interaction in an online tutorial, but a functioning virtual facilitator requires more than still images and text captions. Better graphics and interactive technologies are needed for the future improvement of this design feature.

Design Features that are Boring

As discussed earlier, it is important for self-directed online instruction to gain learners' interest early on in the tutorial and keep them engaged during the learning process as learners are more likely to give up their online learning if they find the instruction unexciting. When reviewing the feedback collected in this study, it is interesting to note that while many complaints were directed towards different aspects of the tutorial (e.g. background information, case description, and review quizzes). Those complaints shared one common underlying theme: they are directed at design features that were repetitive, redundant, and tedious, in a word, boring. While the learners in general agreed that the tutorial was fun to study and highly engaging compared to their other online learning experiences, they also pointed out a few design features in the tutorial that bored them at some point of their learning, including:

- Too much text-heavy background information at the beginning of the tutorial
- The amount of text description for some tutorial cases
- The monotonous review quiz at the end of each instructional unit

While recognizing the importance of providing basic background information on entrepreneurship education and on how to use the tutorial, many learners considered the total amount of text content used for presenting such background information to be too much, and can be quite overwhelming at the beginning of the tutorial. Some learners complained that text reading became repetitive and tiresome after a while, and some text content was actually more suitable to be presented in the format of a short video or image caption. Learning preference was a frequently cited reason for such dislike for text content, as many learners branded themselves as visual learners, and found multimedia content such as video and image to be more visually stimulating. Despite their complaints, the learners still carefully studied the text content in the tutorial and persisted to the end in order to give a more comprehensive evaluation of the tutorial.

However, the actual users of the tutorial do not have the same obligations as the research participants in this study, and might not have the same patience and perseverance to study the text content if they find it to be overwhelming. As a result, it may be desirable to convert more text content into multimedia formats, distribute text content more evenly throughout the tutorial so as not to overwhelm the learners and discourage them from continuing to study, or develop a layering of content detail in which a summary of content is presented with links to more information as required by the learner.

The review quiz is another area that can be further improved in tutorial's future revisions. Compared to Tutorial 1.0, the review quiz in Tutorial 2.0 has made some important improvements: Thanks to the template offered by the new e-learning development tool – Articulate Storyline, the review quiz takes the form of a drag and drop game and is more interactive than its previous version − the short answer question. More importantly, it can provide learners with instant feedback on whether or not they correctly responded to the questions. However, all review quizzes in Tutorial 2.0 had the same format and they started to loose learners' interest and attention after a few repetitions. The learners were unsatisfied with the amount of variation in the review quiz format and suggested that different quiz formats be incorporated and that more challenging questions be asked. Thus, future versions of the tutorial should include more interactive and engaging review quizzes. Using new programming technologies and expanding online resources like design templates or modules that provide a variety of quizzing format will make the process of incorporating these design features possible.

Design Challenges for Self-Directed Online CBI

Many problematic design features identified in Tutorial 1.0 seemed to be resolved or significantly improved in Tutorial 2.0, as indicated by the positive feedback from the field test.

However, some design problems continued to recurring in the field test. The analysis of those complaints revealed two design challenges inherent in self-directed online CBI that should continue to be addressed in future research. The two persisting design challenges are:

- Integrating decision-making and problem-solving activities in case development
- Providing timely feedback during the tutorial learning process

Many researchers have recommended CBI to include more decision-making and problem-solving exercises (Barnes et al., 1994; Choi & Lee, 2009; Doyle, 1990; Jarz, 1997; Shute & Glaser, 1990; Sykes & Bird, 1992), and suggested group discussion to be an effective approach engage learners in those higher-order thinking exercises through discussion and debate (Barrows, 1985; Christensen & Hansen, 1987; Kleinfeld, 1991). However, the autonomous nature makes it difficult to integrate the component of group discussion in self-directed online CBI, which deprives learners of the opportunities to exchange and construct knowledge through shared inquiry while online. Consequently, the exercises that practice problem-solving and decision making become hard to design without the facilitated group discussion.

While visual cues and review quizzes in the tutorial were effective in promoting certain types of higher-order thinking such as analysis, evaluation, and reflection, they were inadequate to provide opportunities that allow learners to contemplate solutions, compare their pros and cons, and decide the best solution to a case problem. Another approach is to insert different decision points in a case and requires learners to make their own decisions on how to proceed. This approach was validated by Choi and his colleagues through a series of studies (Choi et al., 2008; Choi et al., 2013; Choi & Lee, 2009). Unfortunately, more advanced technical skills (e.g. programming, video editing) and greater cost of time and efforts are often needed to execute such approach in case development.

How to provide learners with accurate and timely feedback during their tutorial learning is another problem that yet to be solved. According to the questionnaire results from the pilot test, meaningful feedback and a sense of two-way communication are the only two aspects of tutorial learning that received negative ratings from the learners (Statement No. 22 and 26 in Table 3.7). Despite the attempted revising efforts made to Tutorial 2.0, about one third of field test learners were still not convinced about the quality of feedback offered in the tutorial (Statement No. 22 in Table 4.2). The biggest improvement on feedback provision is seen in the review quiz, which now can immediately inform learners whether or not they get the answer right. However, the learners were not impressed with the addition of the virtual facilitator due to its limited interactive options to provide feedback, and complained about the lack of channels to direct their questions on tutorial cases. At the same time, the learners also seemed to be quite understanding as they agreed it was unfair to expect the self-directed online tutorial to offer the same type of feedback as seen in a face-to-face classroom.

It is important to note that the previous discussion on the two design challenges is based on the specific design instance of the tutorial in this study, where factors such as lack of resources and informal nature of learning all contributed to the problem. The context-specific discussion in this section should not be interpreted as the impossibility of integrating problem-solving and feedback-providing activities in self-directed online instruction. On the contrary, the literature has suggested many different strategies to both engage learners in decision making without communication online and to provide feedback in their self-study process. The following are a few strategies that might provide solutions to the aforementioned design challenges, and their effectiveness should be further examined in future research:

- Gamification of online learning to engage learners in problem analysis and solution exploration (Deterding, Sicart, Nacke, O'Hara & Dixon, 2011; Kapp, 2012)
- Providing decision tree exercises that highlight the criteria and consequences of learner-made decisions (Cardie, 1993; Kirkwood, 2002)
- Encouraging offline communication beyond the online learning experience by providing learners with convergent tasks, prompt questions, and directing them to appropriate offline communities (Ellison, Steinfield, & Lampe, 2007; Wang, 2010).

Section Summary

To answer Research Question 2, this section identifies and discusses the design features in the tutorial that were not valued by the learners. To summarize, not-valued design features can be divided into two major types based on learners' complaints: Confusing design features that caused misunderstanding and distraction in learners' learning process, and boring design features that include excessive text, redundant content, and unvarying repetitions. While many of the problematic design features have been modified, there are two persisting challenges facing the design of self-directed online CBI: How to effectively and efficiently engage learners in decision-making and problem-solving practice, and how to provide learners with timely feedback on their learning progress. Instructional strategies such as gamification, decision tree, and offline communication proposed by the literature might provide potential solutions to those two design challenges, but need to be further examined in future research. Based on the findings in Chapter 4 and the discussion in this chapter, Figure 5.2 summarizes the classification of not-valued design features and the revising suggestions proposed by the learners:

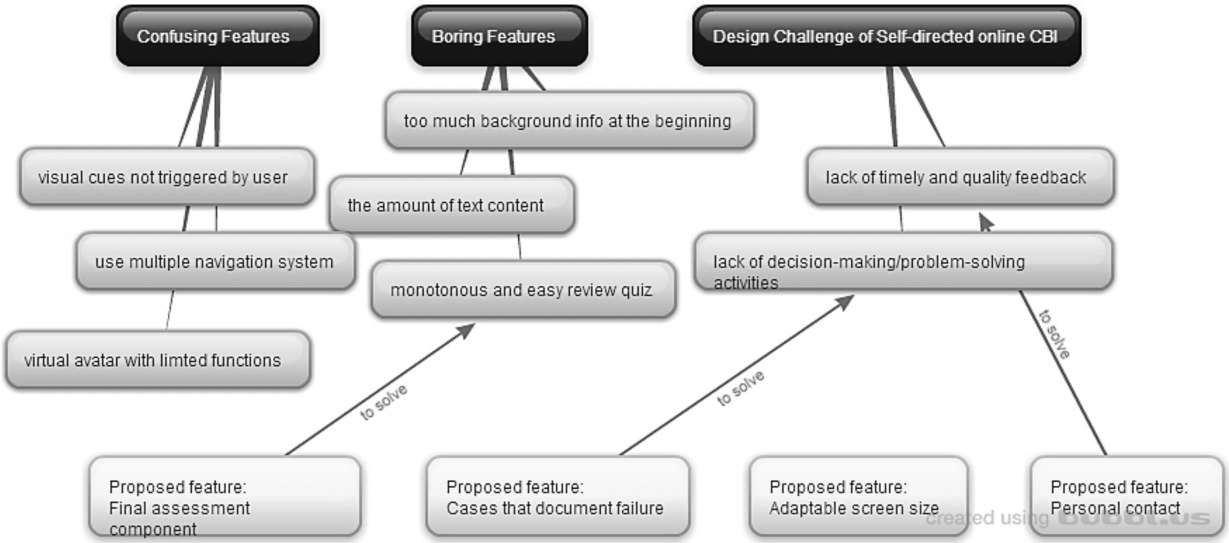


Figure 5.2. Design features that were not valued by the learners and the learner-proposed solutions

Research Question 3: Answers and Discussion

Research Question 3 asks: *What are the benefits and limitations of applying the case-based method to design self-directed online instruction?* The empirical results indicate three major types of benefits of applying the case-based method to the design of the tutorial, including: desirable learning outcomes, enjoyable learning experiences, and cost-effective design solutions. Those benefits make the case-based method a preferable instructional-design theory for creating self-directed online instruction. However, the two iterations of tutorial design and evaluation in this study also revealed a few limitations of the design theory due to the unique characteristics of CBI and the instructional context. This section discusses both the benefits and limitations of the case-based method for designing self-directed online CBI with the purpose of providing a tentative answer to Research Question 3.

Benefits of Self-Directed Online CBI

As previously discussed, demonstrating best practices and providing reflective opportunities are two important pedagogical purposes of the case-based method (Doyle, 1990; Merseth, 1996; Shulman, 1992; Sykes & Bird, 1992). Consequently, learners in CBI can benefit from two desirable learning outcomes: the emulation of exemplary practices and the exercise of higher-order thinking. The study results suggest those two desirable learning outcomes can also be achieved in the context of self-directed online instruction since evidence of learners' deliberate emulation and active reflection is found in learners' interviews and their submitted design plans.

Many learners made revisions to their design plans after studying the tutorial, and most revisions were considered as deliberate attempts to follow the case examples. As seen in both the pilot test and the field test, some learners initially designed their entrepreneurship programs to be heavily lecture-based and business-centered, but later changed their designs drastically to embrace the concepts of service learning and project-based instruction, and employ the theme, format, and schedule similar to the exemplar program described in the tutorial. The various case examples in the tutorial also provided learners with a toolbox of useful instructional activities, techniques, and materials that were easily adaptable and potentially useful for their own designs. The analysis of the final design plans identified many instances where learners actively tried to integrate those activities, techniques or materials in their own entrepreneurship programs..

With the right scaffolding features such as visual cues and review quizzes, the case-based method is also able to engage online learners in reflective actions such as analysis, interpretation, and evaluation, prompting them to use higher-order thinking skills and develop powerful design ideas. For example, many learners shared in their interviews how studying the tutorial cases prompted them to analyze the pros and cons of a case activity, compare the exemplar program with similar programs they knew, synthesize teaching principles from the case stories, and contemplate possible improvements to their own programs. Moreover, the tutorial cases also seemed to inspire design ideas, as evidenced in their final design plans. Those design ideas included: the skill-based learning objectives and program activities, the inclusion of research components, and use of different service-oriented program themes (e.g. lemonade stand, book publishing). As a result, it can be concluded that self-directed online CBI presents exemplary teaching practices for learners to study and follow and it engages learners in meaningful reflective actions that prompt development of higher-order thinking skills.

Apart from the desirable learning outcomes, the application of the case-based method in tutorial design also brings about other benefits. It makes the tutorial more appealing to the learner and makes the overall self-directed online learning experience more enjoyable. The learners enjoyed studying the authentic case stories in the tutorial and were specifically interested in seeing the consequences of implementing a case activity or technique in a real context. The use of actual photos, video clips, and genuine artifacts further enhanced the appeal of the tutorial, making it “colorful”, “fun”, and “interesting” for the tutorial learners. In addition, the learners also appreciated the interactive features such as user-triggered visual cues, drag-and-drop quizzes, and customizable navigation control as those features infused a sense of exploration and added variation and stimulation to the hour-long tutorial learning process. In fact, the enjoyable learning experience from studying interactive multimedia cases seems to be a deciding factor that distinguished this tutorial from other self-directed online instructions the learners experienced, making it “probably the best online tutorial” for some learners.

This study also showed that the case-based method can be a cost-effective solution for designing and developing online instruction if the instructional designer has first-hand knowledge of case events and has access to the materials for case development such as photos, video footage, worksheets, student assignments, or other artifacts. The total development time was 70 hours for Tutorial 1.0 and 15 additional hours for Tutorial 2.0 with a team of two graduate students. Although more complex design features such as interactive review quiz, virtual avatar, and user-triggered visual cues were added to Tutorial 2.0, the upgrade of the e-learning authoring software to Articulate Storyline greatly reduced its development time thanks to embedded graphic resources and pre-installed design templates. With the advancement of web technologies and the rapid growth of an online design community, the cost of time, effort, and resources for designing self-directed online CBI could be further reduced in the future. The enhancing of the complexity, flexibility, and responsiveness of self-directed online CBI should be possible in more efficient development processes as compared to previous efforts over the last decade.

Limitations of Self-Directed Online CBI

The case-based method is not the answer to all instructional challenges and has its own deficiencies. However, the limitations and drawbacks of CBI were rarely reported or examined in the literature. Shulman (1992) is one of the few researchers who discussed this issue, and has listed a few potential disadvantages of the case-based method: For teachers, CBI can be time-consuming and expensive to create and requires more advanced facilitating skills; it also lacks efficiency since little content may be covered for long periods of time. For learners, the episodic cases make it difficult for learners to structure and organize the instructional content, and over-generalization is a threat if too much emphasis is placed on the particularity of a single case. The findings in this study agree with some of those claimed disadvantages, and also revealed a few new limitations that might be specific to the context of self-directed online instruction.

Shulman’s concern about inefficiency of CBI was also voiced by the tutorial learners in this study, who felt the tutorial took longer time to finish than their initially expected. While it is important to include contextual details in case development, going through all those details in the tutorial would result in much longer study time and a sense of redundancy. However, removing those details is also not recommended since doing so might risk oversimplifying the cases. One possible solution is to enable more learner control in case design by providing learners with both high-level case summaries and the links to in-depth case details, allowing learners to decide how much time they want to spend on a case.

Over-generalization also turned out to be a legitimate issue in this study due to the emphasis on a single exemplar program: Many learners simply tried to replicate the case examples with little or no variations, and failed to properly address the contextual differences. As a result, excessive imitations were commonly found in learners' final design plans. However, this limitation might be greatly reduced if more scaffolding features are provided in the future design to help learners avoid such generalization. For example, the tutorial can provide a checklist asking learners to identify the unique contextual characteristics of their schools before the design activity to increase their contextual awareness, or have an introduction video warning learners against the excessive imitation that might happen, or include a few debriefing questions at end of each tutorial unit focusing on contextual differences and possible adaptation. The effectiveness of those scaffolding features should be further investigated in future research.

Some disadvantages of CBI claimed by Shulman become inapplicable in this study. For example, the cases in the tutorial were no longer episodic since all of them were from the same exemplar program and were part of the big picture. Shulman's concern about instructor facilitating skills was unwarranted in this study since the tutorial was specifically designed to be self-directed, and the design features such as visual cues and review quizzes seemed to be feasible alternatives to instructor facilitation since they were effective in engaging learners in reflective actions. While Shulman believed that cases were expensive to create, the total cost of time, efforts and resources to develop CBI actually depends on many factors. This study indicated factors such as familiarity with cases events, access to case materials, and the use of e-learning authoring tool can effectively reduce the total cost of producing online CBI.

This study also reveals two challenges of applying the case-based method to the tutorial design: the difficulty to design problem-solving or decision making exercises, and the difficulty to provide timely and quality feedback. Those challenges are largely due to the self-directed nature of the tutorial, and deserve extra attention from instructional designers. Fortunately, the literature has offered various approaches to address those design challenges: some approaches involve emerging technologies such as virtual reality to provide more intelligent and sophisticated human-computer interactions, while the other approaches might simply require a little creativity to integrate old teaching strategies into the online setting. For example, many types of student-instructor and student-student interactivity can be achieved through offline communication (Ellison, Steinfield, & Lampe, 2007; Wang, 2010) or programmed instruction enabled by hyperlinks in webpages (Cairncross & Mannion, 2001; Saye & Brush,2001) or even PowerPoint slides (De Wet, 2006).

Section Summary

This section discusses the benefits and limitations of applying the case-based method to the design of the online tutorial. The study results suggest that the benefits far outweigh the limitations, and thus supports the preferrability of the case-based method as an instructional-design theory. The following is a summary of the key benefits and limitations of applying the case-based method to design self-directed online instruction:

Benefits:

- It provides an effective way to showcase exemplary teaching practices and capture their authenticity, complexity, and practical details, making it easier for learners to apply what they have learned from the case examples in their own contexts.
- It engages learners in meaningful reflective actions during their case learning process to develop their higher-order thinking skills such as analysis, interpretation, comparison, synthesis, and evaluation.
- It makes the online learning experience more appealing, interesting and enjoyable, attracting learners' interest early on and keeping them engaged throughout the learning process.
- It can be a potentially efficient design solution if the design team have in-depth knowledge about the case events and have access to the case development material.

Limitations:

- The in-depth description of cases requires more time and efforts to study and sometimes can result in redundancy and information overload.
- Learners might over-generalize the applicability and transferability of case examples and try to replicate them in other settings without properly addressing the contextual differences.
- It is usually difficult to conduct group discussion in self-directed online CBI, posing challenges for designing related instructional activities that heavily rely on discussion.
- It is a challenge to provide learners with timely and quality feedback during their online learning session.

Research Question 4: Answers and Discussion

Research Question 4 asks: *What possible improvements could be made to the case-based method in the context of self-directed online instruction?* Based on the literature review, this study has proposed 13 theoretical assumptions for designing self-directed online CBI in Chapter

Two (Table 2.2), which informed the two iterations of the tutorial design, evaluation, and revisions. The empirical evidence from the two iterations has revealed important information regarding the effects, feasibility, and potential issues of those theoretical assumptions, which in turn can extend our understanding of CBI in the context of self-directed online instruction, and help identify possible improvements to the case-based method in this new context.

Validity of the Proposed Design Assumptions for Self-Directed Online CBI

Based on the empirical results, this study is able to provide context-specific discussions regarding the validity of the proposed design assumptions for self-directed online CBI. The discussions for individual design assumptions are elaborated in below:

Assumption No.1.1: Case materials can be collected from various authentic sources and in different formats. This design assumption is supported by the study results. Learners generally prefer to study real stories, and take great interest in studying photos, video footage, student works, and instructional materials from real teaching practice. The contextual details in authentic case materials are also found to enhance the credibility of case stories and facilitate case comprehension. In order to follow this assumption in design, instructional designers need to have in-depth knowledge of and free access to the sources of cases.

Assumption No. 1.2: Case content should include narrative accounts of typical problematic situations that can be interpreted, analyzed and solved from different perspectives. Without instructor facilitation and group discussion in self-directed online CBI, learners are more likely to emulate case examples in their own practices rather than analyze or interpret those examples from different perspectives. The tendency to emulate cases can be useful for CBI whose primary purpose is to exemplify best teaching practice. However, for cases to engage learners in critical and analytical thinking, scaffolding is needed to prompt them in deconstructing the case and using its key teaching points to support their own practices.

Assumption 1.3: Case content should include adequate contextual information and details about the case problem or scenario. This design assumption is supported in this study. Contextualized case stories are highly valued by the learners as they capture the complexity of real-world problems and provide practical details on how to implement activities or techniques in new settings. The contextual details also allow learners to determine the transferability of case examples when they compare the similarities between the case context and their own context. Multimedia resources in the case help to achieve this design assumption, as images and videos are both effective means to present contextual details.

Assumption 1.4: Case design should be determined by its instructional purpose. Different purposes place emphasis on different types of instructional activities. The case design in the tutorial exemplifies this design assumption. Since the main purpose of the tutorial is to demonstrate a best teaching practice, the case development focuses on depicting case stories and contextual details, showcasing facilitator activities and students' reactions, issues within the practices, and providing examples of ready-to-use instructional materials. While problem-solving and decision-making exercises might not be the focus of design for this particular tutorial, they deserve more attention when creating CBI that aims for critical thinking and analytical skill development.

Assumption 1.5: Online cases should articulate the purpose of CBI and emphasize the connection between case events and prior instructional sessions. Links to supplementary information should also be included to facilitate the comprehension and analysis of the cases.

This assumption has resulted in two design features that were perceived as valuable by the tutorial learners: the skill-based learning objectives and the background information section. The articulated skill-based learning objectives constantly reminded learners of the purpose of CBI, and provided the basis for self-assessment. The background information on entrepreneurship education provided necessary prior knowledge and/or just-in-time information to help learners better understand cases in unfamiliar fields. The positive feedback on those two design features support the validity of this theoretical assumption.

Assumption 1.6: The design of online CBI cases should emphasize adaptivity, interactivity and flexibility, offering sufficient learner control for learners to customize their own learning sequence and access instructional contents in their preferable formats. Without instructor facilitation, well-designed learner control became highly important to the self-directed nature of this online CBI. The following are a few design features that were perceived to afford learner control: hyperlinked cases in chronological order, a menu panel with links to all cases, user-triggered visual cues, and the option to skip case examples. It is recommended to include some of those design features in online CBI design to provide learners with flexible, interactive, and customizable learning experience.

Assumption 1.7: Online cases should provide explicit instruction and clear visual/verbal cues on how to navigate and study the self-directed online CBI. This study suggested that the flexible and exploratory nature of self-directed online CBI can be overwhelming for some learners at the beginning. Explicit instruction on how to approach this type of instruction proved to be a useful feature in helping learners navigate this instruction.

Assumption 2.1: Critical decision points and a variety of scaffolding features should be included in online cases to guide learners to practice decision making and problem solving. Ideally, critical decision points can be a useful design feature to engage learners in decision making and problem-solving practice. However, it also requires advanced technical skills to build interactive and responsive decision points in cases and thus can increase the total cost of case development. Prompt question was an alternative used in the tutorial, but there was little empirical evidence collected that describes the effects of these prompting questions on promoting problem-solving skills. This is an area for further study.

Assumption 2.2: Online cases should present multiple perspectives regarding certain decisions made in the case events. Whether or not multiple perspectives should be included in case development depends on the purpose of the CBI. For the purpose of showcasing a best practice in a specific context, too much emphasis on multiple perspectives without proper guidance and feedback may cause confusion and indecisiveness in regards to the optimal teaching practice, thus defeats the purpose of this type of CBI. In other words, this design assumption might not be applicable for all online CBI.

Assumption 2.3: Timely feedback and expert commentary should be provided in online cases to have learners compare, evaluate, and reflect on their proposed decisions or solutions for the case problems. Providing timely and quality feedback in self-directed online CBI is a design challenge that was not well addressed in this study. While automated grading technologies like the review quiz in Tutorial 2.0 enable learners to get instant feedback regarding their submitted answers, learners were often limited to the design of selected response assessment. Novel solutions are needed to design feedback that can guide learners' learning process or answer additional inquires about the cases.

Assumption 3.1: Self-directed online CBI should establish a learning environment that is fun, relaxing and tolerating, which supports the diversity of viewpoints and beliefs. This assumption seems to have been successfully followed in this study since the overall learning experience with the tutorial was perceived to be fun, engaging, and highly enjoyable. The use of authentic stories, genuine materials, multimedia content, and interactive elements contribute to the fun factor, while the open-ended questions, game-like quizzes, reduced text content, and conversational tone help make the tutorial learning experience more relaxing and informal.

Assumption 3.2: Pre-specified questions that induce and guide discussions should be phrased and sequenced carefully so that they are non-leading, open-ended, engaging, and relevant. Although the option of group discussion is not always applicable for self-directed online CBI, this tutorial included pre-specified prompt questions that ask learners how they would facilitate a session using a technique or identify evidence of learning in students' reaction, with the purpose of facilitating "internal discussion" to engage learners in mentally playing with ideas as they apply to their own context. These types of prompts can promote deep learning and enhanced practices.

Assumption 3.3: Self-directed online CBI should allow learners to submit and share their responses to the discussion questions. This design assumption was not tested in this tutorial. However, data suggested that the learners expressed wishes to reach out to other tutorial learners or even the exemplar program facilitator to discuss and share ideas. Providing social interaction spaces (e.g., online learning community) for sharing ideas, discussion, and exchanges could expand the range of support mechanisms for self-directed CBI learners and meet their social learning needs without having to convert self-directed to facilitator-directed instruction.

Possible Improvements to the Case-Based Method

Design and presentation assumptions

Design Assumption 1.1 to 1.7 are for designing and presenting cases in self-directed online CBI. As discussed, most of these design assumptions are supported by empirical evidence from this study. The only design assumption that was not fully supported was Assumption 1.2: *Case content should include narrative accounts of typical problematic situations that can be interpreted, analyzed and solved from different perspectives*. Introducing problems to be analyzed and solved from different perspectives may be one way to develop and present cases in CBI, but this is not the only way or the superior way. The types of activities in which learners are engaged when studying cases should be determined by the purpose of CBI. When the purpose is to demonstrate best teaching practices, the case development should focus on guiding learners to gain a deeper understanding of the case examples, and providing sufficient practical details and supplementary resources for learners to follow the examples in their own contexts. When the purpose is to develop learners' critical and analytical thinking skills, the case development should include activities where the is exploration of multiple perspectives, prompts and activities that have a higher-degree of uncertainty, and a sufficient number of decision making and problem-solving exercises. Thus, the purpose of the CBI should guide the development of the case information and the ways in which the learners is engaged with the case.

Based on the learner feedback, this study suggests two additional design assumptions for case development and presentation in self-directed online CBI. The first added assumption (Assumption 1.8) would be to divide one big case example into smaller cases and organize them in a logical order for presentation. Chunking instructional content into smaller units reduces the overwhelming feeling of self-directed learning, making the learning process seem more manageable, and providing mental breaks along the way. Guiding learners to go through the cases in CBI via a desirable logical order, be it chronological, spatial, or causal, also enables learners to see the connection between those cases and thus gain a better understanding of the case problem. This finding is supported by the cognitive load theory, as chunking and meaningful organization of instructional content were found to effectively reduce cognitive overload, enhance information storage and retrieval, and develop expertise thinking (Chase & Simon, 1973; Miller, 1956; Sweller, 1994).

The second added assumption (Assumption 1.9) would be to present multimedia cases in a layout that aligns multimedia content such as images and videos with instruction and commentary in text format in order to emphasize the connection of the two types of content. The side-by-side layout used in the tutorial provides a good layout template, as it is intuitive to most tutorial learners and seems to bring additional benefits to their learning. The presence of multimedia content enhanced the appeal of the case and attracted learner interest early in the tutorial. The brief introductory text instruction highlighted the key points in a case and allowed learners to understand key points without having to delve into multimedia content for contextual details. However, as seen in this study, learners were more likely to study both types of content and try to understand how abstract concepts and principles are applied in case examples. Such learning patterns were expected to facilitate the comprehension of cases and develop learners' analytical thinking skills since learners were constantly testing theories in realistic problems and applying principles to practice (Christensen & Hansen, 1987; Merseth, 1996; Shulman, 1992).

Reflection assumptions

Design Assumption 2.1 to 2.3 focus on providing reflective opportunities in self-directed online CBI. In order to do so, Assumption 2.1 and 2.2 suggest to include critical decision points and multiple perspectives in case development respectively to engage learners in decision-making and problem-solving exercises. Nonetheless, for CBIs that seek to demonstrate best teaching practices, those two design features might not be the most cost-effective options. As shown in this study, embedded visual cues with emerging captions, highlights, or prompt questions and end-of-case review quizzes provoked adequate reflective actions such as analysis, evaluation, comparison, or synthesis from learners, therefore should be considered as useful scaffolding features. Assumption 2.3 highlights the importance of offering feedback in self-directed online CBI. While this assumption stands true, it needs to be more specific about the possible design solutions. According to the study results, automated grading seems to be a feasible and cost-effective approach to provide immediate feedback in self-assessment, and was included in the assumption statement as a recommended design solution.

Social assumptions

Design Assumption 3.1 to 3.3 are for facilitating group discussion in CBI. Since group discussion was not applicable for this particular design instance investigated in the study and yielded no substantial empirical results, this study hereby suggests removing them from the proposed design framework. The validity of those design assumptions on group discussion need to be further investigated in future research. However, this study seems to support the principle implied in Assumption 3.1 on creating a fun, relaxing and tolerating online learning environment, and this principle can be rewritten as a design assumption for case design and presentation (Assumption 1.10) that focuses on enhancing the appeal of online CBI. Assumption 1.10 might read: *To enhance the appeal of CBI, it is recommended to include more authentic stories, genuine materials, multimedia content, and interactive elements while avoid using excessive text and repetitive design features*.

Summary of design assumption revision

To summarize, a total of 10 revisions are suggested to the existing design assumptions for self-directed online CBI. Adaptations are suggested to three design assumptions (Assumption 1.2, 2.1, 2.3). It is suggested that four design assumptions (Assumption 2.2, 3.1, 3.2, 3.3) be removed. Finally, it is suggested that three design assumptions (Assumption 1.8, 1.9, 1.10) be added. Those revisions were based on the empirical evidence collected from both the pilot test and the field test. Combining them with the validated design assumptions, this study proposes to refine the case-based method for the context of self-directed online instruction. The refined CBI design assumptions are presented in the following section

Refined Case-Based Method

According to Reigeluth and Frick (1999), an important outcome of formative research is an improved instructional-design theory for a particular instructional context. Synthesizing the answers to Research Question 4, this section proposes a refined case-based method for the context of self-directed online instruction, which is consisted of 12 design assumptions. Since providing reflective opportunities is part of case design and presentation, and facilitating group discussion is inapplicable for most self-directed online CBI, the design assumptions in the refined case-based method are renumbered numerically from 1 to 12, removing the categories of *provide reflective opportunities* and *facilitate group discussion*. The 12 design assumptions are listed in the following table (Table 5.2).

Table 5.2. *Refined Assumptions for Designing Self-Directed Online CBI with their Origins and Supporting Evidence*

Refined Design Assumptions	Origin	Supporting Evidence
1. Case materials can be collected from various authentic sources and in different formats.	validated Assumption 1.1	survey results, design

Refined Design Assumptions	Origin	Supporting Evidence
		documents, interviews
2. Case content should include sufficient practical details and ready-to-use resources to assist learners in following the case examples in their own contexts.	revised Assumption 1.2	survey results, interviews, design plans
3. Case content should include adequate contextual information and details about the case problem or scenario.	validated Assumption 1.3	survey results, interviews
4. Case design should be determined by its instructional purpose. Cases seeking to demonstrate best practices and develop problem-solving skills should place emphasis on different types of instructional activities.	validated Assumption 1.4	design documents, design plans
5. Online cases should articulate the purpose of CBI and emphasize the connection between cases and prior instructional sessions. Links to supplementary information should also be included to facilitate case comprehension and analysis.	validated Assumption 1.5	interviews
6. Case design should provide sufficient learner control that allows learners to easily customize their learning sequence, access specific instructional content, and engage with interactive elements.	validated Assumption 1.6	survey results, interviews, screen recordings
7. Online cases should provide explicit instruction on how to navigate and study the self-directed online CBI.	validated Assumption 1.7	interviews
8. It is recommended to divide one big case example into smaller cases and organize them in a logical order for presentation.	newly added Assumption 1.8	interviews
9. One desirable way to present multimedia cases is to use the side-by-side layout that aligns concrete examples in multimedia format with general instruction and commentary in text format.	newly added Assumption 1.9	interviews, screen recordings
10. To enhance the appeal of CBI, it is recommended to include more authentic stories, genuine materials, multimedia content, and interactive elements while avoid using excessive text and repetitive design features.	newly added Assumption 1.10	survey results, interviews
11. A variety of scaffolding features should be included in online cases to promote higher-order thinking. For CBIs seeking to showcase the best teaching practice, visual cues and review quiz are two effective ways to provoke reflective actions.	revised Assumption 2.1	survey results, interviews

Refined Design Assumptions	Origin	Supporting Evidence
12. It is important to provide learners with timely and quality feedback in self-directed online CBI. Automated grading technologies provide a possible design solution for feedback provision.	revised Assumption 2.3	survey results, interviews

Section Summary

To answer Research Question 4, this section first examines the validity of the 13 existing design assumptions proposed in Chapter 2 with the purpose of identifying areas for further improvements. Most assumptions for case design and presentation prove to be true in this study. However, the empirical results also suggest the necessity to refine the design assumptions for facilitating reflection and group discussion in self-directed online CBI. As a result, this section has identified a total of 10 revisions that should be made to the initially proposed case-based method. Based on the validated design assumptions and the proposed revisions, this section concludes with a refined case-based method specifically for the context of self-directed online instruction.

Limitations of Study

The research design in this dissertation study is based on the formative research methodology proposed by Reigeluth and Frick (1999). The five phases in this study highlight the underlying logic of formative research that successively improves the theory through the iterative examination of its design instance. However, it is not always easy to follow such logic in research practice, and this study has revealed a few potential challenges. First, it is not always easy to determine if the design instance is exclusively based on a specific design theory, as many theories overlap and share similar design assumptions. Second, there is a lack of research instruments (e.g., questionnaires, interview protocols, and coding schemes) that are easily adaptable to guide the data collection and analysis activities. Lastly, some interesting findings might emerge from the data analysis that are not directly related to the design theory, therefore justifying what to report in formative research can be a challenge.

In general, the research design in this study has generated useful empirical findings that are expected to answer the research questions and inform the evaluation and improvement of the case-based method in the context of self-directed online instruction. However, there are also a few limitation to this study.

The first limitation is the limited transferability of the research findings due to the uniqueness of the design instance investigated in this study. While the tutorial was designed and developed based on the assumptions of the case-based method, it has some unique characteristics that differ the tutorial from other traditional CBI. The tutorial focuses on showcasing best teaching practices rather than developing learner problem-solving or professional skills. The context is informal, e.g., non-degree based, and the tutorial's content topic falls out of traditional academic subjects. Therefore, some research findings are exclusive to the tutorial context and might risk over-generalization. In addition, the research findings might also be gender/race-biased since the participants in this study are predominantly white females, and the perspectives from male learners and minority groups are limited. As a result, a caveat is offered when interpreting the research findings, Additional replications studies should be conducted with different audiences and design instances using this self-directed online CBI approach.

The second limitation is that the participants were not given enough time to absorb and process what they have learned from the online tutorial before proceeding to design their own entrepreneurial programs. While studying the online tutorial was a one-time learning experience, it is possible that participants would keep reflecting on the cases and eventually come up with design ideas days or even months after. In this case, the evidence of learning from the case would not have been fully reflected in the design plans. Also, limiting the field test to 2 hours might have applied pressure to participants to take the easy route in their own design practice. For example, a number of participants confessed that they developed new design ideas after studying the tutorial but had not articulated them in their work because they feared not completing the design plan requirement in time.

The third limitation was that field test participants were not prepared in advance to both learn from the tutorial and be prepared to critique the tutorial design and their learning experiences. Reigeluth and Frick (1999) point out that learners tend to blame the learning problems on themselves rather than on the instructional design instance, and are often reluctant to criticize the design instance in the presence of its designer or developer. Therefore, it is advisable for researchers to establish rapport with the participants before data collection and prepare the participants to be more open to share their reactions. Unfortunately, the participants in this study were busy in-service teachers who did not have time for advanced preparation before the field test. The fact that the participants came from different schools also made it more difficult for the researcher to establish rapport with them at different sites.

The fourth limitation is that a participant's interaction and learning pattern with the online tutorial could not be fully captured using only the screen recording software. While the screen recording did capture mouse movements, clicks, and keyboard input, it was not able to accurately indicate how the learner diverted his/her attention during the learning process. For example, a learner might be still reading the text content after clicking open a video clip, therefore the screen recoding of a video clip playing does not mean the learner is watching it. To solve this problem, it may be advisable for the researcher to use think aloud approaches prompting learners to verbally describe what they are doing during the study. However, think aloud approaches also have limitations that may cause distractions to the natural online learning experience. Another approach may be to have learners wear eye tracking devices during the learning process so that the data of their eye movement, fixation time, and fixation counts can be collected. Unfortunately, the eye tracking technology was not available to be used by the researcher at the time of the study.

The limited resources available for developing the tutorial was another possible limitation in this study. The resources did not have the capabilities to easily follow all of the CBI design assumptions in depth during the tutorial design process. Therefore, not all design assumption could be fully evaluated. For example, design assumptions regarding the use of multiple perspectives, critical decision points, and problem-solving exercises are not emphasized in the tutorial, therefore are not able to be full empirically validated in this study. For design features that are not valued by the learners, the poor usability due to the restraints of time, resources, or technology might be the reason behind learners' disapproval of some features rather than the underlying CBI design assumptions. For example, the virtual avatar in Tutorial 2 was a perceived weakness, however, with more advanced software the learners might have liked (valued) the design concept of a virtual facilitator. As it was, their negative feedback on this design feature seemed to be largely due to its limited functions and lack of interactivity. In other words, the claims of problematic CBI design features might be unwarranted due to factors unrelated with the case-based method.

The aforementioned limitations are largely due to time and resources allocated to conducting this dissertation research, and they are not expected to have major impact on the credibility and trustworthiness of the overall research findings. The integrity of the study is strong and the data have provided powerful insights into the problems being studied. Nonetheless, these limitations still need to be addressed to allow research findings to be properly interpreted and understood. They also suggest a need for further research

Recommendation for Future Research

This dissertation study was conducted in a naturalistic setting without manipulation and control of variables, therefore the research findings on the case-based method are context-specific and influenced by the contextual characteristics of the design instance – the case-based online tutorial. However, formative research also seeks to produce generalizable design knowledge that is informative and transferrable beyond the particularity of a single design case. As a result, it is recommended to conduct additional formative research studies to investigate different design instances of self-directed online CBI. The replication studies can further enhance the credibility of the proposed CBI design assumptions, and the variation of contextual characteristics in those studies can help filter out findings irrelevant to the instructional-design theory. By conducting additional formative research, the refined case-based method can be expanded to accommodate different situationalities and provide more appropriate and specific design assumptions for them.

For research purposes, the design instance of self-directed online CBI in future research should be more comprehensive, embracing different pedagogical purposes, integrating various CBI design features, and applying novel design concepts and technologies. As a result, future research will be able to investigate more aspects of the case-based method and empirically validate more design assumptions. For example, the future CBI design instance could include cases that seek to develop learners' problem-solving skills and employ design richer features such as multiple perspectives, critical decision points, and interactive simulations, which are not empirically validated in this study.

It is also recommended to expand the field test length to 3 or 4 hours in future research and collect learners' feedback for a second time a few weeks after the field test. By providing adequate time for learners to reflect on their CBI learning experiences and apply learnt knowledge to practice, the future research can collect more meaningful data regarding learning outcomes and measure the effects of the case-based method more accurately. However, doing so would also place higher demand of time and efforts on learners therefore increases the difficulty of recruiting willing participants.

The field test learners have proposed a few new design features to be added to the future versions of the tutorial, including a more summative assessment component, more cases that describe the difficulties in practice and implementation, and responsive web design (ability to view in different technologies). However, the effects of those design features in self-directed online CBI are still unknown and need to be further investigated in the future. The future research can examine the same tutorial with an additional iteration of revision and evaluation, or it can investigate new design instances of online CBI with those proposed design features intentionally built-in.

In addition, if a third iteration of tutorial design, evaluation, and revision is to be conducted in future research, it might be worthwhile to employ objective measures (e.g., pre- and post- test, experiment design) to evaluate the actual effectiveness of the tutorial and the case-based method on teaching and learning rather than using only the perceived effectiveness self-reported by the participants. As suggested by Reigeluth and Frick (1999), doing so would further enhance the credibility of the research findings by infusing a sense of the general acceptability of the research outcomes.

Conclusion

This dissertation study employed formative research methodology to validate and improve the instructional-design theory of case-based method for the context of self-directed online instruction. Based on the literature review results, this study defines the case-based method by proposing 13 theoretical assumptions for designing self-directed online CBI, which guided the design and development of the design instance in this study – the case-based tutorial. Based on the empirical data collected from two iterative cycles of tutorial evaluation and revision, this study has identified many CBI design features that are valued by the online learners, and also a few problematic design features that need to be fixed in the future. Following Reigeluth and Frick's (1999) suggestion, this study also investigates the preferrability of the proposed case-based method by empirically examining its effects, efficiency, and appeal as an instructional-design theory. Informed by research findings, this study attempts to validate and improve the previously proposed case-based method, and has identified 12 empirically validated design assumptions for creating self-directed online CBI.

APPENDICES

Appendix A: IRB Approval Letter for the Dissertation Study

SYRACUSE UNIVERSITY
Institutional Review Board
MEMORANDUM

TO: Tiffany Koszalka
DATE: September 10, 2013
SUBJECT: **Determination of Exemption from Regulations**
IRB #: 13-257
TITLE: *Applying the Case-Based Method in Designing Self-Directed Online Instruction*

The above referenced application, submitted for consideration as exempt from federal regulations as defined in 45 C.F.R. 46, has been evaluated by the Institutional Review Board (IRB) for the following:

1. determination that it falls within the one or more of the five exempt categories allowed by the organization;
2. determination that the research meets the organization's ethical standards.

It has been determined by the IRB this protocol qualifies for exemption and has been assigned to categories 1 & 2. This authorization will remain active for a period of five years from **September 10, 2013** until **September 9, 2018**.

CHANGES TO PROTOCOL: Proposed changes to this protocol during the period for which IRB authorization has already been given, cannot be initiated without additional IRB review. If there is a change in your research, you should notify the IRB immediately to determine whether your research protocol continues to qualify for exemption or if submission of an expedited or full board IRB protocol is required. Information about the University's human participants protection program can be found at: http://orip.syr.edu/human-research/human-research-irb.html Protocol changes are requested on an amendment application available on the IRB web site; please reference your IRB number and attach any documents that are being amended.

STUDY COMPLETION: The completion of a study must be reported to the IRB within 14 days.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Tracy J. Cromp

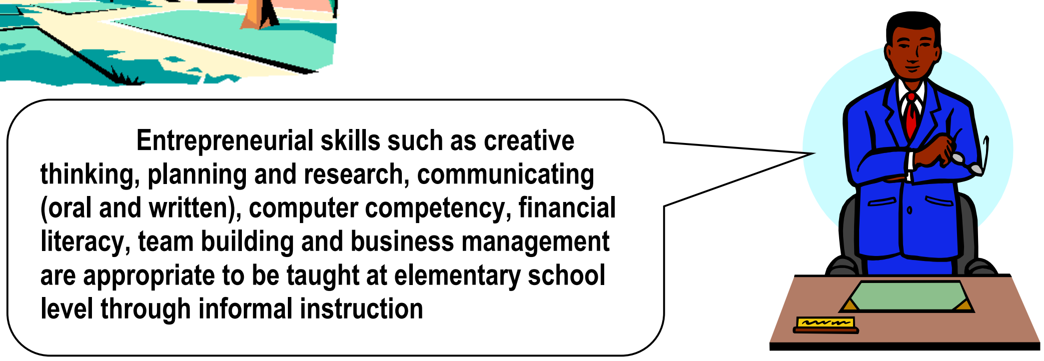
Tracy Cromp, M.S.W.
Director

Note to Faculty Advisor: This notice is only mailed to faculty. If a student is conducting this study, please forward this information to the student researcher.
DEPT: Instructional Design Development and Evaluation, 335 Huntington Hall **STUDENT**: Heng Luo

Office of Research Integrity and Protections
121 Bowne Hall Syracuse, New York 13244-1200
(Phone) 315.443.3013 ♦ (Fax) 315.443.9889
orip@syr.edu ♦ www.orip.syr.edu

Appendix B: Instructional Design Task for the Pilot Test

The Principal of Little Town Elementary School believes that entrepreneurship education at younger age will bring many potential benefits to the students, thus should be integrated in the school curriculum. As a result, you are hired as an instructional designer to design an after-school program for 6th grade students, which engages students in activities that develop their entrepreneurial competencies.



The Principal checks the school calendar and tells you that there are two open slots every week (Tuesday and Thursday) for after-school programs, and it is up to you to decide how many program sessions will be conducted each week and how long each session will be. The Principal also reminds you of the characteristics of the 6th graders in his school: generally, they are interested in various things, but might lose interest quickly; they like to do hands-on activities and respond to real-life situations; though they like to work with other kids, they usually don't have very good team skills; and they will sometimes exhibit immature behaviors as well.
The instructional goal of the program will be developing certain entrepreneurial skills for 6th graders. The program should be activity-oriented and the students in the program should work together to create products or services with educational value in it. You will have support from both the administration and teachers, thus resources concern (technologies, materials, rooms, etc) should not be a big issue during your design stage.

Now, you can start to sketch out your design, in whichever way you think that best represents your design ideas. One preferred format will be a general outline of the whole program, and several sample sessions with more detailed plans.
Good Luck!

Appendix C: Questionnaire Used in the Pilot Test

As an instructional designer, you were assigned to design an after-school program that will engage children in entrepreneurial skills development. A tutorial was given to you to help your design. On a scale of 1 to 5, how much do you agree with the following statements regarding your learning experiences using the online tutorial? “1” means completely disagree, and “5” means completely agree.

No.	Statement	1 Completely disagree	2 disagree	3 neutral	4 agree	5 Completely Agree
1	The content in the tutorial presented specific knowledge within the context of an after-school program for elementary and middle school students.					
2	I needed to memorizes many facts during the tutorial					
3	The scenarios discussed in the tutorial helped me understand my instructional design context better.					
4	I needed to assess my comprehension of the content in one tutorial before moving to the next.					
5	I often got bored during the tutorial.					
6	I engaged in many hands-on activities during the tutorial.					
7	The cases discussed in the tutorial helped me focus on designing for entrepreneurial skills development.					
8	What I found the most useful in the tutorial were the definitions of key concepts *(e.g. entrepreneurial traits, innovation, etc.)*					
9	My design ideas at the end of the tutorial were inspired by studying the cases in the tutorial.					
10	My learning heavily relied on the external information sources *(e.g. websites, database, linked documents)* provided by the tutorial.					
11	I learned useful lessons of how to develop entrepreneurial skills for children by completing the tutorial.					
12	Multimedia elements (e.g. video, audio, images, and animation) used in the tutorial increased the authenticity of the cases. (authenticity: the quality of being real or true)					
13	Multimedia elements like the help-aids and examples of student products helped me better understand the concepts presented in the tutorial					
14	Some of my design ideas were inspired by studying multimedia elements (video, image, or animation, etc.) presented in the tutorial					

No.	Statement	1 Completely disagree	2 disagree	3 neutral	4 agree	5 Completely Agree
15	I prefer cases to be presented in text with less multimedia.					
16	I like how the cases were presented in an online tutorial.					
17	Multimedia elements used in the tutorial made the cases more interesting					
18	I think the use of multimedia in the case descriptions was distracting					
19	Use of multimedia enhanced my understanding of the cases.					
20	Use of multimedia prolonged my process of studying a case.					
21	The tutorial offered me a wide range of hints and help options to help me understand the case					
22	I felt like I was having a conversation with the tutorial during my learning process.					
23	The case narrations included enough interactions to help me reflect on my learning process. *(Interaction can be defined as learner controlled instructional engagement, such as controlling the learning progress, reflecting on the prompting questions, etc.)*					
24	I responded to most of interaction cues offered in the tutorial during my learning process. *(an interaction cue is a sign for users to interact with the tutorial)*					
25	I developed appropriate design ideas when responding to interaction cues.					
26	The tutorial offered me useful feedback on my learning.					
27	I was able to control my own learning speed during the tutorial.					

Appendix D: Interview Protocol for the Pilot Test

Project title: Study of an Instructional Method and its Online Application

Interview Location: Office in the Instructional Design, Development and Evaluation suite.

Protocol: ***After*** completing the online tutorial on creating instruction for children that engages them in developing entrepreneurial competencies. Interview begins with: Introduction of interviewer, Overview of study purpose (see consent letter). Interview based on questions below (responses noted, audiotaped when consent provided).

1. Please tell me about yourself in regards to: your graduate major/minor, type of work you currently do, work experience related to instruction and education, and work with children.
    a. What is your major/minor, degree level here? (background in education, instruction, psychology)
    b. What types of work do you currently do?
    c. What work experience have you had related to instruction and education
    d. Have worked with children, please describe your experiences working with elementary and middle school students.
    e. Other than your experiences as a student in K-12 and higher education, what kinds of formal or informal teaching experiences do you have with children and adults?

2. Have you used an online tutorial/other forms of self-study online instruction before this tutorial?

    a. If yes, how did you like those experiences and which do you prefer, online or classroom, please explain?
    b. If no, describe your experience and why you did not like the type of instruction.

3. Please describe your overall learning experience with this tutorial.

    a. If learning experience is positive, please explain how the online tutorial helped you complete the design task? Which features of the tutorial do you think were most useful?
    b. If negative, please explain why it was not effective/useful? What features of the tutorial do you think were distracting or inhibiting to your learning?

4. Please describe you what you believe was the purpose of this tutorial and how you engaged with the tutorial.

    a. How did you complete the tutorial, what strategies did you employ?
    b. What did you notice about the instruction... what were the components of the instruction?
    c. What will you be able to do as a result of this tutorial?

5. In summary, did you enjoy the process of learning with this tutorial?

    a. In your opinion, what made in enjoyable?
    b. What would make it more enjoyable or more effective?

6. What did you think about the use of multimedia like graphics, pictures, etc. (explain) in the tutorial?
    a. Were they helpful? Please explain.
    b. How would you enhance the multimedia components?
7. What did you think about the interaction cues in the tutorial? (e.g., emerging captions, prompted questions, highlighted text,)
    a. Were they helpful? Please explain.
    b. How would you enhance the multimedia components?
8. What two things did you like most about the tutorial? Why?
9. What two things would you change about the tutorial? Why?
10. How well do you believe you were able to accomplish the design task with the tutorial? Please explain.
11. What else would you like to share with me regarding the online tutorial? (did you learn something or develop a new skill other than what was intended)
12. What else would you like to share with me about your experience with this tutorial?

Appendix E: Consent Form for the Field Test Participants

SYRACUSE UNIVERSITY
INSTRUCTIONAL DESIGN, DEVELOPMENT AND EVALUATION

Consent Form

Project Title: Study of an Instructional Theory and its Online Application.

My name is Heng Luo, and I am a Ph.D. candidate from the department of Instructional Design, Development and Evaluation at Syracuse University, working under the direction of Dr. Tiffany A. Koszalka. I am inviting you to participate in a research study. This letter explains the study to you. You may ask questions about the research and I will be happy to provide additional information.

This study is about investigating the design of self-directed online instruction. If you agree to participate in the study, you will be involved in the following activities: (1) spend 60 to 90 minutes studying an online tutorial; (2) propose solutions to one or two instructional problems before and after studying the tutorial; (3) complete a learning experience survey (24 questions); (4) participate in an 30 to 60 minute interview (face-to-face or online) where you will describe your learning experience with the online tutorial and provide evaluative feedback on its design.

All collected data will be kept confidential in a locked cabinet and/or password encrypted computer files. All personally identifiable information will be removed from the data so that data will not link back to you. Your personal information will be kept anonymous at all times in all publications and presentations. For the purpose of transcribing, the interview will be audio recorded, but the recordings will be erased after the study is completed. If you choose not to be audio taped, extensive notes will be taken during the interview. The research will be conducted in a commonly accepted educational setting and we do not anticipate any risk to this study greater than normal life. If you decide to take part and later no longer wish to continue, you have the right to withdraw from the study at any time, without penalty.

By participating in this research, you will help us better understand the design of self-directed online learning. You might also experience the following benefits: (1) the knowledge about the content subject taught in the online tutorial; 2) an opportunity to study and critique theory-based instructional design materials. You will also receive a $ 50 value gift card as the compensation for your time and efforts of participating in this study.

If you have any questions about this research project, please contact Heng Luo by telephone at 315-447-1226 or by e-mail at heluo@syr.edu or Professor Koszalka at takoszal@syr.edu. If you have any questions about your rights as a research participant, or you have questions, concerns, or complaints that you wish to address to someone other than the investigator, please contact the Syracuse University Institutional Review Board at 315-443-3013.

All of my questions have been answered, I am over the age of 18 and I wish to participate in this research study. I have received a copy of this consent form.

___ I agree to be audio recorded
___ I do not agree to be audio recorded

____ _________________________
Signature of participant Date

____
Printed name of participant

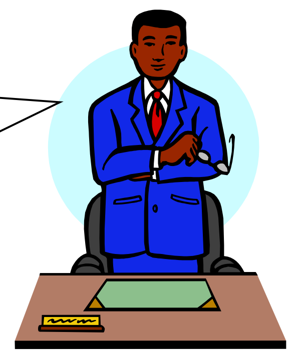
_______________________________________ _________________________
Signature of researcher (Heng Luo) Date

Appendix F: Instructional Design Activity Handout for the Field Test

After-School Entrepreneurship Program for Elementary School Students

The Principal of CNY Elementary School believes that entrepreneurship education at younger age will bring many potential benefits to the students, thus should be integrated in the school curriculum. As a result, you are invited to design and facilitate an after-school program that engages elementary students in activities that develop their entrepreneurial competencies.

Entrepreneurial skills such as creative thinking, planning and research, communicating (oral and written), computer competency, financial literacy, team building and business management are appropriate to be taught at elementary school level through informal instruction.



The Principal checks the school calendar and tells you that there are two open slots every week (Tuesday and Thursday) for 12 weeks that are available for after-school programs, and it is up to you to decide how many program sessions will be conducted each week and how long each session will be. The instructional goal of the program will be developing certain entrepreneurial skills and other important skills for interested students (most of them are expected to be 5th and 6th graders). The program should be activity-oriented and the students in the program should work together to create products or services with educational value in it. You will have support from both the administration and other teachers, thus resources concern (technologies, materials, rooms, etc) should not be a big issue during your design stage.

Now, you can start to sketch out your design, in whichever way you think that best represents your design ideas. One preferred format will be a general outline of the whole program (from Week 1 to Week 12), and two or three sample sessions with more detailed plans (like lesson plans).

Good Luck!

Appendix G: Learning Experience Questionnaire for the Field Test

No.	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
1.	The tutorial teaches me how to design and conduct entrepreneurship programs for elementary school students.	○	○	○	○	○
2.	The tutorial increases my knowledge of entrepreneurship and entrepreneurial skills that are relevant to the elementary school setting.	○	○	○	○	○
3.	The tutorial improves my skills of designing elementary school activities that engage students in entrepreneurial skills development.	○	○	○	○	○
4.	The tutorial teaches me useful techniques that I can use to facilitate elementary-level entrepreneurship programs.	○	○	○	○	○
5.	The tutorial improves my skills of identifying or developing instructional materials for elementary-level entrepreneurship programs.	○	○	○	○	○
6.	The tutorial teaches me how to handle the common problems of facilitating an elementary-level entrepreneurship program.	○	○	○	○	○
7.	The tutorial makes me more interested in the task of designing an entrepreneurship program for elementary school students.	○	○	○	○	○
8.	The tutorial keeps me engaged in the learning process.	○	○	○	○	○
9.	The tutorial provides me with meaningful learning experiences.	○	○	○	○	○
10.	I prefer the online tutorial to the paper-based tutorial.	○	○	○	○	○
11.	The stories and vignettes discussed in the tutorial help me better understand the context of my instructional design task.	○	○	○	○	○

12. The tutorial provides me with useful examples of designing and conducting entrepreneurship programs.	○	○	○	○	○
13. The stories and vignettes in the tutorial are thought-provoking, making me wonder what I would do under similar circumstances.	○	○	○	○	○
14. Some of my design ideas were inspired by studying the stories and vignettes in the tutorial.	○	○	○	○	○
15. The use of multimedia (e.g. video, audio, images, and animation) increases the authenticity of the tutorial stories and vignettes.	○	○	○	○	○
16. The use of multimedia makes me more interested to study the tutorial content.	○	○	○	○	○
17. The use of multimedia helps me better understand the stories and vignettes described in the tutorial.	○	○	○	○	○
18. The use of multimedia provides me with useful information that is not described in the tutorial text content.	○	○	○	○	○
19. The tutorial includes sufficient scaffolding features (e.g. prompt questions, visual cues, hints) to help me reflect on my learning process.	○	○	○	○	○
20. I responded to most of the scaffolding features (e.g. reflect on prompt questions, study cued information, and explore interactive elements).	○	○	○	○	○
21. I developed appropriate design ideas when responding to the tutorial scaffolding features.	○	○	○	○	○
22. The tutorial offered me useful feedback during my learning process.	○	○	○	○	○

23.	The tutorial allows me to control my learning process (e.g. the sequence, content and pace of learning)	○	○	○	○	○
24.	I would recommend this tutorial to other teachers who want to design and conduct elementary-level entrepreneurship programs.	○	○	○	○	○

Appendix H: Semi-Structured Interview Protocol for the Field Test Participants

Introduction: Thank you very much for agreeing to participate in the interview. My name is Heng 'Patrick' Luo, a doctoral candidate from Syracuse University. The purpose of this interview is to get some feedback from you regarding the tutorial that you have studied a few days ago. Since you have studied the tutorial and completed the instructional design task, I think you are in a good position to provide us some useful information, such as your learning experience with the tutorial, your comments on some of the tutorial features, and your suggestions for revising the tutorial. The interview will be audio recorded, and you have the right to withdraw from the interview at any time.

1. Would you please tell me a little bit about yourself? (*Ask about demographic information, and working/education background*)
    a. How many years have you working as an elementary/middle school teacher?
    b. What is the highest degree you have earned? Which major did you graduate from?
    c. Have you designed or conducted any types of informal instruction for children? Such as an after-school program, an enrichment program, a club of special interest?
    d. How much do you know about the entrepreneurship education before the field test? What do you think of the idea of developing entrepreneurial skills for children?
2. Have you studied other online tutorials or other forms of self-directed online instruction before this tutorial? (*get to know the participant's prior online learning experience of studying online and their concerns and attitude toward self-directed online instruction*)
    a. If yes, how did you like such learning experience, and which do you prefer, online or face-to-face instruction? Please explain.
    b. If no, is there a reason that kept you away from self-directed online instruction? For what kind of learning task would you consider studying an online tutorial by yourself?
3. Please describe your overall learning experience with the online tutorial. (*use open-ended, non-leading question to have the participant to respond descriptively and honestly using their own terms and language*)
    a. How much time did you spent on the module?
    b. What was the sequence of your studying the module? Which part did you study first, and why?
    c. What learning strategies did you employ to complete the tutorial?
    d. What design features of the tutorial stood out to you? What do you think of them?
    e. Did you encounter any problems during studying the tutorial? What are they and how did you solve the problems?
4. What do you think is the purpose of the online tutorial? Do you believe the tutorial has fulfilled such purpose? (*elicit summative evaluation of the tutorial from the participant*)
    a. If yes, please explain what features of the tutorial are most useful in fulfilling such purpose, and why?
    b. If no, what do you believe are the reasons? What features of the tutorial do you think were less useful or inhibiting to fulfill the purpose of the tutorial?

5. What do you think of the stories, vignettes and examples in the tutorial? (*seek the participant's feedback on the case-based features of the tutorial*)
    a. In your opinion, why were those stories and vignettes from Curiosity Creek included in the tutorial?
    b. Can you image what the learning experience with the tutorial would be like if those stories and vignettes were removed from the tutorial?
    c. All the stories and vignette are based on real events from Curiosity Creek. How do you like studying authentic materials in the tutorial?
    d. What have you learned from those stories and vignettes?
    e. How did studying those stories and vignettes affect your design of the entrepreneurship program?
6. A variety of multimedia was used in the tutorial, including video clips, audio narrations, images, and animations. What do you think of such multimedia content in the tutorial? (*seek the participant's feedback on cases presented in multimedia format and their unique benefits for learning*)
    a. What do you think of the quality, length and style of the multimedia content? Do you think multimedia content is redundant to the text content?
    b. Do you enjoy studying the multimedia content?
    c. What type of multimedia content is the most useful? Why?
    d. What type of multimedia content is the least useful? Why?
    e. What type of multimedia content would benefit your learning but was not present in the tutorial?
    f. Can you image what the learning experience with the tutorial would be like if the multimedia content is replaced by text?
7. Did you notice the different visual cues used in the tutorial, such as emerged captions, arrows, and highlight boxes? What do you think of them? (*ask about the impact of visual cues on the participant's case learning experience, cognitive activity, and learning effect*)
    a. Did you pay attention to the cued content?
    b. Did you think they were distracting for your learning?
    c. What impact did the presence of visual cues have on your tutorial learning experience?
    d. Can you imagine what the learning experience will be like without those visual cues?
8. Did you notice the different interactive elements in the tutorial, such as prompt questions, rollover content, and quizzes? What do you think of them? (*ask about how the participant interacted with the tutorial and how such interaction affected their case learning experience, cognitive activity, and learning effect*)
    a. How often did you respond to those interactive elements?
    b. What do you think of the prompt questions?
    c. What do you think of rollover content?
    d. What do you think of the quizzes?
    e. Did you receive adequate feedback when studying the tutorial? What do you think of the feedback you received?
    f. Are there any interactive elements that you particularly like or dislike in the tutorial?

9. What do you think of the navigation control of the tutorial? (*seek the participant's feedback on the scaffolding features that allow learners to control and customize their learning process*)
    a. When studying the online tutorial, were you able to control the speed and sequence of learning?
    b. When studying the online tutorial, can you easily access, revisit, or download instructional content?
10. What are the two things about the tutorial that you like most? (*ask about the tutorial design features that are valued the most by the participant and explore the reasons behind such valuation*)
11. What are the two things about the tutorial that you want to change? (*ask about the tutorial design features that are not valued by the participant and seek feedback for revising those features*)
12. What else would you like to share with me about your learning experience with the online tutorial? (final open-ended question to seek comments and feedback on related areas not covered in the interview)

Closing comments: Thank you very much for your time. Your comments and feedback are greatly appreciated. If you have any questions regarding this interview, please feel free to contact me.

REFERENCE

Aamodt, A., & Plaza, E. (1996). Case-based reasoning: Foundational issues, methodological variations, and system approaches. *Artificial Intelligence Communications, 7* (1).

Allen, B. S., Otto, R. G., & Hoffman, B. (2000). Case-based learning: Contexts and communities of practice. In S. Tobias & J.D. Fletcher (Eds.),*Training & retraining: A handbook for business, industry, government, and the military*. New York: Macmillan reference USA.

Allen, I. E., & Seaman, J. (2011). *Going the distance: Online education in the United States, 2011*. Babson Survey Research Group. Retrieved from: http://sloanconsortium.org/publications/survey/going_distance_2011

Amiel, T., & Reeves, T. C. (2008). Design-Based Research and Educational Technology: Rethinking Technology and the Research Agenda. *Educational Technology & Society*, *11* (4), 29–40.

An, Y. J., & Reigeluth, C. M. (2006). Functional contextualism: An Ideal framework for theory in IDT. *Educational Technology Research & Development, 54*(1), 46-50.

Andrews, K. R. (1954). The role of the instructor in the case method. In McNair, M.P. (Ed.), *The case method at the Harvard business school*. New York: McGraw-Hill.

Andrews, L. (2002). Preparing general education pre-service teachers for inclusion: Web-enhanced case-based instruction. *Journal of special education technology*, *17*(3), pp.27-35.

Andrews, D. H., Hull, T. D., & Donahue, J. A. (2009). Storytelling as an instructional method: Descriptions and research questions. *The Interdisciplinary Journal of Problem-Based Learning*, *3*(2), 6-23.

Angeli C. (2004) The effects of case-based learning on early childhood pre-service teachers' beliefs about the pedagogical uses of ICT. *Journal of Educational Media*, *29*,139–151.

Aslan, S., Reigeluth, C.M. (2011). A trip to the past and future of educational computing: Understanding its evolution. *Contemporary Educational Technology*, *2*(1), 1-17.

Auerbach, C. F., & Silverstein, L. B. (2003). *Qualitative Data: an introduction to coding and analysis*. New York: New York University Press.

Ayersman, D. (1996). Reviewing the research on hypermedia-based learning. *Journal of Research on Computing in Education*, *28*(4), 500-525.

Bailey, R. M. (2000). *Visiting the music classroom through the use of the case method in the preparation of senior-level music teacher education students: A study of reflective judgment*. Unpublished doctoral dissertation, College Conservatory of Music, University of Cincinnati, OH.

Baker, E. A., & Wedman, J. (2000). Lessons learned while using case-based instruction with preservice literacy teachers. In T. Shanahan & F. Rodriguez-Brown (Eds.), *Forty-ninth*

National Reading Conference Yearbook (pp. 122-136). Chicago: National Reading Conference.

Baker, E. A. (2002, April). *Improving Elementary Preservice Teachers' Kidwatching Abilities: Evaluation of Multimedia Case-based Instruction.* Paper presented at the American Educational Research Association, New Orleans, LA.

Baker, E. A. (2005). Can preservice teacher education really help me grow as a literacy teacher? Examining preservice teachers' perceptions of multimedia case-based instruction. *Journal of Technology and Teacher Education*, *13*(3), 415-431.

Baker, E. A. (2009). Multimedia Case-based Instruction in Literacy: Pedagogy, Effectiveness and Perceptions. *Journal of Educational Multimedia and Hypermedia*, *18* (3), 249-266.

Baran, E. (2006). *The effects of video-case based instruction on preservice teachers' achievement of course content*. Unpublished doctoral dissertation, Middle East Technical University, Ankara.

Barnert, C. S., & Tyson, P. A. (1994). *Facilitating mathematics case discussions while preserving shared authority*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Barnes, L.B., Christensen, C.R., and Hansen, A., (1994) *Teaching and the Case Method* (3rd Ed). Boston MA, Harvard Business School Press.

Barnett, C. S. (1991). Building a case-based curriculmn to enhance the pedagogical content knowledge ofmathematics teachers. *Journal of Teacher Education*, *42*(4), 263—272.

Barrows, H. S. (1985). How to design a problem-based curriculum for the preclinical years. New York: Springer.

Beck, R. J., King, A., & Marshall, S. K. (2002). Effects of Videocase Construction on Preservice Teachers' Observations of Teaching. *Journal of Experimental Education*, *70*(4), 345-362.

Bednar, A. K., Cunningham, D. J., Duffy, T. M., & Perry, J. D. (1995). Theory into practice: how do we link? In *Instructional Technology: Past, Present, and Future*, edited by G. J. Anglin, pp. 100–112. Englewood, CO: Libraries Unlimited, Inc.

Bencze, L., Hewitt, J., & Pedretti, E. (2001). Multi-media case methods in pre-service science education: Enabling an apprenticeship for praxis. *Research in Science Education*, *31*(2), 191-209.

Bennett, S., Harper, B., & Hedberg, J. (2001). Designing real-life cases to support authentic design activities. In G. Kennedy, M. Keppell, C. McNaught , & T. Petrovic (Eds.), *Meeting at the Crossroads. Proceedings of the 18th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education* (pp. 73-81). Melbourne: Biomedical Multimedia Unit, University of Melbourne.

Berg, E. V. D., Jansen, L., & Blijleven, P. (2004). Learning with multimedia cases: An evaluation study. *Journal of Technology and Teacher Education*, *12*(4), 491-509.

Bloom, B. S. Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956).*Taxonomy of educational objectives: Handbook I: Cognitive domain*. New York: David McKay.

Boling, E. C. (2007). Linking technology, learning, and stories: Implications from research on hypermedia video-cases. *Teaching and Teacher Education*, *23*(2), 189-200.

Bolter, J. D. (1991). *The Writing Space*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Bransford, J.D., Vye, N., Kinzer, C., & Risko, V. (1990). Teaching thinking and content knowledge: Toward an integrated approach. In B.F. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction* (pp. 381-413). Hillsdale, NJ: Lawrence Erlbaum Associates.

Broadfoot, P. M., Daugherty, R., Gardner, J., Harlen, W., James, M., & Stobart, G. (2002). *Assessment for learning: 10 principles*. Cambridge, UK: University of Cambridge School of Education.

Brooke, S. (2006). Using the case method to teach online classes: promoting Socratic dialogue and critical thinking skills. *International Journal of Teaching and learning*, *18*(2), 142-149.

Brookfield, S. D. (2009). Self-Directed Learning. In Maclean, R. & Wilson, D. (Eds.) *International Handbook of Education for the Changing World of Work* (pp. 2615-2627). Netherlands: Springer.

Brown, A. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences*, *2*(2), 141–178.

Brown, A. & Green, T. D. (2008). Issues and trends in instructional technology: Making the most of the mobility and ubiquity. In M. Orey, V. J. McClendon & R. M. Branch (Eds.), *Educational media and technology yearbook: Volume 33*, 2008 (pp. 4-16). Englewood, CO: Libraries Unlimited.

Brown, J. S., Collins, A. & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, *18*(1), 32-42.

Brown, J.S., & Duguid, P. (1993). Stolen knowledge. *Educational Technology*, *33*(3), 10-15.

Cairncross, S., & Mannion, M. (2001). Interactive multimedia and learning: Realizing the benefits. *Innovations in education and teaching international*, *38*(2), 156-164.

Campbell, D. T. (6). Stanley. JC 1966. *Experimental and quasi-experimental designs for research*. Chicago, IL: Rand McNally.

Cardie, C. (1993). Using decision trees to improve case-based learning. In *Machine Learning: Proceedings of the Tenth International Conference*, pp. 25–32. Amherst, MA. Morgan Kaufmann.

Carter, K., & Unklesbay, R. (1989). Cases in teaching and law. *Journal of Curriculum Studies*, *21*(6), 527—536.

Carter, K. (1993). The place of story in the study of teaching and teacher education. *Educational Researcher, 22*(1), 5-12, 18.

Ceci, S.J., & Ruiz, A.I. (1993b). Inserting context into our thinking about thinking: Implications for a theory of everyday intelligent behavior. In M. Rabinowitz (Ed.), *Cognitive science foundations of instruction* (pp. 173-188). Hillsdale, NJ: Lawrence Erlbaum Associates.

Chase, W. G., & Simon, H. A. (1973). Perception in chess. *Cognitive psychology*, *4*(1), 55-81.

Cherubini, L. (2009). Exploring prospective teachers' critical thinking: Case-based pedagogy and the standards of professional practice. *Teaching and Teacher Education, 25*, 228-234.

Ching, C. P. (2014). Linking Theory to Practice: A Case-based Approach in Teacher Education. *Procedia-Social and Behavioral Sciences*, *123*, 280-288.

Choi, I., Hong, Y. C., Park, H., & Lee, Y. (2013). Case-based learning for anesthesiology: Enhancing dynamic decision-making skills through cognitive apprenticeship and cognitive flexibility. In R. Luckin, P. Goodyear, B.Grabowski, S. Puntambeker, J. Underwood, & N. Winters (Eds.), *Handbook on Design in Educational Computing*. New York: Routledge.

Choi, I., Hong, Y. C., Kellam, N., Gattie, D., Gay, M., Park, H., Jensen, L. J., & Lee, Y. (2012, June). Promoting second-year engineering students' epistemic beliefs and real-world problem solving abilities through case-based e-learning resources. *2012 ASEE Proceedings*. San Antonio, TX. http://edesign.coe.uga.edu/app/Tutorial/ASEE2012_Proceedings_AC%202012-5074.pdf

Choi, I., & Lee, K. (2009). Designing and implementing case-based learning environments for enhancing ill-structured problem solving skills: Classroom management problems for prospective teachers. *Educational Technology Research & Development*, 57, 99-129.

Choi, I., Lee, S., & Jung, J. (2008). Designing multimedia case-based instruction accommodating students' diverse learning styles. *Journal of Educational Multimedia and Hypermedia*, *17*, 5-25.

Choi, I., Lee, S., & Kang, J. (2009). Implementing a case-based e-learning environment in a lecture-oriented anesthesiology class: Do learning styles matter on complex problem solving over time? *British Journal of Educational Technology*, *40*, 933-947. doi: 10.1111/j.1467-8535.2008.00884.x.

Christensen, C. M., Johnston, C., & Horn, M. (2008). *Disrupting class: How disruptive innovation will change the way the world learns.* New York, NY: McGraw-Hill.

Christensen, C. R., & Hansen, A. J. (1987). *Teaching and the case method*. Boston: Harvard Business School Press.

Churchland, P. M. (1995). *The engine of reason, the seat of the soul*. Cambridge, MA: MIT Press.

Clark, A. (1997). *Being there: Putting brain, body, and world together again.* Cambridge, MA: MIT Press.

Clark, A. (2003). *Natural-born cyborgs: Why minds and technologies are made to merge.* Oxford: Oxford University Press.

Clark, C. M. (1988). Asking the right questions about teacher preparation: Contributions of research on teacher thinking. *Educational Researcher*, *17*(3), 5-12.

Craik, F. I., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of verbal learning and verbal behavior*, *11*(6), 671-684.

Cochran-Smith, M. (2005). The new teacher education: For better or for worse? *Educational Researcher*, *34*(7), 3-17.

Cognition and Technology Group at Vanderbilt (1990). Anchored instruction and its relationship to situated cognition. *Educational Researcher*, *19*(6), 2-10.

Collins, A. (1988). *Cognitive apprenticeship and instructional technology* (Technical Report No. 6899). BBN Labs Inc., Cambridge, MA.

Collins, A., Brown, J. S. and Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L.B. Resnick (Ed.), *Knowing, learning and instruction: Essays in honour of Robert Glaser*, Hillsdale, NJ: LEA, pp. 453-494.

Conant, J. B. (1947). On understanding science; an historical approach.*American scientist*, *35*(1), 33.

Copeland, W., & Decker, D. (1996). Video cases and the development of meaning making in preservice teachers. *Teaching and Teacher Education, 12*(5), 467-481.

Cossom, J. (1991). Teaching from cases: Education for critical thinking. *Journal of Teaching in Social Work*, 5, 139-155.

Cox, M. J. (2005). Educational conflict: The problems in institutionalizing new technologies in education. In G. Kouzelis, M. Pournari, M. Stoeppler & V. Tselfes (Eds.), *Knowledge in the new technologies*. Frankfurt, Berlin: Peter Lang.

Creswell, J. W. & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into Practice*, *39*(3), 124-131.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.

Cuban, L. (2012). *How New Technologies Can End Age-Graded Schools (Part 3)*. Retrieved from: http://larrycuban.wordpress.com/2012/02/07/how-new-technologies-can-end-age-graded-schools-part-3/.

Culbertson, J., Jacobson, P., & Reller, T. (1959). *Administrative relationships: A case book*. New York: Prentice-Hall.

Davies, D., & Dodd, J. (2002). Qualitative research and the question of rigor. *Qualitative Health research*, *12*(2), 279-289.

De Wet, C. F. (2006). Beyond Presentations: Using PowerPoint as an Effective Instructional Tool. *Gifted Child Today, 29*(4), 29-39.

Denzin N.K. (1989) *The Research Act: A Theoretical Introduction to Sociological Methods* (3rd Ed). Prentice Hall, Englewood Cliffs, New Jersey.

Design-Based Research Collective. (2003). Design based research: An emerging paradigm for educational inquiry. *Educational Researcher*, *32*(1), 5–8. doi:10.3102/0013189X032001005

Deterding, S., Sicart, M., Nacke, L., O'Hara, L., & Dixon, D. (2011). Gamification: Using game-design elements in non-gaming contexts. In *Proceedings of the 2011 annual conference extended abstracts on human factors in computing systems (CHIEA'11)*, Vancouver, Canada.

Dewey, J. (1999). *The Essential Dewey. Volume 2*. Bloomington: Indiana University Press, 1999.

Dick, W., & Carey, L. (1990). *The systematic design of instruction* (3rd Ed.). Glenview, IL: Scott Foresman.

Driscoll, M. P. (1994). *Psychology of learning for instruction* (2nd ed.). Boston; MA: Allyn & Bacon.

Doebler, L., Roberson, T., & Ponder, C. (1998). Preservice teacher case study responses: A preliminary attempt to describe program impact. *Education*, *119*(2), 349-358.

Dooley, A. R. & Skinner, W. (1977). Casing case method methods. *Academy of Management Review*, *2*(2), 277-289.

Doyle, W. (1990). Case methods in the education of teachers. *Teacher Education Quarterly*, *17*(1), 7-16.

Ebel, R. L. (1967) Some Limitations of Basic Research in Education. *Phi Delta Kappan*, 49, 81-84.

Eberly, J. & Rand, M (2003). *Identifying and describing perceptual factors used for inferring teacher candidate dispositions from online case-based discussions*. Eric Documents, ED 478618.

Edelson, D. C. (1996). Learning from cases and questions: The Socratic case-based teaching architecture. *Journal of the Learning Sciences,* 5, 357–409.

Eisenberg, N. (2010). Self-Regulation and School Readiness. *Early Education and Development*, 21(5), 681-698.

Elias, C., & Perfetti, C.A. (1973). Encoding task and recognition memory: The importance of semantic encoding. *Journal of Experimental Psychology*, 99, 151-156.

Ellison, N. B., Steinfield, C., & Lampe, C. (2007). The benefits of Facebook "friends:" Social capital and college students' use of online social network sites. *Journal of Computer-Mediated Communication*, *12*(4), 1143-1168.

Elman, J. L., Bates, E., Johnson, M. H., Karmiloff -Smith, A., Parisi, D., & Plunkett, K. (1996). *Rethinking innateness: A connectionist perspective on development.* Cambridge, MA: MIT Press.

English, R. E. (1992). *Formative research on the elaboration theory of instruction* (Doctoral dissertation, Indiana University).

Ertmer, P. A., Newby, T. J., & MacDougall, M. (1996). Students' approaches to learning from case-based instruction: The role of reflective self-regulation. *American Educational Research Journal*, *33*(3), 719-752.

Ertmer, P. A. & Russell, J. D. (1995). Using case studies to enhance instructional design education. *Educational Technology*, *35* (4), 23-31.

Eshach, H., & Bitterman, H. (2002). From case-based reasoning to problem-based learning. *Academic Medicine*, *78*(5), 491-496.

Firestone, W.A. (1987). Meaning in method: The rhetoric of quantitative and qualitative research. *Educational Researcher*, *16*(7), 16-21.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, *34*(10), 906-911.

Floyd, D. M. & Bodur, Y. (2005). Using case study analysis and writing to structure clinical experiences in a teacher education program. *The Educational Forum,* 70, 48-60.

Flynn, A.E., & Klein, J.D. (2001). The influence of discussion groups in a case-based learning environment. *Educational Technology Research and Development*, *49*(3), 71-86.

Fox, E. J. (2006). Constructing a pragmatic science of learning and instruction with functional contextualism. *Educational Technology Research & Development, 54* (1), 5-36.

Frankel, J. R., & Wallen, N. E. (2003). *How to design and evaluate research in education* (5th ed.). Boston, Massachusetts: McGraw-Hill.

Friel, S. N., & Carboni, L. W. (2000). Using video-based pedagogy in an elementary mathematics methods course. *School Science and Mathematics Journal*, *100*, 118-127.

Gagné, R. M., Briggs, L. J., & Wager, W. W. (1992). Principles of instructional design (4th ed.). New York: Harcourt Brace Janovich College Publishers.

Greenwood, G. E., & Parkay, F. W. (1989). *Case studies for teacher decision making*. New York: Random House.

Guest, J. M. (2007) *The effectiveness of using case-based instruction in an online course*. Unpublished doctoral dissertation.University of South Alabama, Alabama.

Guba, E.G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Technology Research and Development*, *29*(2), 75-91.

Guba, E. G., & Lincoln, Y. S. (1983). The epistemological and methodological bases of naturalistic inquiry. In G. Madaus, M. Scriven, & D. L. Stufflebeam (Eds.). *Evaluation Models and Conceptualizations*. Boston: Kluwer-Nijhof. Reprinted and abridged from the *Educational Communications and Technology Journal*, (Winter, 1982) *31*, 233-252.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105-117). Thousand Oaks, CA: Sage.

Guba, E. G., & Lincoln, Y. S. (2005). Paradgmatic controversies, contradictions, and emerging confluences. In N. K. Denzin & Y. S. Lincoln (Eds.), *The sage handbook of qualitative research* (3rd ed., pp. 191-215). Thousand Oaks, California: Sage Publications, Inc.

Haley, M. H. (2004). Implications of Using Case Study Instruction in a Foreign/Second Language Methods Course. *Foreign Language Annual*, *37* (2), 290-300.

Hammerness, K., Darling-Hammond, L., & Shulman, L. (2001, June). *Towards expert thinking: How case writing contributes to the development of theory-based professional knowledge in student teachers*. Paper presented at the annual meeting of the American Educational Research Association, Seattle, WA.

Harrington, H. L, & Garrison, B. (1992). Cases as shared inquiry: A dialogical model of teacher preparation. *American Educational Research Journal*, *25*(4), 715-736.

Hawkins, J. & Blakeslee, S. (2004). *On intelligence.* New York: Times Books.

Hayward, L., & Cairns, M. A. (2001). Allied health students' perceptions of and experiences with Internet-based case study instruction. *Journal of Allied Health*, *30*, 232-238.

Helms, M. M. (2006). Case method of analysis. In M. M. Helms (Ed.), *Encyclopedia of management* (pp. 67–69). Farmington Hills, MI: Gale Cengage.

Hennessey, M. G. (1999). *Probing the dimensions of metacognition: Implications for conceptual change teaching-learning*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Boston, MA.

Herreid, C. G. (1994). Case Studies in Science—A Novel Method of Science Education. *Journal of College Science Teaching*, *23*(4), 221–229.

Herrington, J., & Oliver, R. (1995). Critical characteristics of situated learning: Implications for the instructional design of multimedia. In J. Pearce & A. Ellis (Eds.), *Learning with technology* (pp. 235-262). Parkville, Vic: University of Melbourne.

Hewitt, J., Pedretti, E., Bencze, L., Vaillancourt, B. D., & Yoon, S. (2003). New Applications for Multimedia Cases: Promoting Reflective Practice in Pre-service Teacher Education. *Journal of Technology and Teacher Education, 11*(4), 483-500.

Hmelo, C. E., Gotterer, G. S. & Bransford, J. D. (1997). A theory-driven approach to assessing the cognitive effects of PBL. *Instructional Science*, *26*(6), 387-408.

Hofer, B. K. (2004). Epistemological understanding as a metacognitive process: Thinking aloud during online searching. *Educational Psychologist*, *39*(1), 43-55.

Horvath, J. & Lehrer, R. (2000). The design of a case-based hypermedia teaching tool. *International Journal of Computers for Mathematical Learning*, 5, 115–141.

Hourigan, R. (2008) The Use of Student-Written Cases in Music Teacher Education. *Journal of Music Teacher Education*, *17*(2), 19-32.

Howe, K., & Eisenhart, M. (1990). Standards for qualitative (and quantitative) research: A prolegomenon. *Educational Researcher*, *19*(4), 2-9.

Hughes, J. E., Packard, B. W., Pearson, P. D. (2000). The role of hypermedia cases on preservice teachers' views of reading instruction. *Action in Teacher Education, 22 (2A)*, 24-38.

Hyde, T. S., & Jenkins, J. J. (1973). Recall for words as a function of semantic, graphic, and syntactic orienting tasks. *Journal of Verbal Learning and Verbal Behavior*, 12, 471-480.

Hylton, I. E. (2000). *Classroom management skills: Can video-modeling make a difference?* Unpublished Dissertation, New York University, New York.

Jarz, E. M., Kainz, G. A., & Walpoth, G. (1997). Multimedia-based case studies in education: Design, development, and evaluation of multimedia based case studies. *Journal of Educational Multimedia and Hypermedia*, *6* (1), 23-46.

Johnson, R. B., & Christensen, L. (2012). *Educational research: Quantitative, qualitative, and mixed approaches*. Los Angeles, CA: SAGE publication.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33* (7), 14-26. http://dx.doi.org/10.3102/0013189X033007014

Jonassen, D. H. (1991). Context is everything. *Educational Technology*, *31*(5), 35-37.

Jonassen, D. H. (1997). Instructional design models for well-structured and ill-structured problem-solving learning outcomes. *Educational Technology Research and Development*, *45*(1), 65–94.

Jonassen, D. H. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (Vol. 2, pp. 215–239). Mahwah, NJ: Lawrence Erlbaum Associates.

Jonassen, D. H. (2010, September/October). *Research on problem solving: Past and potential.* 11th International Conference on Education Research (ICER), New Educational Paradigm for Learning and Instruction, Seoul National University, Seoul, Korea (keynote).

Jonassen, D. H. & Hernandez-Serrano, J. (2002). Case-based reasoning and instructional design: Using stories to support problem solving. *Educational Technology Research and Development*, *50* (2), 65-77.

Jonassen, D. H. & Reeves, T. C. (1996) Learning with technology: Using computers as cognitive tools. In Jonassen D.H. (ed.) *Handbook of Research for Educational Communications and Technology*, pp. 693-719. New York: Macmillan.

Kapp, K. M. (2012). *The gamification of learning and instruction*. San Francisco: Wiley

Kaempf, G. L., Klein, G. A., Thordsen, M. L., & Wolf, S. (1996). Decision making in complex Naval command and control environments. *Human Factors*, *38*(2), 220-231.

Kang, H., & Lundeberg, M. A. (2010). Participation in science practices while working in a multimedia case-based environment. *Journal of Research in Science Teaching*, *47*(9), 1116-1136.

Kim, K. J. (2004). *Motivational influences in self-directed online learning environments: A qualitative case study*. Paper presented at the 27th annual conference of the Association for Educational Communications and Technology, Chicago, IL. Retrieved June 30, 2012, from ERIC Document Reproduction Service No. ED485041.

King, P. M., & Kitchener, K. S. (1994). *Developing reflective judgment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults*. San Francisco: Jossey-Bass.

Kirkwood, C. W. (2002). *Decision tree primer*. Available at: http://www.public.asu.edu/~kirkwood/DAStuff/ decisiontrees/index.html.

Kirschner, P. A., Sweller, J. & Clark, R. E. (2006). Why minimal guidance during iInstruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and iInquiry-based teaching. *Educational Psychologist*, *41*(2), 75-86.

Kitchener, K. S. (1986). The reflective judgment model: Characteristics, evidence, and measurement. In Mines, R. A., and Kitchener, K. S. (Eds.), *Adult Cognitive Development: Methods and Models* (pp. 76–91). Praeger, New York.

Klein, G. A. (1989). Recognition-primed decisions. In W. Rouse (Ed.), *Advances in man-machine systems research*, Greenwich, CT: JAI Press, Inc. (Vol. 5, pp. 47–92).

Klein, G. A. (1997). The recognition-primed decision (RPD) model: Looking back, looking forward. In C. E. Zsambok & G. A. Klein (Eds.), *Naturalistic Decision Making* (pp.285-292). Mahwah, N.J.: Lawrence Erlbaum Associates.

Klein, G. A. (1998). *Sources of Power people make decisions*. Cambridge, Massachusetts: Massachusetts Institute of Technology.

Klein, G. A. (2008). Naturalistic decision making. *Human Factors*, *50*, 456-460.

Klein, G. A. & Calderwood, R. (1988). How do people use analogs to make decisions? In J. Kolodner (Ed.), *Proceedings: Workshop on Case-Based Reasoning* (DARPA). San Mateo, CA: Morgan Kaufmann.

Klein, G. A., Calderwood, R., & Macgregor, D. (1989). Critical decision method for eliciting knowledge. *IEEE Transactions on Systems, Man and Cybernetics*, *19*(3), 462-472.

Klein, G. A., & Peio, K. J. (1989). The use of a prediction paradigm to evaluate proficient decision making. *The American Journal of Psychology*, *102*(3), 321-331.

Klein, G.A., Wolf, S., Militello, L., & Zsambok, C.E. (1995). Characteristics of Skilled Option Generation in Chess. *Organizational Behavior and Human Decision Processes*, *62*(1), 63-69.

Kleinfeld, J. (1991). *Changes in problem solving abilities of students taught through case methods*. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago.

Kleinfeld, J. (1992a). *Can cases carry pedagogical content knowledge? Yes, but we've got signs of the "Mathew Effect."* Paper presented at the Annual Meeting of the American Education Research Association, San Francisco, CA. (Eric Document Reproduction No. ED344887).

Kleinfeld, J. (1992b). "Learning to think like a teacher: The study of cases." In J. H. Shulman (Ed.), *Case methods in teacher education.* (pp. 33-49). New York: Teachers College Press.

Koehler, M. & Lehrer, R. (1998). Designing a hypermedia tool for learning about children's mathematical cognition. *Journal of Educational Computing Research*, *18*(2), 123–145.

Kolodner, J. L. (1993) *Case-based reasoning*. San Francisco, CA: Morgan Kaufman Publishers, Inc.

Koury, K., Fitzgerald, G., Hollingsead, C., Miller, K., Tsai, H. H., & Zha, S. (2009). The Effects of instructional implementation on learning with interactive multimedia case-based instruction. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, *32*(4), 297-318.

Kowalski, T. J., Weaver, R. A., & Henson, K. T. (1990). *Case studies on teaching.* New York: Longman.

Krathwohl, D. R., Bloom, B. S., & Masia, B. B. (1956). *Taxonomy of educational objectives: The classification of educational goals, handbook II: Affective domain*. New York: David McKay Co.

Kuhn, D. & Dean, D. (2004). A bridge between cognitive psychology and educational practice. *Theory into Practice*, *43*(4), 268-273.

Kumta S. M., Psang P. L., Hung L. K., Chenge J. C. Y. (2003). Fostering critical thinking skills through a web-based tutorial programme for first year medical students – A randomized controlled study. *Journal of Educational Multimedia and Hypermedia*, *12*(3), 267-273.

Laboskey, V. K. (1992). Case investigations: Pre-service teacher research as an aid to reflection. In J. H. Shulman (Ed.), *Case methods in teacher education* (pp. 175-193). New York, NY: Teachers College Press.

Lacey, C. A. and Merseth, K. K. (1993) Cases, hypermedia and computer networks: Three curriculum innovations for teacher education. *Journal of Curriculum Studies*, 6, pp. 543-552.

Lampert, M. (1990). When the problem is not the question and the solution is not the answer: Mathematical knowing and teaching. *American educational research journal*, *27*(1), 29-63.

Lave, J. and Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

LeCompte, M. D., & Preissle, J. (1993). *Ethnography and qualitative design in educational research*. (2nd Ed.). San Diego: Academic Press.

Lee, S. H., Lee, J., Liu, X., Bonk, C. J., & Magjuka, R. J. (2009). A review of case-based learning practices in an online MBA program: A program-level case study. *Educational Technology & Society*, *12* (3), 178–190.

Leinhardt, G., & Greeno, J. G. (1986). The cognitive skill of teaching. *Journal of Educational Psychology*, *78*, 75-95.

Levin, B. B. (1993). *Using the case method in teacher education: The role of discussion and experience in teachers thinking about cases*. Unpublished doctoral dissertation, University of California, Berkeley.

Levin, B.B. (1995). Using the case method in teacher education: The role of discussion and experience in teachers' thinking about cases. *Teaching and Teacher Education*, *11*, 63-79.

Levin, B. B., He, Y., & Robbins, H. H. (2006). Comparative analysis of pre-service teachers' reflective thinking in synchronous versus asynchronous online case discussions. *Journal of Technology and Teacher Education*, *14*(3), 439-460.

Linn, M. C., Songer, N. B., & Eylon, B. S. (1996). Shifts and convergences in science learning and instruction. In R. Calfee & D. Berliner (Eds.), *Handbook of Educational Psychology* (pp. 438-490). Riverside, NJ: Macmillan.

Lipshitz, R., Klein, G., Orasanu, J., & Salas, E. (2001). Taking stock of naturalistic decision making. *Journal of Behavioral Decision Making*, *14*, 331–352.

Lundeberg, M. A., Bergland, M., Klyczek, K., & Hoffman, D. (2003). Using action research to develop preservice teachers' beliefs, knowledge and confidence about technology. *Journal of Interactive Online Learning*, 1(4). Retrieved July 15, 2012, from http://www.ncolr.org/jiol/issues/pdf/1.4.5.pdf

Luo, H., & Koszalka, T. (2011). Making Design Decisions Visible: Applying the Case-Based Method in Designing Online Instruction. *International Journal of Designs for Learning*. *2*(1), Multimedia. Retrieved from http://scholarworks.iu.edu/journals/index.php/ijdl/article/view/1102/1296

Mackay, N. (1997). Constructivism and the logic of explanation. *Journal of Constructivist Psychology*, *10*, 339–361. http://dx.doi.org/10.1080/10720539708404631

Martinez, M. E. (2006). What is metacognition? *Phi Delta Kappan*, 696-699.

Masoner, M. (1988). *An audit of the case study method.* New York: Praeger.

Matejka, J. K. & Cosse, T. J. (1981). *The business case method: an introduction*. Richmond, Va.: Robert F. Dame.

Mayer, R. E., & Sims, V. K. (1994). For whom is a picture worth a thousand words? Extensions of a dual-coding theory of multimedia learning. *Journal of educational psychology*, *86*(3), 389-401.

Mayo, J. (2002). Case-based instruction: A technique for increasing conceptual application in introductory psychology. *Journal of Constructivist Psychology*, 15, 65-74.

McAninch, A. R. (1993). *Teacher thinking and the case method*. New York: Teachers College Press.

McNaughton, D., Hall, T. E., & Maccini, P. (2001). Case-based instruction in special education teacher preparation: Practices and concerns of teacher educator/researchers. *Teacher Education and Special Education*, *24*(2), 84-94.

McNaught, C., Lam, P., Ong, D., & Lau, L. (2007). Challenges in assessments in a case-based science course. In S. Frankland (Ed.), *Enhancing teaching and learning through assessment: Deriving an appropriate model* (pp. 256–264). Dordrecht: Springer.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.

Merseth, K. K. (1991). The early history of case-based instruction: Insights for teacher education today. *Journal of Teacher Education, 42*(4), 243-249.

Merseth, K. K., & Lacey, C. A. (1993). Weaving stronger fabric: The pedagogical promise of hypermedia and case methods in teacher education. *Teaching & Teacher Education*, *9* (3), 283—300.

Merseth, K. K. (1996). Cases and case methods in teacher education. In Sikula, John (Ed.), *Handbook of Research on Teacher Education* (2nd Ed.) (pp. 722-741). New York: Macmillan and the Association of Teacher Educators.

Miles, M.B. & Huberman, A.M. (1984) *Qualitative Data Analysis: A Sourcebook of New Methods*. Beverly Hills, CA: Sage Publications.

Miles, MB. & Huberman, AM. (1994). *Qualitative Data Analysis* (2nd edition). Thousand Oaks, CA: Sage Publications.

Miller, G. A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological review, 63*(2), 81-97.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for integrating technology in teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.

Mitchem, K. J., Fitzgerald, G., Hollingsead, C., Koury, K., Miller, K., & Tsai, H. (2008). Enhancing case-based learning in teacher education through online discussions: Structure and facilitation. *Journal of Interactive Learning Research*, *19*(2), 331-349.

Molenda, M. (2003). In search of the elusive ADDIE model. *Performance improvement*, *42*(5), 34-37.

Morrison, G. R., Ross, S. M., & Kemp, J. E. (2004). *Designing effective instruction* (4th ed.), New York, NY: John Wiley & Sons Inc.

National Center for Education Statistics. (2010). Digest of Education Statistics, 2009 (NCES 2010-013), Chapter 2. Retrieved from http://nces.ed.gov/pubs2010/2010013_2a.pdf.

Nolan, R. (1994). *Cognitive practices: Human language and human knowledge*. Oxford: Blackwell.

Noordhoff, K., & Kleinfeld, J. (1991, April). *Preparing teachers for multicultural classrooms: A case study in rural Alaska*. In annual meeting of the American Educational Research Association, Chicago.

Norman, D. N. (1988). *The design of everyday things*. New York: Doubleday

Oha, E., & Reeves, T. (2010). The implications of the differences between design research and instructional systems design for educational technology researchers and practitioners. *Educational Media International*, *4*(47), 263–275.

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: Recent developments. *Educational Psychologist*, *38*, 1–4.

Paris, S. G. & Winograd, P. (1990). Promoting metacognition and motivation of exceptional children. *Remedial and Special Education*, *11*(6), 7-15.

Paris, S. G. (1997). Situated motivation and informal learning. *The Journal of Museum Education*, *22*(2/3), 22-27.

Patterson, R., Fournier, L., Pierce, B.P., Winterbottom, M. & Tripp, L. (2009). System dynamics modeling of the recognition-primed decision model. *Journal of Cognitive Engineering and Decision Making*, 3, 250-276.

Patton, Q. M. (1990). *Qualitative Evaluation and Research Methods* (2nd Ed). Sage Publications Inc., Newsbury Park, London, New Dehli.

Peshkin, A. (1988). In search of subjectivity—one's own. *Educational researcher*, *17*(7), 17-21.

Powell, A. G. (1980). *The uncertain profession. Harvard and the search for educational authority*. Cambridge, MA: Harvard University Press.

Reigeluth, C. M. (1989). Educational technology at the crossroads: new mindsets and new directions. *Educational Technology Research & Development*, *37* (1), 67-80.

Reigeluth, C. M. (1999). What is instructional-design theory? In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (pp. 5-29). Mahwah, NJ: Lawrence Erlbaum Associates.

Reigeluth, C. M., & An, Y. (2006). Functional contextualism: An ideal framework for theory in instructional design and technology. *Educational Technology Research & Development, 54*(1), 49-53.

Reigeluth, C. M. & Frick, T. W. (1999). Formative research: A methodology for creating and improving design theories. In C.M. Reigeluth (Ed.), *Instructional-Design Theories and Models – A New Paradigm of Instructional Theory* (pp. 633-652). New Jersey: Lawrence Erlbaum.

Richardson, V. (1993). Use of cases in considering methods for motivating students. In H. Harrington & H. Thompson (Eds.), *Student motivation and case study manual* (pp. 57—60). Boone, NC: Appalachian State University.

Richert, A. E. (1991). Case methods and teacher education: Using cases to teach teacher reflection, In B. R. Tabachnik & K. Zeichner (Eds.), *Issues and practices in inquiry-oriented teacher education* (pp. 130—150). London: Palmer.

Richey, R. C., & Klein, J. D. (2007). *Design and development research*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Riesbeck, C.K., & Schank, R. (1989). *Inside case-based reasoning*. Northvale, NJ: Erlbaum

Risko, V.J., Yount, D., & McAllister, D. (1992). Preparing preservice teachers for remedial instruction: Teaching problem solving and use of content and pedagogical knowledge. In N. Padak, T.V. Rasinski, & J. Logan (Eds.), *Inquiries in literacy learning and instruction* (pp. 179-189). Pittsburg, KS: College Reading Association.

Ritchie, J., Lewis, J., & Elam, G. (2003). Designing and selecting samples. *Qualitative research practice: A guide for social science students and researchers, 2*, 111-145.

Rosen, D. (2008). Impact of case-based instruction on student teachers' reflection on facilitating children's learning. *Action in teacher education*, *30*(1), 28-36.

Ross, B. H. (1989). Some psychological results on case-based reasoning. In K.J. Hammond. (Ed.) *Proceedings: Second Workshop on Case-Based Reasoning (DARPA).* San Mateo, CA: Morgan Kaufmann.

Reber, A. S. (1995). *The Penguin Dictionary of Psychology*. New York: Penguin Books.

Reeves, T. C. (1995). Questioning the questions of instructional technology research. In M. R. Simonson & M. Anderson (Eds.), *Proceedings of the Annual Conference of the Association for Educational Communications and Technology, Research and Theory Division* (pp. 459-470), Anaheim, CA.

Reeves, T. C. (1999). A research agenda for interactive learning in the new millennium. In B. Collis & R. Oliver (Eds.). *Proceedings of the World Conference on Educational*

Multimedia, Hypermedia and Telecommunications (pp. 15-20). Charlottesville, VA: Association for the Advancement of Computers in Education.

Reeves, T.C., Herrington, J., & Oliver, R. (2005). Design research: A socially responsible approach to instructional technology research in higher education. *Journal of Computing in Higher Education*, *16*(2), 97-116.

Reigeluth, C. M. (1999). What is instructional-design theory? In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (pp. 5-29). Mahwah, NJ: Lawrence Erlbaum Associates.

Reigeluth, C. M. & Frick, T. W. (1999). Formative research: A methodology for creating and improving design theories. In C.M. Reigeluth (Ed.), *Instructional-Design Theories and Models – A New Paradigm of Instructional Theory* (pp. 633-652). New Jersey: Lawrence Erlbaum.

Rosen, D. (2008). Impact of case-based instruction on student teachers' reflection on facilitating children's learning. *Action in teacher education*, *30*(1), 28-36.

Ross, S. M., Morrison, G. R., & Lowther, D. L. (2010). Educational technology research past and present: Balancing rigor and relevance to impact school learning. *Contemporary Educational Technology*, *1*, 17 – 35.

Saint-Gennain, H. (1993). *L'Ecriture de cas*. Rimouskj: ACPAS.

Saldaña, J. (2013). *The coding manual for qualitative researchers* (2nd ed). Thousand Oaks, California: Sage Publications Ltd.

Sandberg, J., & Wielinga, B. (1992). Situated cognition: A paradigm shift? *Journal of Artificial Intelligence in Education*, *3*, 129-138.

Savenye, W.C., & Robinson, R.S. (2004). Qualitative research issues and methods: An introduction for educational technologists. In Jonassen, D.H. (2004). *Handbook of Research on Educational Communications and Technology* (pp.1045-1072). Mahwah, NJ: Erlbaum.

Saye, J., & Brush, T. (2001). The use of embedded scaffolds with hypermedia-supported student-centered learning. *Journal of Educational Multimedia and Hypermedia*, *10*(4), 333-356.

Schank, R. C. (1999). *Dynamic memory revisited*. New York: Cambridge University Press.

Schell, J. W., & Black, R. S. (1997). Situated learning: An inductive case study of a collaborative learning experience. *Journal of Industrial Teacher Education*, *34*(4), 5–28.

Schneider, W. & Lockl, K. (2002). The development of metacognitive knowledge in children and adolescents. In Perfect, T. & Schwartz, B. (Eds.), *Applied metacognition*. Cambridge, UK: Cambridge University Press.

Schofield, J. W. (1990). Increasing the generalizability of qualitative research. In E. Eisner & A. Peshkin (Eds.), *Qualitative inquiry in education: The continuing debate* (pp. 201-232). New York: Teachers College Press.

Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education, 36*, 111-139.

Schwandt, T. A. (1994) Constructivist, Interpretivist Approaches to Human Inquiry. In: N.K.Denzin and Y.S.Lincoln (eds) *Handbook of Qualitative Research*, pp. 118-137. London: Sage.

Schwier, R.A. & Misanchuk, E. (1993). Interactive Multimedia Instruction. Englewood Cliffs, NJ: Educational Technology Publications.

Scott, K.M., Kitching, S., Burn, D., Koulias, M., Campbell, D. & Phelps, M. (2010). "Wherever, whenever" learning in Medicine: Interactive mobile case-based project. In C.H. Steel, M.J. Keppell, P. Gerbic & S. Housego (Eds.), *Curriculum, technology & transformation for an unknown future. Proceedings ascilite Sydney 2010* (pp.888-890). Retrieved from http://ascilite.org.au/conferences/sydney10/procs/Scott-poster.pdf

Seale, C. (1999). Quality in qualitative research. *Qualitative Inquiry*, *5*(4), 465-478.

Selwyn, N. (2011). In praise of pessimism: the need for negativity in educational technology. *British Journal of Educational Technology*, *42*(5), 713-718.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, *22*(2), 63-75.

Shute, V. J., & Glaser, R. (1990). A large-scale evaluation of an intelligent discovery world: Smithtown. *Interactive Learning Environments*, *1*(1), 51-77.

Shulman, J. H., Colbert, J. A., Kemper, D., & Dmytriw, L. (1990). Case writing as a site for collaboration. *Teacher Education Quarterly*, *17*(1), 63-78.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–22.

Shulman, L. S. (1992). Toward a pedagogy of cases. Ln J. Shulman (Ed.), *Case methods in teacher education* (p. 1—30). New York: Teachers College Press.

Silverman, D. (2000). *Doing qualitative research: A practice handbook*. London: Sage.

Smith, J. C., & Diaz, R. (2002). Evolving uses of technology in case-based teacher education. Retrieved June 15, 2012, from http://www.eric.ed.gov/PDFS/ED469864.pdf

Smith, P.L., & Ragan, T. J. (1999). *Instructional design* (2nd ed.). Columbus, OH: Merrill/Prentice Hall.

Spector, J. M. (2010). An overview of progress and problems in educational technology. *Digital Education Review*, (3), 27-37.

Spiro, R.J., Feltovich, P.J., Jacobson, M.J., & Coulson, R.L. (1991a). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. *Educational Technology*, *31*(5), 24-33.

Stake, R. E. (2005). Qualitative case studies. In N. K. Denzin, & Y.S. Lincoln (Eds.), *The Sage handbook of qualitative research* (3rd ed., pp. 443-466). Thousand Oaks, CA: Sage.

Stenbacka, C. (2001). Qualitative research requires quality concepts of its own. *Management Decision*, *39*(7), 551-555

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques.* Newbury Park, CA: Sage.

Stolovitch, H. D., Keeps, E. J. (1991). Selecting and Writing Case Studies for Improving Human Performance. *Performance Improvement Quarterly*, *4*(1), 43-54.

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and instruction*, *4*(4), 295-312.

Sykes, G. and Bird, T. (1992) Teacher education and the case idea. In Grant, G. (ed.) *Review of research in education*, (pp. 457-521). Washington, DC: American Educational Research Association.

The Consortium for Entrepreneurship Education. (2004). National Content Standards for Entrepreneurship Education. Retrieved from http://www.entre-ed.org/Standards_Toolkit/index.htm

Thomas, M. D., O'Connor, F. W., Albert, M. L., Boutain, D., & Brandt, P. A. (2001). Case-based teaching and learning experiences. *Issues in mental health nursing*, *22*(5), 517-531.

Tippins, D. J., Koballa, T. R., & Payne, B. D. (2002). *Learning from cases: Unraveling the complexities of elementary science teaching*. Boston, MA: Allyn and Bacon.

Tripp, S.D. (1993). Theories, traditions and situated learning. *Educational Technology*, *33*(3), 71-77.

Uribe, D., & Klein, J. D. (2003). The effect of case based vs. systematic problem solving in a computer-mediated collaborative learning environment. *Quarterly Journal of Research on Distance Education*, *4*(4), 417-435.

van den Akker, J. (1999). Principles and methods of development research. In J. van den Akker, N. Nieveen, R.M. Branch, K.L. Gustafson & T. Plomp (Eds.), *Design methodology and developmental research in education and training* (pp. 1-14). The Netherlands: Kluwer Academic Publishers.

van den Akker, J., Bannan, B., Kelly, A., Nieveen, N., & Plomp, T. (2007). *An introduction to educational design research*. Paper presented at the Conference on An Introduction to Educational Design Research, Shanghai, China.

Van Merriënboer, J. J., Clark, R. E., & De Croock, M. B. (2002). Blueprints for complex learning: The 4C/ID-model. *Educational Technology Research and Development, 50*(2), 39-61.

van Merrienboer, J. J. G., Kester, L., & Pass, F. (2006). Teaching complex rather than simple tasks: Balancing intrinsic and germane load to enhance transfer of learning. *Applied Cognitive Psychology, 20*, 343–352.

Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., & Afflerbach, P. (2006). Metacognition and learning: conceptual and methodological considerations. *Metacognition and Learning, 1*, 3-14.

Vinaja, R., & Raisinghani, S. (2001, December). *Teaching with online case studies: Implementation and evaluation issues.* Paper presented at the annual meeting of the International Academy for Information Management, New Orleans, LA.

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development, 53*(4), 5-23.

Wang, M. J. (2010). Online collaboration and offline interaction between students using asynchronous tools in blended learning. *Australasian Journal of Educational Technology, 26*(6), 830-846.

Wasserman, S. (1994). *Introduction to case method teaching: A guide to the galaxy*. New York: Teachers College Press.

Watson W. (2007) *Formative research on an instructional design theory for educational video games* (Doctoral dissertation, Indiana University).

Williams, S. M. (1992). Putting Case-Based Instruction Into Context: Examples From Legal and Medical Education. *Journal of the Learning Sciences*, *2*(4), pp.367-427.

Willis, J. (2007). *Foundations of qualitative research: Interpretive and critical approaches*. Thousand Oaks, CA: Sage Publications.

Wilson, S. M. (1989). *A case concerning content: Using case studies to teach subject matter* (pp. 64-89). National Center for Research on Teacher Education.

Winkler, J. D., & Polich, J. M. (1990). *Effectiveness of interactive videodisc in Army communication training*. (ERIC Document Reproduction Service No. ED337144)

Wood, P. K. (1997). A secondary analysis of claims regarding the Reflective Judgment interview: Internal consistency, sequentiality and intra-individual differences in ill-structured problem-solving. In *Higher education: Handbook of theory and research* (Vol. 12, pp. 243-312). New York: Agathon.

Worthen, B., & Sanders, J. (1987). *Educational evaluation: Alternative approaches and practical guidelines*. New York: Longman.

Yin. R. K. (1984). *Case study research design and methods (1st ed.).* Beverly Hills, CA: Sage Publications

Yin, R. K. (2009). *Case study research: Design and methods (4th ed.)*. Thousand Oaks, CA: Sage Publications.

Young, M.F. (1993). Instructional design for situated learning. *Educational Technology Research and Development*, *41*(1), 43-58

VITA

NAME OF AUTHOR: Heng ‘Patrick’ Luo

PLACE OF BIRTH: Wuhan, China

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:

China University of Geosciences, Wuhan, China

DEGREES AWARDED:

Master of Science in Instructional Design, Development, and Evaluation, 2013, Syracuse University

Master of Art in Linguistics and Applied Linguistics, 2008, China University of Geosciences

Bachelor of Engineering in Electronic Engineering, 2005, China University of Geosciences

AWARDS AND HONORS:

The Outstanding Research Paper Award in AECT’s Training and Performance Division—2014

Penn State COIL Research Initiative Grant Recipient—2013

Syracuse University Certificate in University Teaching—2012

Syracuse University School of Education, Research and Creative Grant Award

Recipient—2012

William M. Millard Instructional Technology Graduate Scholarship—2010

Syracuse University Graduate Fellowship—2008

Award of Excellent Thesis in Hubei Province, China—2008

PROFESSIONAL EXPERIENCE:

Research Associate, the Pennsylvania State University, 2013-present

Graduate Teaching Assistant, Syracuse University, 2011-2013

English Instructor, Jiangcheng College, 2006-2008