Description of Instructional Design Framework Usage in the Development of Learning Objects

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ABSTRACT

The present study used a case study approach to gather information about learning object usage from multiple instructional design contexts. The study examined three case contexts: A non-profit organization, a corporate organization, and a military organization. The research obtained information from two sources within each context – interviews conducted with current instructional design practitioners and documentation used within the process of developing learning objects – to find out if, when, and how, instructional design processes are modified to accommodate learning objects as defined in publications reviewed in this study. The interview of the practitioners identified issues of instructional design process structure, context, and methods that were used in the context of their professional practice, as well as solicited their opinions on learning object uses for their particular context. A document analysis approach was then used to identify issues and themes within learning object development. Document analysis was also used to further explain and clarify the findings of the interview of the research participants.

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Chapter 1: Introduction and Need for the Study

Introduction

In commercial instructional development, there are generally three criteria for evaluating instructional development: cost, quality, and speed (Wiley, 2005). Often only two of these criteria can be met simultaneously. For example: Materials can be developed quickly at a high cost; materials can be developed inexpensively at low quality and so on (Wiley, 2005). The idea of rapidly creating quality learning modules at a minimum cost often refers to the re-usability of portions of instruction within a standard format (Poldoja, Leinonen, Valjataga, Ellonen, & Priha, 2006). These reusable educational items are known as learning objects.

Defining learning objects has proven to be a difficult task because there are many varying definitions of learning objects currently being used (Parrish, 2004). Instructional designers practice their craft in a multitude of career contexts, therefore, learning objects are used in multiple settings. Many researchers have attempted to define learning objects, however, the context in which the learning object will be used has a direct correlation to the definition of learning objects. Variations in size, instructional content, instructional strategies, administrative features, and testing cause researchers to define learning objects differently (Fletcher, Tobias, & Wisher, 2007).

The literature reviewed indicates that current research surrounding learning objects in practice does not seem to examine how the uses of learning objects affects the instructional design process. The present study used a case study approach to gather information about learning object usage from multiple instructional design contexts. The

study examined three case contexts: A non-profit organization, a corporate organization, and a military organization. The research obtained information from two sources within each context – interviews conducted with current instructional design practitioners and documentation used within the process of developing learning objects – to find out if, when, and how, instructional design processes are modified to accommodate learning objects as defined in publications reviewed in this study. The interview of the practitioners identified issues of instructional design process structure, context, and methods that were used in the context of their professional practice, as well as solicited their opinions on learning object uses for their particular context. A document analysis approach was then used to identify issues and themes within learning object development. Document analysis was also used to further explain and clarify the findings of the interview of the research participants.

Instructional Design and Learning Objects

Instructional Design and Technology

Reiser (2001) defined instructional technology to include "(a) the use of media for instructional purposes and (b) the use of systematic instructional design procedures (often simply called instructional design)" (p. 54). Seels and Richey (1994) defined the field of instructional technology as the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning. Reiser and Dempsey (2007) on the other hand, provided a briefer definition of instructional design as "a systematic process that is employed to develop education and training programs" (p.11). Furthermore, Smith and Ragan (2005, paragraph four), contended that "Instructional Design refers to the systematic and reflective process of translating principles of learning

and instruction into plans for instructional materials, activities, information resources, and evaluation". Reiser (2001) went on to define the field more specifically:

> The field of instructional design and technology encompasses the analysis of learning and performance problems, and the design, development, implementation, evaluation and management of instructional and non-instructional processes and resources intended to improve learning and performance in a variety of settings, particularly educational institutions and the workplace. Professionals in the field of instructional design and technology often use systematic instructional design procedures and employ a variety of instructional media to accomplish their goals. Moreover, in recent years, they have paid increasing attention to non-instructional solutions to some performance problems. Research and theory related to each of the aforementioned areas is also an important part of the field. (Reiser, 2001, pp. 53-64)

These varied but related definitions indicate the instructional design process is systematic and that it involves some designing, development, implementation and evaluation and revision of some kind.

Learning Objects

The term" learning object" has grown to generate multiple definitions. For purposes of this study, a definition by Wiley (2002). Wiley (2002) termed a learning object as any digital resource that can be reused to support learning. This definition includes anything that can be delivered across the network on demand, be it large or small. Examples of smaller reusable digital resources include digital images or photos, live data feeds (like stock tickers), live or prerecorded video or audio snippets, small bits

of text, animations, and smaller web-delivered applications, like a Java calculator. Examples of larger reusable digital resources include entire web pages that combine text, images and other media or applications. Alonso, Lopez, Manrique, and Vines (2008) further pointed out that learning objects are designed to deal with information related to a very specific item of knowledge.

In these two varied definitions, one feature about learning objects clearly comes out, their reusability. This feature gives learning objects great value that would hugely benefit instructional designers.

Purpose Statement

The purpose of the present study was to find out how the use of learning objects impacts the instructional design process. Through in-depth interviews with Instructional Design and Technology (IDT) practitioners and document analysis, the study aimed at acquiring an in-depth understanding of the current practices used in the development of instructional materials using learning objects and how learning objects fit into those development processes.

Research Question

The present study sought to answer the following research question:

"How do current IDT practitioners utilize learning objects in the development of instructional design frameworks for instructional materials?"

Importance of the Study

The qualitative findings of the study may provide useful information to practitioners that wish to use learning objects in the development of instructional materials. This study would help to expand the existing body of literature on learning

objects and instructional design processes. There is very little literature that encompasses both instructional design processes and learning objects simultaneously. Most of the current literature discusses pedagogy and learning objects; learning objects and their interoperability; user perceptions of learning objects; effectiveness of learning objects; and the problems and concerns associated with using learning objects. Through a combination of in-depth interviews and document analysis, this study investigates and describes the process of developing instructional materials that include learning objects and thereby contributes to filling the gap in instructional design research and learning objects.

Definition of Terms

Definition of key terms used throughout this document is presented in this section so that potential ambiguities do not obscure the readers' understanding of issues raised in this study.

Instructional Design Process: The instructional design process is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. The design process encompasses the entire process of developing instructional materials including; analysis, design, development, implementation and evaluation (Reiser, 2001; Reiser & Dempsey, 2007; Sees & Richey, 1994).

Learning objects: A learning object is any digital resource that can be reused to support learning. This definition includes anything that can be delivered on demand, be it large or small (Wiley, 2002).

Organization of the Study

Chapter One provides background information to the study. It addresses the research problem, introduces the research question, purpose, and importance of the study. Chapter Two provides a rich account of the literature espoused in relation to this study. Chapter Three on the other hand provides an in depth account of the methodological approach that was employed to address the set research question to guide the present study. The rationale for the study and the research strategy are discussed in detail. Chapter Four analyzes and discusses the data collected through interviewing practitioners in three organizations that currently participate in the design of instruction using learning objects. Chapter Five presents a summary of the study where conclusions and final implications are made including a discussion of contributions of the study, limitations and directions for future investigations. Finally, supporting documents to the study are included in the appendices section at the end of the document.

Chapter 2: Review of Literature

Introduction

In order to identify a gap related to the extent to which the use of learning objects impacts the instructional design process, an in-depth review of the literature on learning objects and instructional design was conducted. This chapter begins with a description of instructional design practices in the business and industry settings and goes on to define learning objects and how they could potentially fit the into instructional design process. Specifically, the review identifies advantages of using learning objects and their specific uses, challenges associated with their use and also empirical research associated with learning objects. The literature review goes on to describe the instructional design process with a detailed description of the most basic and popular Analyze, Design, Develop, Implement and Evaluate (ADDIE) model. In the overall summary of the review, a need for this study is identified..

Instructional Design

Instructional design is a career field in which practitioners have various career environments and positions from which to choose, including higher education, K-12 education, corporate education, government agencies, healthcare, and non-profit organizations (Larson & Lockee, 2004; Larson & Lockee 2009). With each of the environments identified, inherently, there are variations in the job role of the instructional designer. Project manager, subject matter expert, trainer, instructor, curriculum designer, and human performance technologist are just a few of the potential roles of an instructional designer (Larson & Lockee, 2004; Larson & Lockee 2009; Park, Kim, & Byun, 1999). Although instructional design positions are available in each of the career environments listed above, educational institutions and corporations represent the

environments in which most instructional designers practice (Cennamo & Kalk, 2004). The context in which education is developed has proven to have an effect on instructional design roles, resources, use of instructional design models, and implementation of instructional strategies (Cennamo & Kalk, 2004; Gustafson & Branch, 2002: Larson & Lockee, 2004; Noe, 2002). The following research will explore the development process of instructional materials to identify commonalities and trends across different settings.

Instructional Design in the Business and Industry

Business and industry settings serve as some of the largest employers of instructional design professionals (Cennamo & Kalk, 2004; Richey, Morrison, & Foxon, 2002). Business and industrial settings often produce instructional materials to train staff members on how to improve their current job functions, inform target customers of product functions and uses (instructional manuals, etc.), and are designed to be sold as a product (Cennamo & Kalk, 2004). Within the corporate sector of instructional design, instructional design professionals generally serve as individual designers, members of a design team, and consultants (Dick, Carey, & Carey, 2000; Richey, et al., 2002; Larson & Lockee 2009). Many of the materials developed by instructional designers are delivered by trainers or some form of digital delivery (Cennamo & Kalk, 2004). Specific models are used to address the needs of corporate instruction. Product oriented models have been designed help aid instructional designers in instructional design in corporate settings (Gustafson & Branch, 2002).

Corporate instructional design is often called product oriented design, which addresses the needs of instruction related to the development of materials that are intended to serve as a standalone instructional product (Gustafson & Branch, 2002). Four

assumptions characterize the features of a product oriented instructional design. The first assumption is the need for the instructional product. The second assumes that materials need to be produced instead of revising an existing product. Third, assume multiple iterations in the development of the product. And lastly, the product must not require a teacher for delivery (Gustafson & Branch, 2002).

Higher education instruction is designed to meet the needs of students who will enroll in classes that will meet for a predetermined length of time or a predetermined amount of sessions (Gustafson & Branch, 2002). Instructional design positions within higher education include instructional technologists, instructional designers, distance learning coordinators, instructional technology manager/administrators, technical support specialists, web development specialists, and instructional technology librarians (Surry & Robinson, 2001). In cases where resources are limited, traditional faculty positions such as instructors or professors are called upon to design, develop and facilitate an entire online course (Gustafson & Branch, 2002; Surry & Robinson, 2001).

In the case of developing a course for higher education, often this involves making adaptations to existing courses to meet the need of the online environment (Gustafson & Branch, 2002). Use of instructional design models is appropriate for redesigning courses for e- learning because the complex process of restructuring material for online delivery requires planning and implementation procedures (Passerini & Granger, 2000).

Literature has identified the Analyze, Design, Develop, Implement, and Evaluation (ADDIE) as the stages used among the common models in corporate

instructional design for process based instructional design as well as higher education (Cennamo & Kalk, 2004; Gustafson & Branch, 2002; Noe, 2002).

Learning objects: What are they?

In most cases, researchers identify learning objects as digital resources that are reusable and serve an educational purpose (Kim, 2009; McGreal, 2004; Quinn & Hobbs, 2000; Van Merrienboer & Boot, 2005; Wiley, 2005). Learning objects have also been defined as small instructional components that are reused by instructional developers when creating multiple learning units (Alonso, Lopez, Manrique, & Vines, 2008). In most cases, researchers identify learning objects by three necessary features. Learning objects are designed to deal with information related to a very specific item of knowledge. So, initially, to qualify as a learning object, it has to be determined if it can be used to teach or learn, which can only be determined by its use (McGreal, 2004; Sosteric & Hesemeier, 2002). Second, proponents of digital learning objects argue that the idea of a learning object has grown out of the object-oriented programming movement (Quinn & Hobbs, 2000). Thirdly, these proponents also argue that the term learning object should not be used to describe non-digital entities (McGreal, 2004). Wiley (2000) stated that a learning object is any digital resource that can be used to support learning. More specifically, Wiley (2002) went on to term a learning object as any digital resource that can be reused to support learning. This definition includes anything that can be delivered across the network on demand, be it large or small. In the final analysis, when these objects are combined, they can help to support attainment of individual instructional objectives in a variety of different contexts (Alonso, et al., 2008).

Education is a field that is constantly changing, and a continuous effort is required by developers to update courses (Weller, 2004). High costs associated with development of instructional materials have the potential of being alleviated if created materials reach a large audience of learners through reuse (Parrish, 2004). Literature states that cost-effectiveness, reusability, modifiability and adaptability serve as the benefits of associated with the use of learning objects (Nurmi & Jaakkola, 2006).

Granularity

As Fletcher at al. (2007) observed, granularity of digital learning resources refers to size, decomposability and the extent to which a resource is intended to be used as part of a larger resource. The size of learning objects is often subject to the needs of the creator. Instructional goals serve as the basis for granularity optimization (South & Monson, 2002). Size or granularity of learning objects may range from complete instructional units to fine grained instructional activities (Kinshuk & Patel, 2005). In Table 3, Kim (2009) identifies five granularity levels that have emerged as a result of comprehensive research.

Table 3
Granularity levels

Granularity Level	Grain Type	Characteristics
Level 1	Asset	Individual Media Units
Level 2	Combined Media	Multimedia Objects
Level 3	Instructional Concept	A portion of instruction designed to meet a single instructional need or assessment utilizing several combined media.
Level 4	Lesson or Module	A combination of multiple instructional concepts/ units.
Level 5	Course	Several lessons or modules that combine to create an entire course
Data adapted from (Kim, 2009)		

Each granularity level is categorized by the level of detail contained in the learning object, its size, and its potential for reuse (Silveira et al., 2007). No general consensus has been found that identifies the optimal granularity level across all educational settings (Wiley, 2005).

Advantages of using Learning Objects

The main advantage of learning objects is the ability to reuse and repurpose information. Reuse drives the interest in learning objects because complete instructional modules are rarely appropriate in all contexts. However, pieces of instruction can be repurposed and reused across institutions, courses, subject areas and countries (Weller, 2004). The reuse of information in multiple learning environments and context seeks to

support designers in the development process of instruction (Kim, 2009). Kim (2009) went on to point out that the reuse of learning objects in multiple contexts turns them into what are called universal learning objects.

Learning objects potentially offer economic benefits because of the increased scalability and ability to facilitate reuse beyond its original context (Parrish, 2004). Also, when technology standards and procedures are in place, learning objects have the potential to cut costs and time because there may not be a need to create complete instruction each time a new module of learning is needed (Robles, 2007).

Challenges in using Learning Objects

Researchers generally agree that reuse of digital learning objects could be valuable, however, reuse of digital materials has not yet been widely accepted in mainstream higher education and company training settings (Collis & Strijker, 2001). Research states the designers should not expect to see a high level of reuse of learning objects because previous attempts at structuring systems of learning objects have failed to show significant progress (Roschelle et al., 2000). Lack of reuse of digital learning resources can be attributed to a number of factors (Collis, Peters, & Pals, 2001).

Again, learning object implementation requires large amounts of instructional content development efforts that often prove to be difficult because of time, budget and expertise constraints (Van Merrienboer & Boot, 2005). Adoption of the learning object approach to address these product requirements has led to debates on the quality of the resulting educational product (Rehak & Mason, 2003).

Technical Considerations

An interest has been taken in improving the cost effectiveness of developing and deploying educational materials. Developers have approached this trend by attempting to standardize digital learning material (Berge & Slotta, 2007).

The Institute of Electrical and Electronic Engineers (IEEE) has prescribed a series of standard specifications for learning objects meta-data that is used when implementing an object-oriented programming approach (El Saddik, Ghavam, Fischer, & Steinmetz, 2000). IEEE's goal in creating learning object meta-data standards was to manage, locate, and evaluate learning objects while using a minimal amount of attributes (IEEE, 2011). According to El Saddik, Ghavam, Fischer and Steinmetz (2000), information gathered in meta-data for learning objects seeks to summarize data, make data searchable, instruct learners how to interpret the data, and restrict access to the data.

Further attempts have been made to ensure that learning objects subscribe to a uniform protocol so that they remain shareable across multiple systems. The Shareable Content Object Reference Model (SCORM) standards have been seen to serve as a integrated set of technical standards, specifications and guidelines that have become the industry standard for learning and content development (SCORM, 2011).

Nomenclature issues have proven to be problematic in the use of learning objects. When designers are searching for items within a learning object repository, they are likely to find a vast array of terms that describe the educational objects (Nash, 2005). Access to learning objects within a repository proves to be impossible unless designers implement a standardized meta-data description and labeling format (Lim, 2007).

Uses of Learning Objects

Similar to the advancements realized in software development, instructional systems promise to improve because of the paradigm shift emerging as a result of learning objects (Douglas, 2001). Learning objects have the potential to make instructional design systems more efficient through the use of existing materials. Learning objects have been used in the development of many instructional design systems because of their development potential (Kim, 2009). Spector and Ohrazda (2003) described two automated instructional design systems that utilize learning objects to aid designers in the ID process. The Guided Approach to ID Advising, and Generic Tutoring Environment both incorporated learning objects guidelines in the design by providing completed examples of instructional units to guide users to incorporate predetermined instructional design principles (Spector & Ohrazda, 2003).

Wiley (2005) argued "Once a collection of learning objects exists, and has been stored and cataloged in a digital library or other storage and indexing facility, instructional designers may select and aggregate learning objects from within the collection" (p.2). These digital libraries or repositories can be made to meet the needs of the general public, or specialized training populations by housing objects on internet based servers that allow simultaneous access by ID professionals (Nash, 2005).

Copyright and Modifiability Issues in Using Learning Objects

As instructional designers attempt to use learning objects to develop instructional material that may not be delivered in the original context, copyright infringement may become an issue. To what extent the information contained in the learning object can be used has been identified as a concern among learning object developers (Guler & Altun,

2010). Modification of learning objects can also present challenges. Modifiability of learning objects may be necessary for the instructional designer to have the learning object meet the needs of the new context for which instruction is to be designed (Kurilovas, Bireniene, & Serikoviene, 2011). Also, if modifications are made, designers must consider how these changes effect copyrights (Kurilovas, et al., 2011).

Repositories

Although research indicates that there are multiple repositories for learning objects, very little evidence has been produced that indicates that there is a large amount of use of these repositories (Weller, 2004). Weller (2004), stated that this may be a result of the concept that repositories and reuse is only beneficial when designers have a large selection of objects to choose from. If there is no perceived benefit then designers will not use nor contribute to repositories. Repositories can be designed to be inter-organizational or intra-organizational. According to Welelr (2004), inter-organizational repositories of learning objects that are used across organizations and contexts are known as open content. Open content repositories must address issues of copyright, modifiability, structure and definition of learning object. Intra-organizational repositories are less likely to have issues related to copyright, modifiability and definition due to the limited access of the repository. In the present study, research only examines intra-organizational repositories to evaluate how individual companies construct learning objects.

Simply compiling a repository of learning objects may not be enough to aid instructional designers in the creation of sound instruction. Standards for use and interoperability must be adopted to ensure consistent use of reusable learning objects. An

example of how a learning object repository is used in the practical application of learning development is exemplified by at the Centre for Economic Development and Applied Research (CEDAR) at Royal Roads University (RRU) in Canada. RRU established CEDAR in 1998 to explore the field of E-Learning as a means of offering post-secondary education (Muzio, Heins, & R. Mundell, 2002). CEDAR follows an instructional design methodology that is incorporated into the course editing tool (Muzio, et al., 2002). CEDAR has strict rules and processes in their use of meta-tagging to label each of the learning objects. For each instructional unit designed, the instructional designer must first search the learning object repository for related items. In the event that there is a need for the creation of a new learning object to meet the specific needs of the learning module, the designer must label each item for future search ability, which is known as meta-tagging, according to the formatting of the repository (Muzio, et al., 2002). Once selected or created, these learning objects are imported into the course editing tool for course delivery as well as the repository for future use (Muzio, et al., 2002). By allowing the created content to reside on a repository, a market-like system is created for the educational content developers (Quinn & Hobbs, 2000).

Learning object use and reuse is directly correlated to the way subsequent learners or designers make use the object in their instructional units (Collis & Strijker, 2001). Developing a system architecture that takes learning objects into consideration helps to aid in the use and reuse of learning objects in educational development (Notargiacomo, Silveria, Omar, & Stump, 2007). Again, Collis and Strijker (2001) suggested implementing a system that guides learners and designers on instructional design process related to learning object usage.

Steps in the Efficient Process of Instructional Design

The instructional design model is best described as a plan that prescribes specific steps and phases in the design before development of instruction starts (Dijkstra, 2005). ID models provide a simplified structure and order to many complex real life events that are involved in the development of instruction (Richey, 2005). ID models generally serve two main purposes: a standard for good design practice and a visual communication tool that explains the developmental plan

The context in which ID models are used may range from large training environments to small educational settings. ID models can serve as a conceptual management and communication tools for analyzing, designing, creating and evaluating learning (Cennamo & Kalk, 2004; Gustafson & Branch, 2002). No single ID model is well matched to all development contexts, therefore, it becomes important for designers to align key components of a model to the given learning environment (Cennamo & Kalk, 2004). The better the comparability of the ID model and the context of the learning environment, the greater the potential for success (Cennamo & Kalk, 2004; Gustafson & Branch, 2002). These assumptions help to form the framework for which instructional models are constructed (Gustafson & Branch, 2002). Research has identified three key ideas that help form a view of instructional design: planning around critical issues, an iterative knowledge-building cycle, and design as a collaboration among stakeholders who share different perspectives and expertise (Cennamo & Kalk, 2004).

Procedural models of instructional design are the most common ID models. Dick, Carey and Carey Model (2005), and the Morrison, Ross, and Kemp Model (2002) are two of the more recognizable procedural models. Most classic procedural

instructional design models are based on the ADDIE (Analyze, Design, Develop, Implement and Evaluate) framework, which focuses on five distinct stages in the development process(Cennamo & Kalk, 2004; Dick, et al., 2005; Gustafson & Branch, 2002). Research will discuss the stages of instructional design as distinct stages, although literature suggests that the process is an iterative and overlapping in nature (Cennamo & Kalk, 2004; Gustafson & Branch, 2002; Tennyson, 1995).

Analysis

Prior to beginning instructional development, developers must determine if there is an instructional need that can be resolved by creating instruction (Dick, et al., 2005; Tennyson, 1995). This determination of instructional need is achieved in the analysis phase of the ADDIE model. In the analysis phase of instructional design, a learning problem or need must be established. Macro and micro level needs should be addressed to ensure that the proposed instruction meets not only the instructional need but this approach also ensures that the learning need also meets the total context in which the knowledge is to be applied (Tennyson, 1995). For designers to gain a better understanding of macro and micro needs, an analysis of setting, learner/population needs, learner entry knowledge, goal identification, task analysis, and subordinate skills analysis should be conducted (Cennamo & Kalk, 2004; Dick, et al., 2005; Gustafson & Branch, 2002; Tennyson, 1995).

Analysis of learner needs and characteristics is a process that involves grasping an understanding of organization, learners, and learner tasks. These three factors must be considered before deciding to use training or instruction as a remedy to the identified problem (Noe, 2002). Organizational analyses are conducted to assess organizational

features that may affect the delivery of instructional training programs (Salas & Cannon-Bowers, 2001). Training goals and outcomes are derived from the information collected in the initial analysis phase (Dick, Carey, & Carey 2005). Noe (2002) suggested that designers assess the company/ institutional strategic direction. Wentland (2003) also observed that the strategic direction of a company is a combination of internal growth strategy, external growth strategy, disinvestment, and concentration strategy. Wentland further contended that support of managers and decision makers for training should also be assessed. Also, training resources such as budget, time, and employee expertise must also be assessed during the analysis phase (Noe, 2002).

A task analysis is required to complete the analysis phase of instruction. The task analysis serves as a gap analysis because the task analysis should assist the instructional designer in identifying what employees actually do on the job as well as what they should be doing on the job (Carnevale, Gainer, & Meltzer, 1990). Task analysis requires the instructional designer to gather information about the characteristics of a job from the individuals who currently operate in that capacity. This information is then cross examined by subject matter experts and job incumbents to validate the job duties (Dick, Carey, & Carey., 2005). Upon completion of a task analysis, instructional designers should have a breakdown of sub-skills required to complete the job function that is performed by the learner (Noe, 2002).

Training needs assessment seeks to begin the design of instructional materials by first gathering information about what the organization views as the desired optimal performance or knowledge of learners and then comparing that desire with the actual or current performance of the learners (Rossett, 1987). The American Society for Training

and Development (ASTD) (2011) identified this strategy as a root cause performance gap analysis. Rossett (1987) suggested that an examination of the causes of the discrepancy of the identified gap and the feelings that trainees have towards the proposed instruction help lead the instructional designers to a comprehensive solution.

Design

The second stage of the ADDIE model is the Design stage. In the Design phase, the model prescribes the instructional designer a set of activities and specifications to creating the learning environment (Gustafson & Branch, 2002). The idea behind this stage of the model is to prepare the program for instructional development. Preparing for the development of instruction requires the designer to address specific variables and conditions of the learning program (Tennyson, 1995). Philosophy and theory of the learning, specification of objectives, instructional goals, instructional strategy, identifying delivery system, evaluation planning, and test items are all compiled in the planning/ design phase (Cennamo & Kalk, 2004; Dick, et al., 2005; Tennyson, 1995). Designers must also consider the reuse of materials in this phase of design. Through the review of existing materials, designers can identify which, if any, materials could be repurposed for instructional use (Tennyson, 1995).

Using the information gathered in the analysis phase of instructional design, it is the responsibility of the instructional design team to design instruction. Subject matter experts, project managers, instructional designers and other various stakeholders can contribute to the instructional design process (Cennamo & Kalk, 2004; Noe, 2002; Press & Kemp, 2006). Generally, a meeting is scheduled with all of the project stakeholders to discuss the information needed to successfully complete the development of a project. In

this design meeting, stakeholders negotiate learning objectives, instructional strategies, and theories to be used in the learning module (Cennamo & Kalk, 2004; Dick, et al., 2005; Noe, 2002).

The single most important part of any instructional design process is the negotiation of learning objectives because every step of the instructional design process is centered on the objectives (Mager, 2011). As the instructional design team negotiates the learning objectives, Heinich, Molenda, Russell, and Smaldino (1999) recommend that objective writers include: audience, behavior, conditions and proficiency level. Regardless of the template used in writing the performance objectives, the commonalities of behavior, conditions and measurability must be present (Mager, 1997).

Instead of simply discussing instructional strategies and design theories, instructional designers often present conceptual prototypes to stakeholders. Previous examples help the project stakeholders gain an understanding of the vision of the instructional designers. Instructional designers may make modifications to the document for the module to meet the needs of the stakeholders (Dorsey, Goodrum, & Schwen, 1997). A custom prototype can also be created during the design meeting, for example, using low quality tools, create a storyboard of ideas compiled during the design meeting (Cennamo & Kalk, 2004).

In most instances, the instructional designer is responsible for presenting design documents to the client for approval. The client must review the document and provide feedback prior to moving to the next stage of development (Cennamo & Kalk, 2004). Decisions regarding technology usage and delivery mode are embedded in the prototype review and approval (Noe, 2002).

Development

In the Development stage of instructional design, one can expect the designer to prepare the instructional materials that were designed in the previous stage. Materials will be prepared for both the learners and the administrators of the course (Gustafson & Branch, 2002). The development phase is the phase of instructional design that requires the most amount of project management skills. Unlike the previous phases of instruction where the instructional designer is primarily responsible, the development phase calls on a team of individuals to complete the tasks. Subject matter experts, audio and video specialists, web developers, graphic designers, and various other specialists may be required to complete the development (Cennamo & Kalk, 2004). Scheduling, collaboration, setting deadlines, and development costs all must be managed during the phase of development.

Instructional design that is completed by a team relies heavily on continuous communication between all project stakeholders if benefits of simultaneous development are to be maximized (Dick, et al., 2005; Press & Kemp, 2006). To ensure that instructional design projects achieve this benefit, instructional design teams may enlist the services of a project manager. The role of project manager may be filled by a dedicated project manager, or the instructional designer may assume this role (Cennamo & Kalk, 2004). Project management is a sub-discipline within the instructional design process. Standards for project management are guided by the Project Management Institute, and project managers often hold certifications that solidify their qualifications (PMI, 2011). Project managers hold the responsibility of gathering information that is imperative to the completion of the project and maintaining visibility of progress of the

projects (Press & Kemp, 2006). According to the PMI website (2011), project management focuses on 9 stages of management: project scope, time, cost, quality, risk, human resources, communication, procurement, and integration. Using a negotiation strategy proves to be an effective means of management because stakeholders are given the opportunity to provide feedback and input on the management goals (Press & Kemp, 2006).

Implementation

Implementation of the developed instruction serves as a stage in most basic instructional design models (Gustafson & Branch, 2002). Implementation also takes into account the activities required to support the delivery of instruction. Implementation of instructional materials involves many key decisions that must be made by project stakeholders. Intulogy Corporation (2011) identified establishment of the course delivery timetable, course scheduling and notification of target learners, selection of course facilitators or instructors, and arrangement of production of course materials as key decisions.

Upon completion of multiple iterations of revisions by the development team in the Design phase, a working prototype is created (Cennamo & Kalk, 2004; Dick, et al., 2005; Dorsey, et al., 1997). The working prototype is pilot tested with learners to evaluate the clarity, impact and feasibility of the instructional module (Dick, et al., 2005). Ideally instructional designers use a three stage process of gathering information about the prototype from the learner perspective: One-to-One evaluation with learners, small group tests, and field testing (Cennamo & Kalk, 2004; Dick, et al., 2005). With one-to-one evaluation, the instructional designer is responsible for selecting a few learners that

represent each of the subgroups in the target population (Cennamo & Kalk, 2004; Dick, et al., 2005). These learners will carefully review the content to identify the most obvious errors made by the instructional design team (Dick, et al., 2005). While the learners are proceeding through the materials, the instructional designer is simultaneously observing the learners reactions to the materials (Cennamo & Kalk, 2004; Dick, et al., 2005). The information gathered in the one-to-one evaluation should be used to revise the content.

Using the revised prototype created as a result of the one-to-one interview, a small group test should be conducted (Cennamo & Kalk, 2004). A sample size should be selected that allows for a diverse mix of each of the subgroups identified in the target population (Dick, et al., 2005). Similar to the techniques used in the one on one evaluation, the instructional design team must ask the learners evaluate the materials while simultaneously observing their reactions (Cennamo & Kalk, 2004; Dick, et al., 2005). The testing materials such as pre and posttest are also administered during this phase of evaluation to assess the materials relation to the desired instructional objectives (Dick, et al., 2005). Results from the small group test data are used to create a final revision that will be used in a field test.

A field test generally requires the instruction to be delivered in the context in which the learners will actually experience the learning. Changes made after the small group test are evaluated for their effectiveness (Dick, et al., 2005). Unlike in the previous stages of formative evaluation, in the field-testing environment for e-learning, designers should not have the learners in a closed environment in which they could be observed. Learners should complete this stage of instruction asynchronous so that the test reflects

real conditions. However, to gain feedback from the learners, designers may consider conducting interviews and surveys after the materials have been completed (Dick, et al., 2005). Using all of the information gathered during the formative evaluation stages, designers are equipped to develop a final product.

Evaluation

The last stage of the instructional design process is the evaluation stage Evaluation of instructional design is a twofold process that involves formative and summative evaluations of the development results. Formative evaluation is intended to gather data necessary for making revisions to the process of the design and development of instructional materials. Instructional designers attempt to improve achievement of instructional goals by identifying problematic aspects of the instruction and the instructional process (Weston, McAlpine, & Bordonaro, 1995). This form of evaluation is done as a continuous review of information throughout the entire instructional design process. These data are gathered through subject matter expert (SME) analysis, validation of the instructional materials, and feedback from pilot studies and prototyping (Tennyson, 1995). The second form of evaluation comes in the form of summative evaluation. Summative evaluation is an evaluation of how effective the product is. It examines the instructions achievement of the original goals and objectives. This is often completed after the instruction has been fully developed (Dick, et al., 2005). According to Cennamo and Kalk (2004), summative evaluation should answer questions regarding learner attitudes, instructional effectiveness, delivery, and costs.

Summary

The ADDIE model is a generic process traditionally used by instructional designers and training developers. The five phases—Analysis, Design, Development, Implementation, and Evaluation—represent a dynamic, flexible guideline for building effective training and performance support tools.

Empirical Research on Learning Objects

Upon review of the empirical research surrounding learning objects, this discussion has identified several over-arching themes in the current literature. This review examined studies that represent learning object usage in higher education, K-12 education, and industrial settings in which the studies conducted experimental research from the perspectives of both the learners and the instructors/ course facilitators. The following information will discuss the themes of content development, interoperability, and pedagogy.

Content Development

The use of learning objects in educational development is a growing trend across all sectors of education. The empirical research reviewed has shown that learning objects can be implemented in all types of educational settings such as traditional face to face instruction, blended learning, and e-learning environments (Collis & Strijker, 2001; Fulantelli, Gentile, Taibi, & Allegra, 2008; Lau & Woods, 2009; Qi & Boyle, 2010; Roschelle, et al., 2000). Regardless of the educational setting, learning objects are generally created and or housed in a repository, whether it be a Learning Management System, Website or Document library (Collis & Strijker, 2001). Because the development and use of learning objects is highly reliant on the repository in which they

are held, the software environment plays a vital role in the implementation of learning objects in education (Cameron & Bennett, 2010; Guler & Altun, 2010; Kurilovas, et al., 2011).

Depending on the software environment, learning objects may or may not be created within the software program that will house the final product. Instructional developers must familiarize themselves with the procedures and standards that are required for the integration and development of learning objects within the software environment used in the delivery of their final instructional materials. Because learning object use is a relatively new paradigm in education, a learning curve is often realized among the developers of educational learning objects (Farha, 2009; Fulantelli, et al., 2008; Guler & Altun, 2010; Lau & Woods, 2008; McCormick & Li, 2006). Research conducted by Guler and Altun (2010), identified a need for developer/ instructor training due this paradigm shift. As new and existing instructional developers adopt learning objects, there is a need for training to address the process and technological gaps.

In 2002, Wiley stated that the resources that could help learning object developers were very limited. Guter and Altman's (2010) research participants expressed similar views regarding accessible resources by making claims that the information available on the internet did not parallel with their understanding of learning object implementation. Currently, the most common environment for learning object development and delivery is learning management systems (LMS). Research states that LMS's have been used to support e-learning standards in online learning, however the LMS systems lack integrated tools to support teachers in the management of learning objects (Fulantelli, et al., 2008).

Interoperability

In the early adoption of learning objects, researchers hypothesized that learning objects could be assembled like blocks to develop instructional units (Muzio, Heins, Mundell, 2002). The idea that a learning object can be designed to be applicable to all education systems by considering specific features of the design was challenged by the empirical research reviewed in this study. Wiley (2000) contended that instructional learning objects are like atoms of learning material in which, ‘‘not every atom is combinable with every other atom, atoms can only be assembled in certain structures prescribed by their own internal structure, some training is required to assemble atoms’’ (p. 17). This concern of whether learning objects were interoperable has raised a major concern in their development (Sanchez-Alonso & Garcia-Barriocanal, 2001; Farha, 2009, Fulantelli, et al, 2008; Guler & Altun, 2010, Muzio, et al., 2002). Efforts that have been made to ensure interoperability of learning objects through standards such as meta-tagging, SCORM and IEEE address interoperability from a technological standpoint. These efforts ensure that the final deliverable is compatible with the technical standards required by the most common learning and content management systems; however, these efforts do not serve as a means for helping instructional developers in the use of learning objects (Fulantelli, et al., 2008).

Schoner, Buzza, Harrington and Strampel (2005) concluded that technological aspects of learning objects presented no problems for faculty. However, both students and faculty agreed that design issues affected student usage of learning objects. Currently there is no standard for non-technical development of learning objects. Because of the lack of standardization, there is potential to see variance in the definition

and use of learning objects. Quality, evaluation, and complexity are factors that have observable differences given the context (Cechinel, et al., 2011; Farha, 2009). Higher education developers of learning objects have expressed that it will be difficult to find a common ground in learning object standards because what works for one institution may not work for another due to the abundance of idiosyncratic aspects of the various campuses (Griffith, 2003). Learning objects are subject to cultural sensitivity. The culture from which instructional material are developed and employed generally have undertones that affect the design of the learning object because the learning object design is meant to address the specific needs of the original audience (Guler & Altun, 2010; Qi & Boyle, 2010). While considering audits and evaluation of learning objects, Cechinel, Sanchez-Alonso & Garcia-Barriocanal (2011) argued that different institutions and disciplines are not consistent in their evaluation of the same learning objects. The backgrounds, institution, and discipline of the reviewers have been shown to have significant differences in evaluations (Cechinel, et al., 2011). The variances indicated in the non-technical aspects of learning object development could potentially cause a lack of interoperability in collaboration efforts among learning object developers.

Pedagogy

Pedagogy in the development of learning objects presents a unique set of challenges. McCormick and Li (2006) found that, "The fact that practitioners use learning objects in contrasting ways means that they are likely to be able to superimpose their own pedagogy on any learning object:" (p. 228). In the development of learning objects, the pedagogical implications should be aimed at the reuse of instructional experiences rather than the acquisition of instructional material (Collis & Strijker, 2001).

Ilomaki, Lakkala, and Paavola (2006) observed, "The role of learning materials in such approaches is not to deliver knowledge or direct the learning process, but to provide building blocks for the learners' knowledge work in a versatile way (p. 264)" Emphasis of pedagogical strategies that focus on learner participation and contribution allow the learning objects to have better potential for reuse by subsequent instructional developers (Collis & Strijker, 2001).

Throughout the literature, the themes of content development, interoperability and pedagogy resonated. These themes could help serve as a basis for further research and development efforts as the field of instructional design continues to move forward with the implementation of learning objects in educational development.

Overall Summary of the Review of Literature

Learning objects have the potential to give instructional designers access to a plethora of materials to aid in their instructional development. Coupled with the reduced time and cost of producing these materials, it is clear that the implementation of learning objects has many potential advantages. However, the implementation of a learning object approach also has many challenges. The over -bearing issue that has hindered a global acceptance of learning objects begins with defining what a learning object is. The issue with defining learning objects seems to be a gift and a curse. Because literature has not come up with a definition that is acceptable in all genres, the evolution of how learning objects are used has evolved without constraint. While at the same time many of the principles and uses of learning objects in one context may not be generalizable.

Attempts have been made to move closer to a standardized approach to the development of learning objects, however, issues with granularity, meta-tagging,

taxonomy, theories and repositories continue. The empirical research reflects the potential advantages and concerns identified by the theoretical researchers. As a field, instructional design must address the concerns and challenges individually prior to implementation of learning object usage on a global scale.

Information has been written about the advantages and challenges associated with learning objects, however, little is known about how learning objects fit into the process of instructional design. More information is needed on how learning objects can support instructional design and add value to the process. The current research surrounding learning objects revolves around user reactions, interoperability, content development, and pedagogy. More research is needed on the process of the development of instructional materials using learning objects.

Although military and corporate settings represent the largest users of learning objects in the development of educational materials, the majority of the current research surrounding learning objects is set in the K-12 and higher education contexts. It can be assumed that corporations, whose focus is on development and profits, may not take the time to publish their business strategies and internal research. What is missing in the current body of literature is the information about how these organizations are integrating learning objects into their instructional design processes and systems. In an attempt to add to the existing body of literature, the study took a qualitative analysis of organizations and systems. Specifically, processes, documentation, and user reactions in the business and military settings were examined.

Chapter 3: Methodology

In order to find out how the use of learning objects impacts the instructional design process, the present study sought to identify current strategies used by IDT practitioners in three institutions in the development of instructional materials. A case study method was used to frame this study. Interviews were conducted to understand the tendencies of learning object developers and how instructional design processes are used to create instruction that includes the use of learning objects. This study specifically investigated, analyzed, and interpreted the collected data to capture current practices and procedures used by IDT practitioners in the development of learning materials and how learning objects impact that process.

This chapter contains six sections that describe the methodology used to conduct the study: 1) research design, 2) participants, 3) the three cases 4) data collection procedures, 5) data analysis, and 6) limitations of the study.

Research Design

The current study was conducted using a qualitative case study research approach. An in-depth review of particular instances of learning object development within three different instruction design processes were used within this study. Case studies are designed to study a single case to examine and document the complexity of the activities that take place within a context or circumstance (Stake, 1995). This study reviewed three individual cases. The three instances represented three different contexts for which a case study approach was used. Upon completion of the individual cases, findings were compared and contrasted to identify themes across cases.

Denzin and Lincoln (2005) argued that "Qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meaning people bring to them" (p. 3). The data gathered in this study offered heuristic insight by enhancing understanding and contributing to general knowledge of the research area (Rossman & Rallis, 2003). Qualitative research seeks to describe, compare and contrast, and forecast future trends of the study sample (Rossman & Rallis, 2003). Researchers examine the data with the purpose of addressing the research questions (Creswell, 2002).

Table 5 summarizes the research question, data sources, data collection methods, and data analysis techniques used in this study. The first column presents the research question. The second column shows data sources, the third column shows how data was actually collected. The last column delineates the methods that were used to analyze the data.

Table 2
Research Strategy

Research Question	**Data Sources**	**Data Collection**	**Data Analysis**
How do current IDT practitioners utilize learning objects in the development of instructional design frameworks for instructional materials?	• Instructional Designers in Corporate • Instructional Designers in Military, • Instructional Designers in Non-Profit Setting.	<u>Phase One:</u> Purposeful sampling strategy; One-to-one in-depth interviews. <u>Phase Two:</u> Document Analysis; Collection and Review of supporting documents in development	Qualitative open-coding technique: Categorization and thematic analysis Document content analysis technique

The Study Procedure

Before beginning the data collection process, the study sought approval from the Virginia Tech Institutional Review Board for the protection of human subjects (see Appendix A). The study included a two-phase process of data collection. Participants' descriptions of learning object usage were gathered. Researchers explore meaning by

collecting data from the participants who have experienced the phenomenon under investigation (Miller & Salkind, 2002). Interviews were used to examine research participants' experiences, in an attempt to identify common themes in the development of learning object based instruction. As Rossman and Rallis (2003) contended, interviewing is an imperative step in the qualitative research process, helping the researcher understand individual participants' perspectives, deepen the researcher's understanding, and generate rich, descriptive data. Also, it has been suggested that "much of what we cannot observe for ourselves has been or is being observed by others. The interview is the main road to multiple realities" (Stake, 1995, p. 64).

In the second phase, a qualitative document analysis strategy was used. Each of the individuals interviewed were asked to provide any documentation of standardized procedures used in the development of instructional materials. The documentation provided was then evaluated using specific criteria to describe the process of documentation (Stake, 1995). Upon review of the provided documentation, the findings were then interpreted in line with the research question. So, using the gathered data, the researcher constructed meaning of the data (Stake, 1995).

Cases

To address the research question**,** the reviewed cases represented three IDT contexts. Learning object usage was reviewed in each of the three ID processes. A purposeful sampling strategy was employed to gather the data to address the research question under investigation. "Purposeful sampling is based on the assumption that the investigator wants to discover, understand, and gain insight and therefore must select a sample from which most can be learned" (Merriam, 1998, p.61). Prior to the selection of

interview participants, the researcher contacted the each potential participant to conduct a preliminary screening interview to ensure the development context and role of each potential interview participant was consistent with the study needs. The questions found in Table 1 were used in the preliminary screening of potential participants.

Table 3
Preliminary Interview Questions

Preliminary Interview Questions Used to Screen Participants
• What is the type of company (non profit, military, llc, etc.)? • Who are your top competitors? • How is education development conducted? • What is your department size? • Who is the end user? • What is your development process? • Are documents used to capture information? • Is an instructional design model used? • How many clients? • Who are the clients? • How many individuals are involved in the development process? • How are learning objects used? • What is the age of the company?

This purposeful sampling technique allows the researcher to strategically select the participants or sites that provide the best chance of addressing the research question (Creswell, 2009). The study examined IDT practices of corporate, non-profit, and military institutions. Business, industry, and military settings serve as some of the largest employers of instructional design professionals (Cennamo & Kalk, 2004; Richey, et al., 2002). These settings often produce instructional materials that train staff members on how to improve their current job functions, inform target customers of product functions and uses (instructional manuals, etc.), and may be designed to be sold as a

product (Cennamo & Kalk, 2004). Business, industry, and military settings each seek to develop instructional materials at a low cost, of high quality, and expeditiously (Wiley, 2005). This common business goal makes business, industry, and military ideal locations for review their learning object development strategies.

The targeted research cases for this study are organizations that currently participate in the design of instruction using learning objects. In order to conduct in-depth interviews on how learning objects impact the instructional design process, participants needed to meet some requirements. Interview participants in each case needed to be 1) an education manager or developer that currently develops instruction using learning objects; and 2) involved in the process of designing the instructional system used to guide the education development within their company.

Military

A distributed learning group in the United States Army was engaged. The goal of the learning group is to provide relevant and timely training to soldiers and civilians within the Army. Training needs often vary based on the assessed need for the end user. In-house development of instructional materials stopped around 10 years ago. Currently, the distributed learning group manages an umbrella contract for training and distributed learning development efforts in which instructional materials are completed by outside contractors. The group is responsible for 50 to 60 ongoing projects at any given time. Instructional designers within the distributed learning group serve as contracting officers who are responsible for auditing and accounting of outsourced projects. The instructional designers ensure that military regulations and guidelines are used in the development of materials. The United States Army Training and Doctrine Command (TRADOC)

pamphlet, military standard handbook, and Army Learning Concept for 2015 are all used to guide the development process.

Currently, learning objects are self-contained complete learning units that each include specific events of instruction and are SCORM compliant. However, there is no centralized learning repository. The distributed learning group is now in the process of increasing the granularity of their learning objects and making each learning object context-free for increased reusability.

Non-profit

The second of the three cases is a nonprofit organization that was established in the 1960's. Their educational development ranges from print based instruction to the development of e-learning and mobile learning platforms. A team of five instructional designers manages a library of learning objects to customize education solutions. Completed learning objects are housed in a learning management system (LMS) as well as a learning content management system (LCMS).

The current client base for this organization ranges from large pharmaceutical corporations to individuals in the healthcare industry. Each learning object is a self-contained unit of instruction that can be delivered alone. Each learning object is designed to incorporate specific events of instruction. However, these learning objects are often combined to create curricula that cover multiple topics and objectives.

Healthcare

The last of the three cases reviewed in this study is an international healthcare equipment company. This healthcare company has the mission to drive sales through redefining the healthcare industry's education solutions for medical professionals. The

clients of this organization are clinical technicians and institutions that have a need for medical theory and medical equipment. A team of five individuals, known as the instructional system design team, is responsible for the instructional design of instructor led training, web based training, mobile learning, and e-learning platforms. The instructional designers work in conjunction with project managers, and internal auditors to the instructional design process. Subject matter experts aid the development of instructional materials. As Wiley (2002) pointed out, a learning object is any digital resource that can be reused to support learning.

Instructional designers often package learning objects together to meet customizable goals for clients. Each learning object is housed in both a learning management system (LMS) and a learning content management system (LCMS). A customized workflow that is based on the ADDIE model is used in the development of instructional materials including learning objects (Cennamo & Kalk, 2004; Dick, et al., 2005; Gustafson & Branch, 2002).

Participants for the interview were contacted via e-mail. In the event that there was no response to the initial email, reminder emails were sent out a week after the initial email correspondence. When an email response was received from interested participants, a follow up email was sent out to schedule the interview time and date.

The second portion of the data collection focused on the documentation used in the organizations development of instructional materials. In essence, a request for documentation of processes was requested in the initial email that was sent to the participant. The researcher relied on the participants to provide the necessary documentation.

Data Collection Procedures

Upon approval from the dissertation committee, authorization to conduct human subject research was obtained from the University. The researcher secured Institutional Review Board (IRB) approval prior to conducting the study. The approval form submitted to the IRB outlines the details of the research data collection procedures. Data was collected using two methods: Semi-structured interviews and instructional design documentation review.

Interview Process

Prior to the formal research interview, each interview participant was contacted to complete a primary screening. The screening was conducted via telephone conversation. In the conversation the researcher asked questions that would determine the appropriateness of the potential interview participant and the context in which they practice instructional design. Once the interview participant was deemed a valid match for the study, the researcher provided a formal request for study participation via email. The participant then accepted or rejected the request for participation by responding to the email and scheduling an interview with the researcher. Interviews were conducted at an agreed upon location between the researcher and the participant. Prior to conducting the interview, the researcher provided an oral and written overview of the intent, purpose, expectations, and participant rights within the study. The researcher then asked the participant to review and sign an informed written consent form that contains both the researcher and participant signatures. Two digital recorders were used to record the audio during the interview. The researcher also took field notes throughout the interview.

When available, interview participants were ask to provide documents used in the development of instructional materials. If the participants provided documents, the researcher reviewed the documents prior to conducting the interview. The information contained in provided documents were used to used to guide interview questions. The interview was also used to explain or elaborate on any themes identified in the initial document review.

In an attempt to address the research question of the study, the researcher identified background information, learning object definitions, instructional design process, repositories, reuse, documentation, and user reactions as the categorical data required to answer the research question. These terms are discussed in the literature review section. Each category is comprised of interview questions that relate directly to gathering information about the category. Table 6 outlines each interview category, need for the category, and the related interview questions.

Table 3
Interview Questions

Interview Category	**Need for Interview Questions**	**Interview Question**
Background Information	Background information will help validate the credentials of the research participant.	1. What is your instructional design background? 2. What is your current role in your organization?
Learning Objects Defined	Variations in size, granular assets, instructional content, instructional strategies, administrative features, and testing cause researchers to define learning objects differently (Fletcher, et al.,	3. How do you define learning objects?

	2007).	
Instructional Design Process and Learning Object Development	If learning objects are to be valuable in an instructional framework, learning objects must be tied to instructional design strategy and theory (Cheal & Rajagopalan, 2007).	4. What are the stages of the instructional design process? 5. At what stage(s) in the instructional design process are learning objects developed? 6. Does the learning object development process subscribe to an instructional design strategy?
Learning Object Implementation and Repositories	Implementation of learning objects as an instructional strategy relies on the accessibility and availability of the resources via search, locate, and retrieval of the resources (Lim, 2007).	7. How are learning objects delivered to learners? 8. How are learning objects housed and identified (tagged)?
Reuse and Assembly of Learning Objects	The effectiveness of reuse of learning objects is contingent upon the assembly and architecture of new and existing learning objects (Notargiacomo, Silveira, Omar, Stump, 2007).	9. At what stage in the development process are existing learning objects analyzed and evaluated for reuse? 10. How are multiple learning objects combined to create instruction?
Documentation	Systems or documentation procedures help aid instructional designers in the standardized development of instructional materials (Spector & Ohrazda, 2003).	11. What documentation is used in the development of instructional materials (Case Specific Questions)?
User Reactions	User reactions to experiences with learning objects help	12. What advantages do you realize with the implementation of learning objects?

	guide the improvement and the development of learning object usage in the field of instructional design (Ally, et al., 2006; Farha, 2009; Lau & Woods, 2008).	13. What challenges do you face with the development of learning objects? 14. What is your organizations future direction in the use of learning objects?

Interviews lasted between 45 – 75 minutes. At the beginning of the interview, the researcher asked the interviewee a series of background questions that would help to provide context for the responses. Once the background information was secured, the researcher would begin to ask the participant a series of semi structured open-ended interview questions. During the interview, the researcher also asked the interview participant to provide any additional documents or resources used in the development of educational materials. Follow up questions were asked for clarification where needed. At the conclusion of the interview, the researcher reflected on his thoughts by recording post interview field notes to aid in a later data analysis.

Each interview was then transcribed into a text document. To ensure privacy, the transcriptions were held on a password protected computer. Transcribed interviews were delivered to the participant to check the information for accuracy and conformability, known as a member check (Creswell, 2002). The participants were given the opportunity to change any comments found in the transcriptions if they felt that the information might have misrepresented their views.

Document Review

Documents provided by the participants on the procedures used within their educational context were gathered to address the stated research question. According to

Stake (1995), "Gathering data by studying documents follows the same line of thinking as observing or interviewing" (p. 68). The review conducted on the provided documents added another source of information that helped to elucidate the instructional design processes that help to shape the development strategy. The combination of the document analysis and data gathered in the interview helped the researcher to define and capture overarching themes across the various contexts.

Data Analysis Techniques

Interview Analysis

Data collected during the interviews consisted of audio recordings, typed transcriptions, and researcher field notes. This data was organized into individual files for each of the research participants. Whole text analysis was used to examine the continuous text contained within the transcripts. This technique required the researcher to study the data continuously in order to identify specific codes. This procedure for analysis was developed by Glaser and Strauss (1967) and Strauss and Corbin (1998). The interviews were analyzed using the same structure as the interview question organization. The interview questions and responses were first divided into categorical sections as outlined in Table 6. The researcher read the data word by word to achieve immersion and a sense of whole (Tesch, 1990). Next, the researcher highlighted and made notes of words or phrases that captured key concepts (Hsieh & Shannon, 2005). These concepts were then grouped together to create categories that essentially become the emergent themes in the interview (Coffey & Atkinson, 1996; Hsieh & Shannon, 2005; Patton, 2002).

Each interview was coded separately to identify themes within each interview. Each interview was then interpreted separately. Lastly, common themes across all interviews were examined to look for over-arching themes present throughout the study. The overarching themes identified across interviews were interpreted and discussed in their relation to the research question.

Document Analysis

Documents collected from the research participants were used to support the information gathered in the interview. In order to analyze the data collected via text-based documentation, the researcher separated the data based on the participant. Using a content analysis approach, the data was reviewed. Content analysis is known as a flexible means of analyzing text and image-based information (Cavanagh, 1997). Hsieh and Shannon (2005) described qualitative content analysis as "a research method for the subjective interpretation of content of text data through the systematic classification process of coding identifying themes and patterns (p.2)". In most cases, the information contained within a document was not organized in a manner that is best suited for qualitative research document analysis. Instead, the documents were made to be used by individuals other than the research analyst (Krippendorff, 2004). This research project analyzed the documents used in the development of learning objects by the participants. Similar to the approach used in the analysis of interview content, the documents were also divided and reviewed using the categories identified in Table 6.

Two iterations of document analysis were conducted in this research project. In iteration one, a general analysis of the provided documents was conducted. Each document was coded separately to identify themes. Each document was then interpreted

separately. The pre-determined categories identified in Table 6 were used to categorize the themes found in the document analysis. Common themes were examined across all documents to look for overarching themes that might have been present throughout the study. The overarching themes identified across documents were interpreted and discussed in their relation to the research question.

The second iteration involved a directed content analysis approach. In this analysis, existing theory or prior research were utilized to identify key concepts or variables in coding categories (Potter & Levine-Donnerstein, 1999). In this case, themes and information contained within each document were compared with the themes identified within the interview analysis. This directed approach to analyzing documents helps the researcher support and extend the existing findings of the initial interview (Hsieh & Shannon 2005).

Limitation of the Study

The analysis of this study is limited to the three contexts evaluated and may not be generalizable to other research settings. Qualitative generalization is not intended to be applicable to individuals, sites, or places outside of the study (Cresswell, 2009). The value one places in qualitative research lies in the description of themes found in the particular study (Greene & Caracelli, 1997). Yin (2003) stated that qualitative results are generalized when used to explain a broader theory. In this study, the research sought to add to the body of literature on learning object development.

Chapter 4: Data Analysis and Results

This chapter contains an analysis of findings from three case studies discussed independently. Each section in this chapter describes one of the three reviewed organizations. The first portion of each case gives the reader a complete synopsis of the case. A description of the organization, study participants, and program history aid in the context of this study. In addition, this chapter presents the findings of each case study as they relate to the research question. Appropriate information is included from interviews and document analysis to triangulate the data. The purpose of these case studies was to determine the current practices employed by these organizations in the utilization of learning objects in the instructional design process.

Case One Description

This section describes a United States military education development group on the east coast, the study participant, and the company's use of learning objects in the instructional design process. The information provides the context necessary to understand the learning object development process, its products, developers, and users.

Organizational Overview

In its effort to provide soldiers and civilian military workers with education related to their field, job function, and military procedures, this group has an evolving portfolio of educational offerings. Web-based materials, instructor-led courses, print materials, mobile learning strategies and computer-based materials, and so on are used to communicate to learners. This group was established in response to a growing need to provide relevant and timely training to military employees.

The group consists of a team of 26 instructional designers who serve as project consultants who manage the development of instructional materials. The instructional designers within this group do not do firsthand development of educational material; instead, they manage contracts to ensure they meet the standards and guidelines for educational development set by the military. The military has adopted a strategy focused on increasing rapid content development, whether it is accomplished privately or publicly via outside contractors. The TRADOC pamphlet states that organizations must:

> Create multidisciplinary team workforce skills capable of rapidly developing and updating digitized learning content to include applications in the CoEs. May include some use of in-house contractor support and training and certification to upgrade current workforce skills. (TRADOC, p. 39)

Using the guidelines stated above, the U.S. ARMY has adopted the strategy of utilizing independent contractors for the development of all instructional materials. Each contractor's development must adhere to military visual standards, meta-tagging, delivery methods, and SCORM standards (SCORM, 2011). The group manages approximately 50 client sites that require or request training on military policies and procedures.

Interviewee Background Information

The interviewee has been practicing instructional design for the U.S. Army for nine years. While working with the Army, the interviewee works with a technical team in the development of instructional strategies and SCORM standards. The interviewee is currently completing a Ph.D. in Educational Technology.

The interviewee currently manages an acquisition and technical team within the US Army Training and Doctrine Command (TRADOC).

Learning Objects Defined

In the development of instructional units, this group is moving to a learning object approach to instructional design. The goal of implementing a learning object approach is the potential reuse of military learning materials. Even within organizations, it has proven difficult to define learning objects. This military group initially defined learning objects as any shareable content object reference models (SCORM). This approach did not prescribe any level of granularity to allow individual developers the freedom to create their own definition of learning objects with minimal consistency. Learning objects initially ranged from entire courses to the asset level. This lack of consistency caused difficulty in finding any value in the use of learning objects. In the new TRADOC pamphlet, currently used by military developers, learning objects are described at the asset level according to one interviewee, Ricky:

> We decided in our new pamphlet that learning objects really should be the asset level, learning objects should be as small as a flash animations or an audio file. And the reason we wanted to go so small is that we figured out after a number of years that that's where the real reusability and repurposing is because it is hard to reuse information at the course level because all branches of the military are very protective of their persona.

The content was initially developed as complete courses in a multitude of platforms that made it difficult for instructional designers to repurpose sections of a

course. Because there are multiple branches within the military serviced by this group, complete courses may have included branch specific information which is more difficult to repurpose for use across multiple branches. In addition to branding issues, this group discovered once a complete course module was developed and packaged as a learning object, it was very difficult to use portions of the course materials for another course. Designers had to either use the entire contents of a course or none of it. After years of trials and tribulations concerning the use of entire courses, the group realized that the real value of utilizing a learning object approach lies in the asset level. They found the majority of money, time, and resources was not spent in the content development, but rather on the development of flash articles, videos, and other resources. This realization caused the military to re-evaluate the assets value and change the granularity focus within the learning object approach to instructional design to the asset level. It was found that the assets had less context and branch specific information compared to the complete courses, which made a strategy of reuse highly feasible. With focus on the asset level of granularity in learning object development, the military is currently in the process of finding better uses of existing materials.

Reuse of learning material now considers the terminology, context, and information across different branches of the military. Each military branch tends to personalize and contextualize its learning modules. Because this group develops for all branches within the military, learning object reuse was limited due to the original design strategy. The original design strategy was to compile an entire course, which included context specific information, branch branding, and course specific language. With the new focus and classification of learning objects transitioning from the course level to the

asset level, this group aims to increase reuse and re-purposing capabilities within each learning module developed.

Instructional Design Process

The process for education development within the United States Department of Defense (DOD), is a fairly defined process. Guidelines for how a web page or web-based materials are formatted help in the architecture of the design process. As internal system designers develop workflow and standards for web-based content, they ensure standards written in the TRADOC pamphlet, and the Department of Defense Instruction 1322.26 are completed whether the content is outsourced or developed within the U.S. Army's design group. Development of instructional materials within the military is a highly technical delivery environment. The TRADOC pamphlet and the DOD Instruction 1322.26 are designed to ensure content development is compatible with any delivery system used by the Military. These documents outline categories within the ID process that should be carried out to make sure military standards are met. The intent of these documents is not to be prescriptive; instead, they give the instructional designer guidance as he or she proceeds through the process of designing instructional materials to minimize mistakes or variations in the development process.

This group subscribes to a modified version of the ADDIE model of instructional design. The model used by the U.S. Army is the vision of the current U.S. Chairman of the Joint Chief, General Martin Dempsy. According to Ricky,

> General Dempsy was our TRADOC commander until a couple of years ago and he pulled a bunch of smart people together to figure out how to train for the soldier of 2015, who would be the high school student of today. So in his vision

> he really talked about learning object farms. He talked about all of the schools who own a certain piece of the content. If you think of 1000 tasks that are trained in the U.S. Army there is an owner for each task, so there would be one party that knows how to train that task. So his concept was for each of those owners to build training or learning object to train their task. It may be one task or one hundred tasks that would be built into learning objects so across the U.S. Army, we would have access to this farm of learning objects

In this vision, the emphasis in the analysis of instructional design is crucial to implementation of the learning object approach in the instructional design process. Either the internal group or an outside contractor can conduct the first part of the task analysis. Within the task analysis, the group determines the enabling learning objective and the terminal-learning objective. This task analysis influences the gap analysis. In the gap analysis, the instructional designers determine the content and media needed to get the learner from their current state of knowledge or performance to the desired end state.

Unlike the traditional ADDIE model, the next phase of instructional design involves the review of the previously created content. Upon completion of the task analysis and gap analysis, a review of the content in the existing education portfolio is conducted. The internal group conducts what the U.S. Army describes as the media analysis portion of ID. In this media analysis, the internal group is responsible for searching for existing content and determining what existing content is relevant to the new course, if any. If applicable media content is found, it is evaluated for reuse in the

design of the new course. Traditionally, what the U.S. Army considers a media analysis is comparative to the development phase of instructional design. The individuals that conduct a media search do not develop content; instead, they evaluate the existing content and send recommendations to the contractor for modifications and course assembly.

Learning Object Implementation and Repositories

Learning objects are delivered to the learners via multiple formats. Computer based instruction, and web-based instruction used in the Army. Computer based instruction is delivered via CD-ROM. The web-based instruction is delivered via Blackboard LMS. According to the interviewee,

> "CD-ROM (Computer based instruction) and Web-based instruction are both required. We have to consider our reserves, deployed soldiers, and part time soldiers. A few years ago soldiers started training at home and the may or may not have high speed Internet. So we would have the same training offered on the web and on CD, because our commitment was to train on the same standard regardless of the conditions."

The U.S. Army now uses a central registry that links all courses to the learning management system where the content is located. The purpose of the registry is to provide a single location that administrators can easily access files related to any learning module. However, this link to the learning management system only allows the user to access the final product of learning. This registry has limitations. Source files and learning assets are not stored collectively in the learning management system. Instead, the complete module is contained in the LMS.

The search for existing media involves a strategic search for existing inventory of instructional assets for all military branches. Each learning asset has a series of words and phrases, called meta-tags, that help identify its contents. These words and phrases are guided parameters set by the U.S. Army. The U.S. Army adheres to the standards set in the U.S. Army Learning Object (ALO) Document.

> The purpose of the ALO document is to set forth guidelines that are intended to result in consistent formatting of the U.S. ARMY LEARNING OBJECT (ALO) xml files submitted by course developers to the DL/DR Repository. It is assumed that the users of this document are familiar with xml/dtd structuring and syntax. This document, serves as a Help manual to facilitate the creation of ALO based xml documents. Documents should be identified by a unique file id.

The ALO document contains categories, structure, and relationship protocols for meta-tagging assets within any given course.

Prior to the use of standards that specified objects at the asset level, the military used a central repository set up by the Advanced Distributed Learning (ADL) group called the Content Object Repository Discovery and Registration/ Resolution Architecture (CORDRA). The goal of the CORDRA initiative was to create a centralized location for access and discovery of learning objects. However, the developers of the CORDRA repository did not consider variations in size and structure of the objects added to the repository. Therefore, CORDRA's efforts led to a repository of objects that were incompatible or non-reusable. Stated Ricky:

> The failures were basically, the U.S. Army and other services, as I said before, didn't go down to the lowest level of granularity for their tagging or their

development so we ended up with a huge course. And no one can repurpose a huge course, so the whole tagging and sharing concept kind of fell apart.

Although efforts have been made to implement a strategy of asset-based learning object development, the U.S. Army is still in the process of securing a sustainable learning object approach to development.

Reuse and Assembly of Learning Objects

The Army prescribes to a modified version of the ADDIE model of instructional design. In the Analyze phase of instructional design, there are a series of steps required to complete an analysis. A task analysis is contained within the analysis phase. The task analysis is used to determine the terminal learning objectives are required to meet the goals of the new course. Both internal and external developers conduct the task analysis. Upon completion of the task analysis, the Army's instructional designers search for existing learning objects that may aid the attainment of the task to be completed. This search for existing materials is when learning objects are analyzed and evaluated for reuse.

The Army's current definition describes learning objects as entire units of instruction. Under this definition, learning objects are combined to create curricula or a series of courses. Because the learning objects are not defined on the asset level, only entire units of instruction are clearly documented and repurposed. Moving forward, the Army seeks to implement a strategy that defines assets as learning objects. This strategy hopes to aid in the repurposing and documentation of asset level learning objects.

Documentation

When ask about the current documentation procedures used in the development of instructional materials, the interviewee provided the following response:

> The army has a document that called the training developers TDC capabilities which provides structure to web-based developers system for building coursework and data residence and distributed learning. It is a tool that gives you some structure and also helps the resourcing piece. So whether you're talking about distributed learning or resident, there is a certain amount of resourcing that needs to be planned and the budgeted. In terms of the Army we have to budget three years out. Therefore we have to get it on the budget line so there is a resourcing piece and tracking for classrooms, instructors, and training materials.

The documentation outlined in the response provided by the interviewee, outlined many features of project cycle and project management. Upon review of the documents referenced in the statement, there were no specific features within the document that were specific to the design and development of instructional materials.

User Reactions

This organization has realized the increased functionality across web platforms by adopting a learning object approach. By creating an asset level portfolio of learning objects, the Army aims to optimize the compatibility with web delivery. File size, and duration can be better controlled when the granularity of the learning object is increased. With the constant evolution of web standards, the Army hopes to create a more agile and adaptable portfolio of learning object by creating more granular learning objects.

Many of the instructional designers within the Army have been developing instructional materials within the Army in excess of 10 years. The Army has only recently adopted the idea of learning object-based development. One of the challenges found within this organization were directly related to the need for a change in development culture and development structure. The organization realized the design and development of educational materials utilizing a learning object approach required continuing education and training of the existing staff. This training has proven to have a significant learning curve.

In addition to the need for staff development the functionality needs of the repository are constantly evolving. Repositories have the ability to serve as the LMS, LCMS, both the LMS and LCMS, or neither the LMS or LCMS. The decision to determine how the repository will function has proven to be the most difficult decision, however, the decision has a direct correlation on how the entire development process. The Army has changed the functionality of the repository multiple times and each change requires and organizational development strategy shift.

In the future the US Army aims to create all of their courseware in a learning object format. Each learning object will be a self-contained unit of instruction that will have no reference to other courses or learning objects. The Army plans to use these learning objects to develop a multimedia approach to educational offerings. By creating self contained learning objects, the Army hopes to create educational offerings that are easily transferable to mobile learning, e-learning, computer based training, as well as print based educational materials.

Case Two Description

This section describes a learning strategy and innovation corporation in Virginia, the study participant, and the company's usage of learning objects. The information provides the context necessary to understand the learning object development process, its products, developers, and users.

Organizational Overview

The second case reviewed by the researcher involved a non-profit organization. The goal of this organization is to prepare medical representatives to provide doctors with education about new products, policies and procedures. The courses and modules developed by this group are sold to individuals, companies, and as university course credits for master's students at an East Coast university. All profits received by the organization are invested back into the development process, marketing, staff, and products. The educational offerings include textbooks and e-learning and in the future will expand to mobile learning.

The instructional design team consists of five individuals. Each instructional designer is responsible for the design, development, and project management associated with their projects. The internal instructional design team conducts the majority of the instructional design; however, there are instances where portions of the instructional design process are outsourced. This team also leverages group technical writers to aid in the development process. According to their process documentation:

> Writers generally have background in the content, but are usually not subject matter experts. They are experts in training design/development and are responsible for the instructional integrity of the content. Their focus includes:

Developing learning objectives and designing the training around those objectives; writing the content for ease of learning (clarity and cohesive flow of ideas); constructing exam items and review questions that reflect the learning objectives; communicating with SMEs as necessary to ensure accuracy of content.

These writers are provided guidelines and templates to ensure consistency among different writers. The interviewee, Sasha stated the following:

> we have a template as well we have people that don't necessarily have an instructional design background that do things in curriculum and we have writers that write learning objectives and so what those templates let us do is, you know people that have more of education or editing background are able to follow the standards and our process and all of our writers have an instructional design background so we have a team of writers that we contract with so I think every writer might do it at a different way to be honest with you but then the end result is always we have the same format and all the courses and the same design and research to go into them.

Graphics and technical innovations are also outsourced. Because the department only has 5 internal individuals, many of the highly technical portions of development are outsourced to avoid bottlenecking in the development process.

Interviewee Background Information

The interview participant has a bachelor's degree in education and learning. Sasha has served as an education support specialist, product support specialist, and director of curriculum and learning with this company for a total of six years. While working with the company, she attained a Masters degree in Instructional Design.

Currently, Sasha is the Director of curriculum and learning solutions for the organization. Sasha has the responsibility to manage all of the aspects of the curriculum development. Portions of the education development process are outsourced therefore; she is responsible for the management of projects that involve outside entities. Decisions regarding content development, revisions, and archiving are the responsibility of the Director of curriculum and learning

Learning Objects Defined

This organization has recently switched their approach from educational design to a learning object approach. Prior to designing in a learning object format, instruction was delivered as complete manuals and courses. Also, many of the course materials were stored and delivered as paper based manuals. These manuals were limited in their distribution, capabilities, revisions and availability. Granularity and reusability were two of the perceived benefits of developing a digital learning object approach to course content development. Digital learning objects were used to increase the distribution, availability, size and customizability of the education portfolio. In order to convert the existing portfolio into a series of learning objects, a series of steps were taken. First, the team had to define learning objects and determine what should be included within each learning object. The team determined that each learning object should be its own stand-alone unit of instruction. According to the interviewee, each stand-alone learning object should include an overview, learning objectives, content, summary, progress checks, review questions, informal assessment, practice opportunities with feedback, a formal assessment, and an opportunity to provide comments. This group tries to limit the time it takes to complete each learning object to between 30 minutes and an hour.

Currently, the instructional design team creates each new piece of instruction with these guidelines in mind. However, when new standards were put in place, a significant amount of work was required to get the existing portfolios to adhere to the new standards. Many of the courses had to be reverse engineered to meet the standards. Stated Sasha:

> We actually had these courses before we thought of them as reusable learning objects. Because this is what we have always had and then we knew that we wanted to do electronic modules and have a database of reusable learning objects, we had to do a lot of work to the courses to make sure that they could stand on their own. So there had to be language changed with our writing, we had to make sure that every section had objectives. In every section, we had to pull out things that referenced graphics or items from a different section, because if you do not take the entire course, and you just take one section, you may not be able to see the graphic from a previous section.

Complete learning objects are used in a variety of ways within this company. Learning objects may be sold as individual units in which continuing education credits are offered to the end user. Also, certificate programs can be developed for companies or individuals who need custom training. A certificate program consists of a group of learning objects that are selected to address certain competency or subject areas. Some of the certificate programs have also been approved as university credits.

When multiple learning objects are grouped together to form a certificate program, the transition between learning objects is taken into consideration. The first stage in instructional delivery is grouping the learning objects based on topics to be

discussed. Similar topics are then placed in a chapter. Each chapter then receives an introduction that gives an overview of the topical area. Subsequent chapters would have introductions to help with the transition between topical areas. Sasha described the following scenario:

> The structure of the program is made to make it flow. So in the event that you had a lot of different topic areas covered within a program, we would have something like chapters that will hold the learning objects. For example, anatomy and physiology would be in the chapter and then we would use introductions to those chapter to make them all fit together. So it would say, you will now go through the following areas. In the case that the program was about diabetes, we would use the introductions to connect the learning object to the program that may not connect on its own. We also use supplemental materials, like a flyer or progress check off, that would gauge the learner's progress, almost like a study guide.

Instructional Design Process

Before this company decided to use a learning object approach to instructional design, the portfolio consisted of less than 60 modules of instruction. Currently the portfolio has in excess of 400 customizable learning objects to meet the needs of the end user. To achieve this spike in the number of course offerings, the group created an instructional design plan that accounted for the change in instructional strategy to learning objects. The decision to move to a learning object approach required the instructional design team to take into consideration two new processes for how to design

instruction under the new learning object format. Instructional design processes were necessary for revision of existing material and the development of new materials.

When asked about the instructional design process, the research participant indicated that her organization adheres to the ADDIE Model. A significant amount of investment is placed on the Analysis phase. When describing the design process, Sasha stated:

> We do a lot of market research. Because of our industry, we might do a survey to gauge interest in a new program, we will do an outline and then send it out to our existing clients for feedback, or we may conduct a focus group. We are constantly looking for feedback prior to and during the development process.

Once the instructional need was determined, the first process of instructional design was the revision of existing training materials. A revision process was needed for two reasons: Delivery formatting and content updating. The primary reason for the revision process was that conversion from standard learning development to learning object involved the reverse engineering of the previously created learning. Lastly, this company has a content revision standard, in which each course's content must be reviewed every two years to ensure that the most current research revolving around the course content is reflected.

The revision process of instructional design is in many ways unlike the traditional ADDIE model of instruction. Revisions are done in two phases according to the content development guidelines used by the content developers. The guidelines for revision are outlined in Table 7.

Table 4
Content Review Guidelines

First: Review the current content, provide initial input, and recommend references for:	• Deleting (or updating) outdated content • Adding new concepts as applicable to the content and audience • Correcting errors of any kind
Second: Review the content after the writer prepares a revised draft; the focus now is to:	• Ensure the writer correctly understood and incorporated recommended changes • Ensure accuracy and clarity of the content. • Correct any technical errors.

The second type of type of instructional design process involves the custom development of new content, although it is more closely related to the ADDIE model. The guidelines of the company also outline this process as follows in Table 8:

Table 5
Instructional Design Process

When possible (i.e., time and resources available), this company will adhere to the following instructional design model for new development, which includes:	
Research and design/outline	The writer isolates the training issues/needs, learning objectives, content/topics to address, etc. This process also helps us understand the corporate culture, delivery preferences and constraints, etc.
Design/outline review by client and subject matter expert(s)	Ensures training goals are on target before draft development begins.
Rough Draft	Technical writer writes the first draft of content
Content Review	Client/SME review for accuracy, appropriate depth, etc. (pilot studies/focus groups)
Revisions	Writer revises materials based on client/SME review
Sign off	Final draft acceptance (or might require an additional round of revision)

Entire units of instructional materials are defined as learning objects within this organization. Due to the organizational definition, learning objects are considered throughout each stage of the instructional design process.

In this case study, the entire design process revolves around the development of what this company has defined as a learning object. By describing the learning object as a complete self-contained unit of instruction, all phases of the instructional design processes are directly correlated to the development of learning objects.

Learning Object Implementation and Repositories

Content is delivered to learners via a combination of learning content management system (LCMS) and a learning management system (LMS). The systems

interact with each other in the delivery of learning content. The learning content management tool is used to develop the content in its final format. All content editing and exporting of contents are done within the LCMS. The LCMS also serves as a backup to the content captured in the learning management system. The learning management system is the customer-facing platform. All of the information that is developed in the LCMS is presented to the customer within the LMS. In the LMS, a customer can search for a course, search for existing curricula, create a custom curricula, take a course, complete a quiz, and create a client profile.

Learning objects are housed in the LCMS. Each complete course is given a course number and description. Course name, number, or category can be used to search for each course.

In the development of content, many of the courses contain assets such as flash articles, images and others. Many of the assets that are created by outsourced vendors prove to be relevant across multiple learning objects. Although this group does not define assets as learning objects, they do have a separate repository to manage the assets and reuse them similar to the strategy they adopted with learning objects. The assets are meta-tagged and housed within their own separate media repository. This media repository allows each asset to have its own URL so that it can be embedded in multiple places within the LCMS simultaneously. Any given asset may be used within a limitless amount of courses at once. This strategy allows the group to edit, change, and update assets in multiple learning objects with a single point of contact.

In the development of a learning object, this group searches the media library to see if there are assets that meet the needs of the new development project. This search

for assets is done during the writing of the first draft of content. Generally, the writers are familiar with the media library and existing content. With knowledge of the portfolio, the writers use search terms, unique URLs, and completed learning objects to locate existing assets. Sasha describes examples of when assets may need to be updated and not the entire learning object:

> Two years ago a lot of our images were in black and white, not updated. Now we want to make sure that we have updated stock images throughout our portfolio. Our reusable learning objects link to everything (LMS, LCMS, Media Repository), so the benefit is if we update in one spot it is updated everywhere. We used to have to update in, literally, each place that the image may appear and we can go to one place and update across all learning objects.

This use of assets within their learning objects proves to be a process in itself. This company is not limited to one granularity level within the development of learning objects. Learning objects address two distinctly different granularity levels. There is a process in place to address the course level of granularity as well as the asset level of granularity. This use of granularity combination has created a very robust system for reuse, combination, updating, and delivery of learning materials.

Reuse and Assembly of Learning Objects

Each learning object is developed to be re-purposed for print based materials, web based materials, and mobile learning. Each delivery platform contains the same information and structure. This strategy allows the learner to select the delivery method that is most appropriate for their personal needs.

Learning objects are also used to create custom curricula for customers. Each learning object has the potential to be used across several curricula. Each learning object is a 30 to 45 minute unit of instruction. Custom curricula contain multiple learning objects that are combined to meet instructional goals and objectives that are determined by the learner needs.

Learning objects are combined in a book format. Sasha provided the following statement when describing the functionality of the book:

> The structure of the program is divided into different topic areas. Each topic area would serve as a chapter, like chapters in a book. Each chapter will hold learning objects that are related. For example, anatomy and physiology would be in on chapter, and then we would use introductions and descriptions to each chapter to make them all fit together. An introduction would say, you will now go through the following learning objects that will cover the anatomy and physiology. We also use supplemental materials like a checklist that would help the learner gauge their progress in a curriculum.

Documentation

Documents have been created to specify steps and guidelines to follow throughout the instructional design process. Guidelines have been created to ensure consistency across multiple developers. The organization has both internal and external developers of instructional materials. A storyboard is created for each project that outlines all of the development needs. The storyboard also contains guidelines for objectives, content structure and delivery method.

The documentation of the learning object information is housed on a Microsoft Excel Spreadsheet. The spreadsheet is customized to meet the specific needs of the organization. Macros have been placed on the spreadsheet to help with tracking and organization of information. The spreadsheet is used to track learning objects by gathering and housing descriptions, objectives, exam questions, and categorical data.

User Reactions

Utilization of a learning object approach to instructional design has allowed this company to significantly increase their portfolio of courses. By limiting the size and duration of courses, the learning object approach has caused the group to create smaller units of instruction. Therefore a course that may have traditionally been a large course with multiple subjects is no longer offered. Instead, a series of smaller courses are now combined to offer the same information as the traditional large course.

Learning objects have also allowed this group to create custom curricula. Given the learner need, the instructional designer can combine any number of learning objects. Previously, a new course would need to be developed every time the learner need changed. With learning objects, existing learning object can be reused to meet multiple needs and development of new learning objects is only necessary if the content does not currently exist.

The biggest challenge facing this organization is the tracking of the learning objects. Sasha stated:

> Using a learning object approach gives you the ability to have so many objects that it becomes hard to keep up with what you have. So I think the challenge is

keeping up with all of this, where you are using everything, how you're using everything.

When ask about the organizations future direction, Sasha stated:

In the direction that we are going, everything will be reusable learning objects. I don't even think we would have set programs, we would just review all of the reusable learning objects and create different things depending on the client. Because that is really truly what we have been doing over the last two years. Just having this repository of learning objects and then literally creating based off of need. So we call it customizable, not customized. We continue and have a long-term strategy to create more standalone learning objects.

Case 3 Description

This section describes a large international healthcare diagnostics company, and the company's usage of learning objects. The information provides the context necessary to understand this organization's definition of learning objects, the instructional design process and instructional delivery strategies in the development of instructional materials.

Organizational Overview

The third case reviewed by the researcher involved an international healthcare equipment company. This company develops the majority of equipment found in medical facilities. The education group is responsible for the development of educational materials that helps to train medical practitioners on the use of medical equipment, medical theory, and medical software. Many of the courses that are offered by this group also count towards continuing education credits and medical licensure. The clientele consists of internal employees as well as external customers. Course offerings

consist of multiple delivery methods. Instructor led training, virtual instructor led training, and web-based training are offered to customers.

This company is currently in the process of implementing a strategy of learning objects in the development of their web-based trainings. There is no current plan in place to develop other delivery formats into learning objects. To meet the learning object development needs, this company employs 3 instructional designers and a project manager called the instructional design team. This team is tasked with the design, development, and tracking of the life cycle of all projects. This group is responsible for all of the development efforts related to the creation of a new course or learning object. There is no outsourcing in the development of any assets related to the course. However, subject matter experts are used to provide the course content. Table 9 outlines the roles of the Instructional System Design (ISD) team members:

Table 6
ISD Team Member Roles

Instructional Designers	• Facilitate development of training programs within the established standards. • Provide current and updated learning resources to enhance training delivery. • Ensure source files and stored and backed up for future use. • Evaluate training requests to insure appropriate delivery solutions and standardizations are met. • Partner with subject matter experts (SMEs) and instructors to develop innovative training solutions that achieve learning objectives, impact business metrics and organizational effectiveness.
Project Management Team	• Perform project management activities related to training development projects.

Subject Matter Experts	• Provide subject related technical expertise that supports training development activities.

Interviewee Background Information

The research participant has served as an instructional designer within this organization for 5 years. Prior to his role as an instructional designer, Cameron obtained a Masters degree in Educational Psychology.

Cameron serves as the instructional design manager. As the manager, Cameron is responsible for the management of the project managers, LMS managers, IT developers, and instructional designers. Cameron also is heavily involved in the development of the instructional design process, and the development of individual instructional materials.

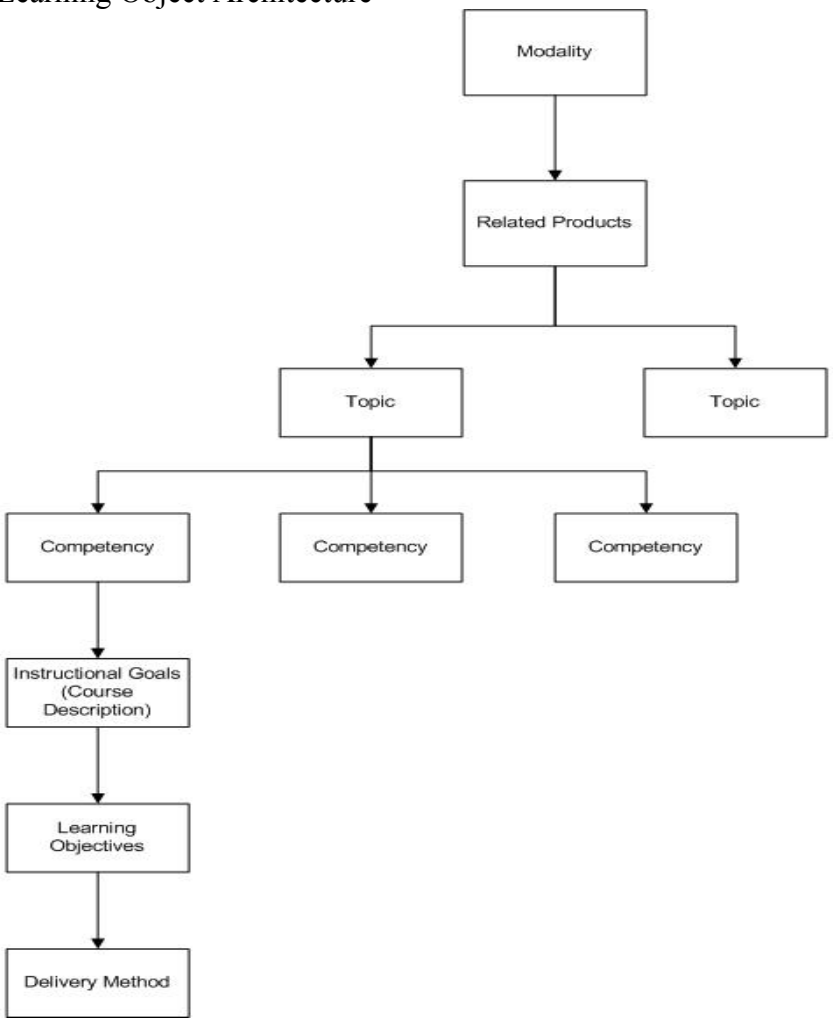
Learning Objects Defined

Using learning objects as a strategy in the development of instructional materials is a new concept to this organization. Traditionally, one unit of instruction was designed to cover multiple topics and subject areas based on the needs of the learners. The company found it difficult to repurpose and reuse the content contained within their courses since the topics and subjects found within the courses were often interdependent. The choice to switch from traditional instructional units to reusable learning objects was made two years ago. Implementation of a learning object approach was done with hopes of increasing the ability to customize education to meet the needs of the end user. With the idea of customization, the company identified the need to reuse and repurpose course content for multiple audiences. Prior to the implementation of a learning object

approach, information architecture was used to help structure what should be contained within a learning object.

The business is divided into multiple sub groups, known as modalities, which are based off of medical equipment type and licensure type. Within these subgroups, specific topics and competencies are identified to meet the needs of the learners. Figure 1, which can be found in this company's standard operating procedures document, outlines the information architecture:

Figure 1
Learning Object Architecture



This structure of information was used as the building platform for learning object development. Learning objects were designed to address specific competencies. The strategy of learning objects in instruction addressing competencies allows for the development of customized education plans for learners. Learners are assessed based on their gaps in topical and competency-based information. This information is used to help select the customized learning plans.

A learning object is defined as a complete instructional unit that addresses a specific competency. The study participant, Cameron, stated the following regarding the components required within a learning object: “A learning object contains an outline of the course, a statement of course objectives, presentation of course content, knowledge checks, and a final assessment". Where learning objects differ from the traditional instruction created by this group is identified in the use of topics and competencies. The interviewee noticed the topics and competency restrictions caused the complete instructional units to be smaller in size than traditional instructional units. Generally a traditional web-based instructional unit contains approximately an hour worth of content. With the transition to the new competency based learning objects, instructional materials now contain between 15 and 30 minutes worth of content. Although learning objects are intended to address one specific modality, there are cases where one learning object may contain content that is relevant across multiple modalities. In this case, the instructional unit is reused across multiple modalities. The content is labeled in a manner that allows developers or learners to access the information in two places.

Instructional Design Process

The education portfolio within this organization currently consists of approximately 60 web-based training modules. There is no current process in place to convert existing materials into learning objects. All of the learning object development revolves around the development of new courses and curricula. The process for new instructional content development is done as a 5 stage process. This company refers to the process as the ADDIE model, although the stages do not directly correlate with the traditional ADDIE stages of development. At the time of conception of learning objects, a new custom instructional design workflow model was created. The workflow contains the following phases: Analyze, Design, Development, Implement, and Evaluation. However, the Design and Development phases are the only phases that involve the instructional design team. Other departments within the company carry out the other phases of instructional design.

The first phase, known as the Analyze phase, is initiated as a result of a market analysis. Generally, the initial market analysis is completed by the SME associated with the project. Included in the analysis are marketing needs, business justifications, resources, projected timelines, and learner needs. Upon completion of the market analysis, the documentation is transferred to a group called the Internal Review Board (IRB) for project approval. Once approved, the project manager schedules a stakeholder meeting. The stakeholder meeting is a conference call that involves the SME, instructional designer, business manager and project manager. Key decisions are made in this meeting regarding content development, project action items, revised project timelines, and resources.

The next phase of development is the design of the instructional materials. In the Design phase, instructional designers conduct the majority of the activities. The project manager is responsible for scheduling a design meeting between the SME and the instructional designer. Prior to attending the meeting, the SME and the instructional designer extensively search existing courses to identify what content is currently available for reuse. The search is used to identify relevant assets for the new course development. Currently, locating reusable assets has proven difficult due to the manner in which the courses were originally packaged. Prior to the learning object approach to instructional design, the courses were produced as a large file to prevent the instructional designer from removing assets or pieces of instruction.

Within the design meeting, there is a dialogue and collaboration between project stakeholders to create an outline of the learning object to be developed. Course description, course objectives, and a task analysis are completed in this meeting to address all project needs. Cameron stated the following regarding the design meeting:

> A design meeting is where we design the learning object. So we sit with the SME and other project stakeholders, and we figure out what they wish to accomplish. Then we gather all of that information and by the end of the design meeting we should have a good structure of the learning object, or at least a skeleton of the learning that we call a storyboard. That storyboard is then give to the SME to fill in the content details. So, the design meeting is where we design to learning object.

At the end of a design meeting, one can expect to have a complete storyboard, a design plan that includes deadlines, and a list of action items needed to complete the

development of the learning object. Instructional designers are provided a checklist that outlines information to gather and what should be communicated to the stakeholder to create consistency in the design process.

The design meeting is the pre-requisite to the development of instructional materials. In the development phase, this company has a minimum of two concurrent development efforts. Using the storyboard, the instructional designer creates a framework for the course delivery. The company's process document lists the following actions during the development phase of instruction:

> Design development plan is executed, ensuring content is instructionally sound. Depending on the delivery method, may include: development in Content Editor (e-learning development software), audio recording, video-taping, editing, meeting with the SME for additional information, and so on.

Concurrently, the subject matter expert is responsible for developing the course content. Often, the instructional designer is unfamiliar with the course content; therefore, the course development is dependent upon the SME providing the course content. The instructional designer to complete the course development uses the information provided by the SME. Once completed, a series of revisions and approvals are communicated between the SME and the instructional designer.

Once a final approval is completed, the instructional designer forwards the final document to the LMS manager for posting. This stage is known as the Implementation phase. In the Implementation phase, each learning object is labeled with a course number and meta-tags based upon the modality, topic, and competency that the course content is

related to. Information regarding accreditation and end of course surveys is also applied to the course during the implementation phase.

Lastly, each course is scheduled for evaluation. Evaluation of each course is conducted annually. The LMS manager is responsible for completing a form that indicates when the document was initially posted. This form is automated to send an email message annually to the project manager. In this email, the project manager is reminded to initiate the annual review process. In this annual review, the instructional design team reviews survey data, revises content, and checks the content to ensure that the learning object material is still relevant.

Each course is developed to meet the company standards. Every educational offering includes an introduction, objectives, presentation of content, an interactive activity, and an end of course assessment. Each of these requirements also is included in the development of learning objects.

Learning Object Implementation and Repositories

Learning objects are delivered to the learner within the LMS. TheLMS serves as the portal for which the learner interfaces with all aspects of the learning objects. In the LMS, a customer can search for a course or existing curricula, and create custom curricula, take a course, complete a quiz, and create a client profile. The LMS also allows for multiple means of learning object delivery. Cameron describes the following:

> Our learning management system is where learners log in and access our course catalog. They can select the courses or learning objects that they wish to take based off of meta-tags, learning object course numbers, topics, or competencies.

We can also push out learning's to the learners if the learning object or series of learning objects (course) is required.

Learning objects are described as one complete unit of instruction. However, a topic may require multiple learning objects to be completely covered. The combination of learning objects to complete a topic is considered a course. Learning objects are combined within the LMS to make courses. The LMS uses a template that contains a general introduction to the topic and chapters to combine multiple learning objects. The general introduction prepares the learner for the overall topic to be covered across all learning objects contained in the course. Because each learning object represents a competency subcategory of a topic, each learning object within the course is presented as its own individual chapter.

The LMS is the portal for how the learning interfaces with the end user, but the content is maintained and housed within a central repository. The central repository for which all course files are contained is a shared drive. This shared drive is simply an external server that allows multiple users the ability to save, share and edit files. All of the files and assets related to each learning object are housed within a central repository. The final published learning object file is also contained in the central repository and linked to the LMS server for delivery. In the event that changes are required to a learning object, the complete learning object must be re-published with the corrections and re-submitted to the LMS manager for posting. Course changes cannot be completed in the LMS system; instead the developer must access and revise the files found in the central repository and re-publish the file to the LMS server.

The use of complete self-contained units of instruction as learning objects help to identify how learning objects are used and when they are considered within the instructional design process. Learning objects are inherently the focus of the design process throughout all phases of instruction within this company because of their use, definition and labeling. Analysis of the existing portfolio of learning objects is used to determine the need for creation of new instruction. In the Design phase, the project stakeholders outline the learning object details. The creation of the final instructional product is completed within the learning object guidelines. When implementing any newly created learning object, the instructional design process requires the proper labeling and categorization of the learning object within the existing topic and competency structure. Lastly, when learning objects are evaluated, the courses are updated to meet the standards of learning object development at the time of update.

Reuse and the Assembly of Learning Objects

Learning objects are defined as complete units of instruction. These complete units are reused to deliver to multiple learners. The instructional design team at this organization creates customized education plans for their client base. Each customized education plan involves a meeting between an instructional designer and the learner or learner group. During this meeting the learners' needs are discussed and the instructional designer will review the existing learning objects to determine if any of the learning objects fit the identified customer need. If learning objects in the existing portfolio meet the learner need then they will be used. If not, the instructional designer will initiate the development of a new learning object.

How are multiple learning objects combined to create instruction?

Multiple learning objects are combined to create custom curricula within the LMS. The LMS packages multiple learning objects into a book like format. Within this book, each learning object becomes its own chapter. Each book contains a table of contents that outlines the sequencing of learning objects. In addition, at the beginning of each chapter, an abstract of the learning object is provided to the learner for a quick reference.

Documentation

What documentation is used in the development of instructional materials?

All instructional material developed within this organization must go through the instructional design process. Prior to the initiation of any project, a work request form must be completed. This form is an interactive document that is used to manage the instructional design process. The work request form is divided into 5 distinct sections: Analyze, Design, Develop, Implementation, and Evaluation. Each section contains prescriptive information that guides the instructional designer. This document serves as a step-by-step form for the complete development of an instructional unit. Technical writing standards, storyboards, categorical information and identification tags are all contained within the Work Request form.

User Reactions

Learning objects have given the instructional designers of this organization a tool to create customized curricula for their client base. The learning object approach has limited the need to develop courses each time a customer expresses new needs. Now it is just a simple matter of repackaging, instead of recreating.

Creating course content that does not refer to other learning objects has been a challenge. Prior to using a learning object approach to instructional design, much of the course material was interlinked. Learning objects, as defined by this organization, must be designed to be self-contained units of instruction. Therefore, it has been a challenge when converting existing course material into the new format. Much time and effort was used to remove any references to other learning objects.

What is your organizations future direction in the use of learning objects?

When asked about the organizational future of learning objects, Cameron stated the following:

> I think that we could be more learning object focused you know it would be nice if our learning objects were actually smaller content-based pieces. For example if we have 3 ultrasound learning objects: general ultrasound, ultrasound theory, and ultrasound components, each of which have a safety component. In the future, it would be nice if we had a safety module that could pop into any one of those courses and reuse without re creating it each time.

Chapter 5: Summary, Conclusions, and Implications of the Study

This chapter contains a summary of the findings from three case studies. The summary identifies themes across the three cases. In addition, this chapter presents commonalities and differences in the case findings, as they relate to the research question. Appropriate information is included from interviews and document analysis to triangulate the data. The purpose of identifying themes across the cases is to identify practices that are present beyond one context. Supportive literature is presented to further validate the conclusions found in this section. This section seeks to identify themes that can help aid in the future development of learning object approaches to instructional design regardless of the development context. The chapter ends with a discussion of how this information relates to the field of instructional design and study implications.

Study Summary

Organizational Restructuring

The idea of adopting a learning object approach to the creation of instructional materials is a new idea for each of the three cases described. Although each organization has been developing instructional materials for more than 15 years, learning object development has only been in existence for 6 years in the case of the earliest adopter among the cases reviewed. Each of the cases had an instructional materials development process in place prior to the implementation of learning objects. In order to change the instructional output to learning objects, a paradigm shift was necessary across all of these cases. In all of the cases, changes were made to move from a face-to-face synchronous delivery method to an asynchronous web-based delivery method. To be classified as digital learning objects, the following necessary components must be present: digital

resources, reusability characteristics, and an educational purpose (Kim, 2009; McGreal, 2004; Quinn & Hobbs, 2000; Van Merrienboer & Boot, 2005; Wiley, 2005). Therefore, any shift in process architecture had to take into account delivery methods as well as content structure.

The choice to switch to a learning object strategy in instructional materials development is a decision that required each organization to re-architect their development process to address the needs of what they define as a learning object. Table 10 outlines the informational needs in the three cases based on how learning objects are defined in the organization.

Table 7
Learning Objects Case Comparison

Learning Objects Case Comparison			
	Learning Object Granularity Level	**Characteristics**	**Information captured in the ID Process as a Result of the LO definition**
Case 1 - Military	Asset	Individual Media Units	• Meta-tags • Repository Location • Which instructional units contain the asset
Case 2 – Non Profit	Lesson or Module	A Complete Instructional Unit designed to meet one instructional need.	• Overview • Learning Objectives • Content • Summary • Progress Checks • Review Questions • Informal assessment • Formal assessment • Feedback
	Asset	Individual Media Units	• Meta-tags • Repository Location • Which instructional units contain the asset • Custom URL
Case 3 - Corporate	Lesson or Module	A Complete Instructional Unit designed to meet one instructional need.	• Course outline • Learning objectives • Course Content • Knowledge Checks • Final Assessment

Advantages of Using LO's

The choice to change instructional strategies for any business is often rooted in the potential advantages of making the organizational change. Moving to a learning object approach to educational development for the study participants is no exception.

Potentially, learning object implementation would give each of the study participants the ability to rapidly create learning modules at a minimum cost, due to the reusability of the learning objects in a standardized format (Poldoja, Leinonen, Valjataga, Ellonen, & Priha, 2006). Advantages realized in utilizing learning objects in the development of education are correlated to how the organization defines learning objects. This section will discuss how advantages of learning objects, defined as self-contained instructional units, differ from asset label learning objects.

Cost, quality, and speed are the three characteristics in evaluation of instructional development. According to Wiley (2005), generally only two of these characteristics can be achieved, however, the implementation of a learning object strategy in this study have identified cases in which all three characteristics have been simultaneously achieved. As a result of the achievement of these characteristics the study participants realized a drastic education portfolio expansion. Portfolio expansion was realized as a result of the choice to move to a standalone instructional unit learning object approach to instructional development. This increase of educational offerings can be attributed to two factors that can result from learning objects; course segmentation and reduced development times. By simply segmenting large instructional courses into separate standalone units of instruction combined to make large instructional courses, the study participants in Case 2 and Case 3 were able to expand their number of educational offerings. Also the choice to develop instruction into smaller learning objects has reduced the time it takes to complete the development of instructional units. Sasha states:

> We have reduced our time on development and we used to only have 40 offerings and now because of the way we package and sell our learning objects, we have

close to 1000 different things that people can do. It's really limitless because clients can mix-and-match.

Utilization of learning objects allows for easily customizable learning plans with minimal effort required to develop content.

Organizations that are required to have their educational offerings gain approval through an accrediting body have also realized the advantage of segmenting large course into combinable learning objects. In the event that a client requires a custom education plan, combining pre-accredited learning objects eliminates the accreditation step required in the creation of a complete new course. Elimination of this stage of the development process can reduce redundancy associated with reaccreditation needs associated with course changes.

Assets were also defined as learning objects within this research study. Case 1 emphasized that their organization gained the most value in reuse of individual assets within a course. Peripherally, the study participant in Case 2 found the same value although this group did not identify assets as learning objects. Smaller learning objects can provide more reusability opportunities, but authoring smaller learning objects are often more expensive and time consuming than their larger counterparts because each object must be packaged and labeled individually (Geissinger, 2001). In an effort to identify development expenses, the Case 2 study participants identified outsourced instructional development as one of the highest development costs. The need to outsource development derived from a lack of expertise within the internal instructional design and development teams. Much of the outsourcing revolved around the need to develop small instructional pieces such as flash, narration, images, etc. Prior to viewing

these assets as reusable learning objects, the organizations were paying to outsource the development of these assets each time they were needed within a new course development. The idea behind creating reusable learning assets was to minimize the frequency of outsourcing needs. However, this strategy is anchored in creating context agnostic assets that are relevant across multiple learning objects.

Challenges with using LO's

The use of learning objects offers its users a variety of advantages, but this may not be achieved without difficulty. An array of challenges has been identified as they relate to learning object process implementation. The first challenge for any organization is the need to define learning objects. As the literature states, there is not one universally accepted definition of learning objects (Edwards, Rai, Phillips, Fung, 2007; Wiley, 2005). The definition for what will be categorized will affect all aspects of the instructional development process when considering how to create learning objects. Prior to making the decision of how to define learning objects, an organization may first want to consider the desired use of the final product.

Once a definition of learning objects is established, a process must be created to capture the necessary information. One of the challenges in establishing a learning object development process is that there are few, if any, standard examples for how to establish a learning object based instructional design system. The lack of examples is also coupled with the heavy customization component required to establish a new instructional design process. These factors have caused the process of conversion to learning objects to be a process that took a considerable amount of time in this study.

The 3 study participants have discussed significant investments in time, money and human resources.

Once a learning object process has been established, new sets of challenges arise. As described in the advantages section, establishment of this type of process can lead to an increase in portfolio offerings. Facilitation of storage and retrieval of learning objects is now included in many current the definition of learning objects which include meta-data to provide further information (Edwards, Rai, Phillips, Fung, 2007). Proper labeling strategies, tagging and tracking of the newly created learning objects can present portfolio maintenance issues. Sasha described the following when ask what challenges her organization has experienced:

> Learning objects give you the ability to have so many objects that it can become hard to keep up with what you have. So I think the challenge is keeping up with the uses and tracking all of the learning objects.

To combat this potential challenge, learning object developers may consider implementation of a portfolio management strategy in addition to the learning object development process.

Research Conclusions

The research question of this study was "How do current IDT practitioners utilize learning objects in the development of instructional design frameworks for instructional materials?" This question was clarified by answering questions related to defining learning objects, design process and learning object development, implementation and repositories, reuse and assembly of learning objects, documentation, and user reactions.

The research question is answered by referring back to the evidence presented within the cases and integrating related literature.

Defining learning objects

Many individuals in the field of instructional design have come up with unique definitions of learning objects given their development context (Parrish, 2004). The definition variations range from the smallest individual asset that resides in instruction to complete courses of instruction (Fletcher, et al., 2007). The cases reviewed in the study were no different. This study found not only differences in definitions across cases, but also changing definitions within individual cases.

In Case 1, the current definition of learning objects is very different from the original definition used by this organization. At the conception of a learning object approach to instructional materials, this group originally defined learning objects as complete instructional units. Through a series of trial and error, it was determined that creating complete instructional units were not as reusable because of military branch specific information. The varying contexts of the learners caused a need for context agnostic instructional materials, which was difficult to produce in a complete course. In theory, reuse is optimized the more granular the learning object becomes (Hodgins, 2002). Therefore, the definition of what a learning object is modified. Learning objects are now classified as individual assets found within a course. This description parallels with the definition found in the literature that describes learning objects as individual media units (Kim, 2009). These items were deemed more reusable across multiple contexts.

Case 2 has a clear definition of what is considered a learning object: a complete self-contained unit of instruction that is deliverable by itself or combined with other learning objects. This group has outlined standards for what should be included in each learning object which include an overview, learning objectives, instructional content, progress checks, review questions, informal assessment, formal assessment, and feedback. This definition of learning objects is consistent with Kim's (2009) definition of a lesson or module, which outlines a learning object as a combination of multiple instructional concepts or units. While some learning object designers work with complete self-contained courses where instructional sequencing and instructional strategy are necessary, many designers focus on much smaller granular objects such as images, text, links, audio files (Cheal & Rajagopalan, 2007). This organization has also identified a reusability strategy for the assets that are contained within their learning objects. A detailed strategy has been incorporated to ensure that all assets contained within a learning object are meta-tagged, placed in a repository, and operate as their own self-contained unit of instructional content. Each asset contained within a learning object can be updated, changed, added, or removed from any or all learning objects by accessing one central repository. By some definitions, it can be argued that these individual assets are learning objects (Kim, 2009)

Case 3 defined learning objects as complete instructional units. Similar to the organization in Case 2, a learning object must be a self-contained unit of instruction that can be administered by itself or in conjunction with other learning objects. Although the definition of what a learning object is remains similar to the previous case, the requirements for what information is contained in a learning object differs. In the third

case, each learning object must contain a course outline, learning objective, course content, knowledge checks, and a final assessment. These differences in requirements cause variation in the completed learning objects. Therefore, the combining of learning objects between Case 2 and Case 3 may be impossible due to the varying structure. This lack of consistency may hinder the idea of creating learning objects that are universally acceptable. In Table 11 research outlines the unresolved issues in uniform learning object characteristics.

Table 8
Unresolved learning object characteristics

Issue Category	**Description**
Definitions	- Standard definition for learning objects - Standard definition of granularity in learning objects
Labeling	- Standardized metadata for learning objects
Content Development	- Generic learning objects content to promote reusability
Repositories	- Separation of learning resources from instructional design to facilitate reuse
Collaboration	- Collaboration between large groups of institutions or educational organizations to facilitate sharing
(Edwards, Rai, Phillips, Fung, 2007)	

How do you outline instructional design process and learning object development?

If learning objects are to be valuable in an instructional framework, learning objects must be tied to instructional design strategy and theory (Cheal & Rajagopalan, 2007). The literature identified the ADDIE model as one of the most common instructional design model (Cennamo & Kalk, 2004: Dick, et al., 2005;Gustafson &

Branch, 2002). Each of the three interviewees identified the ADDIE model as the basis for their instructional design process. Similar to the defining learning objects, in the three practical cases evaluated within this study, the definition of the ADDIE model had key variations. None of the cases used the stages of the model as described in the literature. Sasha stated: "We use the ADDIE model when we are creating instruction but we do not follow all of the stages".

The results of this study made it apparent that there is a significant level of customization required in the development of a real world instructional design system for learning objects. Many of the instructional design processes outlined in the literature were used as a basis for the development of instructional processes. However, each organization created custom terminology, stages, and workflow procedures. Given the needs identified within the organization, accommodations were made to the instructional design process.

Creating a process for developing new content guidelines and a process for revision of existing content present separate challenges. A process for developing an entire new course is a matter of understanding the needs of the instructional unit and catering all instructional processes to meet the needs of the final product. Depending on the definition of learning objects used by the organization, the instructional design process captures different information types

Creating a process for revisions of existing materials presents unique challenges. The revision process assumes that the content has been previously created and is now being repurposed to meet the new instructional need. This strategy requires a level of reverse engineering of the existing materials. The instructional designer is responsible

for the analysis of existing data to determine how, and what information is relevant and reusable in the new learning object structure. Often this analysis of existing materials requires the input of multiple parties. Cameron stated:

> We find it very challenging to convert our backlog of courses into learning objects. Because the structures of the courses are not made to fit the new formatting, often the courses require major revisions. I think that moving forward, we have to create a process that involves all stakeholders originally assigned to the project to aid in the redevelopment of the backlog courses.

The challenge with course repurposing caused the Case 2 interviewee to create two completely separate development processes.

This study indicates that the restructuring of an organization to meet the needs of learning objects must consider specific elements in the development process. First, the organization must identify what they will categorize as a learning object. Once defined, a full understanding of the use of the learning objects will help identify what pertinent information is needed during the instructional design process. Lastly, the development of the procedures to create learning objects is required.

Implementing and storing learning objects

Defining learning objects, the implementation of a process to create learning objects, and the creation of learning objects are essential to the strategy of learning object based education. Implementation of learning objects as an instructional strategy, relies on the accessibility and availability of the resources via search, locate, and retrieval of the resources (Lim, 2007). Any potential adopter of a learning object approach to educational development must consider how these learning objects will be stored,

identified, and delivered to the learner. In the three cases reviewed, management of the source file information, course content, and published learning objects were all critical factors in the delivery of learning objects to the learner.

Regardless of how an organization defines learning objects, the need for a central location to house the course content is necessary to aid in the efficiencies in reuse. Creation of a content repository assists in the standardization of how information is categorized and stored. Information needed to label and identify courses and content within courses is often contained within the content repository. Meta-tagging information and creating meta-tagging standards within a repository make the content contained within the repository searchable. In this study, there were very complex systems used to capture this information, such as the Case 2 LCMS, and there were also very simple repositories, such as the Case 3 external shared drive. Although the systems across the cases were very different, the commonality was found in the access to information by multiple learning developers.

The repository of content is only half of the delivery system. In all three cases, a learning management system was in place to help deliver the content found in the repository to the end user. Learning management systems were used to interface with content repositories, deliver learning objects, and combine multiple learning objects. Learning management systems offer users development options, and packaging and delivery options for digital resources, including learning objects in web based delivery environments (Edwards, Rai, Phillips, Fung, 2007).

The ability to have the LMS interface with the repository of the organization allows for a seamless transition from development of information to the implementation of a live course. Sasha stated the following regarding the use of her organizations LMS:

> The LMS is our outward/ customer facing system where learners interface with our product's. Our LCMS is not accessible to our learners, but this is where we actually make edits and export content to the LMS. Some companies have one system that does both functions, we just happen to have two separate systems.

Within the reviewed cases, the research was unable to find the use of a system that combined the features of an LMS and an LCMS. All three of the study participants were combining two separate systems to deliver completed learning objects to the learner. Upon research of the instructional design systems currently available, a program named CERTPOINT Enterprise Learning Platform claims to offer the features of an LMS and LCMS in a combined system (http://www.certpointsystems.com/en/products-and-services/enterprise-learning-platform/vls-lmslcms). Although the website for this system outlines the features, no documented research exits on its practical uses.

Assembling and re-using learning objects

The effectiveness of reuse of learning objects is contingent upon the assembly and architecture of new and existing learning objects (Notargiacomo, Silveira, Omar, Stump, 2007). Within the review of all three of these cases, one of the motivating factors for going to a learning object approach was the desire to have learner centric customizable instruction. The learner centric strategy involves giving the learner the ability to select and/or combine multiple learning objects to meet their personal needs. In order to meet this learner centric desire for educational delivery, the learning management system must

accommodate learning objects. Specifically, any learning LMS aiming to deliver learning objects to the learner must incorporate the ability to combine multiple learning objects and incorporate a transitional component between learning objects. When asked how learning objects were combined within the LMS the study participant Cameron stated:

> When learners select several learning objects, we do not combine learning objects into one module. Each learning object is still a separate unit of instruction but we have an LMS that creates a book of instructional units. Each book has a title page that is a series of descriptions of the learning objects selected by the learner. And when the learner transitions between learning objects, the LMS gives the appearance of opening a new book chapter.

Similarly, in Case 2 a book chapter like approach was taken in the learning object delivery. The commonality between Case 2 and Case 3 lies in the definition of learning objects. Both groups define learning objects as complete instructional units.

Alternatively, the organization in Case 1 defines learning objects at the asset level. Ricky discussed the following when describing how these assets are used within an LMS:

> General Dempsey's vision was learner centric, where learners would open up the learning environment (LMS) and start pulling assets together. But within the military, sequence and flow is very important so you cannot have learners making their own decision about when and how to assemble learning objects.

This type of automation within instructional design is can be achieved by implementation of an authoring system. Authoring systems are a type of LMS tool that have moved from

program-controlled computer based instructional units to a dynamic learner centered web based environment (Dabbagh, 2001). This type of system could help this organization achieve General Dempsey's vision. Although the military does not currently have a defined process for how learning objects defined at the asset level will be used within an LMS, they have identified the need for sequencing and transitional components within the LMS.

Documenting the development process

Systems or documentation procedures help aid instructional designers in the standardized development of instructional materials (Spector & Ohrazda, 2003). Creation or adoption of a learning object instructional design strategy requires a change in procedure, development culture, and information acquisition. Documentation can be used as a means to outline the workflow, steps, stages, and guidelines of development (PMI, 2011). In the cases reviewed, the researcher was able to locate documents to outline the guidelines for learning object development.

The organization in Case 1 created a pamphlet that outlined the characteristics of a learning module needed to train the soldier of the year 2015. Within this document guidelines are outlined to aid developers in the scope of training. The contents of this document outline the Army's vision for how to train the soldier of the year 2015. This document was a descriptive representation of the future instructional strategy. The document did not contain any prescriptive information that could be used to aid the developer in the stages or steps required to construct a learning object.

The research conducted was not able to identify any prescriptive, step by step documents. This could be due to the development strategy. External vendors completed

the majority of the content development within this organization. Each of the external vendors was responsible for the maintenance and documentation of records regarding instructional design, and instructional design processes.

Case 2 has a document that outlines the workflow stages required to create a learning object. This document provides a step-by-step description of what the purpose of each stage of instructional design is and what information is gathered during the stage. This organization also created standardized documentation forms to aid all designers in the development of learning content. Each from added to the consistency and standardization of gathered information. The forms created were developed to meet serve as tools to help each instructional designer properly complete each stage of instructional design.

In Case 3, a process workflow outlined each stage of the instructional design process. Within the workflow, the organization outlined the roles and responsibilities of all of the involved parties within the organization. Each stage of the instructional design process is detailed, with the party responsible for completing the instructional design task. The workflow is used to the organization an overview of the complete process of instructional design and development.

This organization has a series of step-by-step procedural documents to aid any party that is involved in the development of instructional materials. These documents are developed to meet specific needs that are outlined within the instructional design workflow document. The documents are forms that contain fields to capture information that is necessary for completion of the instructional design process. These forms aid in

the consistency and reliability of the information gathered during the instructional design process.

Designer reactions to learning objects

User reactions to experiences with learning objects help guide the improvement and the development of learning object usage in the field of instructional design (Ally, et al., 2006; Farha, 2009; Lau & Woods, 2008). The study participants all expressed a great deal of optimism when referring to the future of learning objects within their respective organizations.

Implications of the Study

In examining the details, functionality, and uses of learning objects across different settings, it is clear that learning objects are a very complex issue. One must consider the design process, delivery method, reusability, and combination of multiple learning objects. All of the functional activities related to practical uses of learning objects are hinged on how an organization defines what constitutes a learning object.

Current literature has identified multiple practical definitions. Learning objects have been found to have vastly different definitions and granularity levels. The field of instructional design has not identified a universally accepted prescriptive definition of a learning object. Instead, the field has attempted to narrow the definition of learning objects by setting very loose guidelines on learning object definitions, such as, any or everything digital. Similar to the literature, this study has also identified multiple uses and definitions of learning objects in practices (Edwards, Rai, Phillips, Fung, 2007; Wiley, 2005). Literature indicated five district granularity levels of learning objects: asset, combined media, instructional concepts, lesson or modules, and courses.

However, the cases reviewed in this study only found learning objects defined at the asset and course level. Table 12 outlines the learning object definitions as identified in this study.

Table 9
Study Granularity Levels

Granularity Level	Cases Found	Description
Asset	Case 1 Case 2	Individual media units that serve as a piece of instruction found within a course
Course	Case 2 Case 3	Complete self-contained units of instruction that contain specific steps and requirements, such as; an introduction, objectives, interactive elements, etc.

Discussions around learning objects are difficult to have because of the varying uses and definitions found in practice. When discussing learning objects in practice, ideally comparisons of learning objects in multiple settings would be possible. However, this is very difficult when the definitions and practical uses of learning objects are vastly different (Fletcher, et al., 2007). The cases examined in this study reflect the challenges identified in the literature related to defining learning objects. Within the study, it was found that definitions of learning objects permeate throughout every aspect of the creation and use of learning objects. The development process, repositories,

implementation, and assembly are each influenced by and organizations definition of learning object.

The creation of a process for the development of learning objects must first take into consideration a framework that accounts for the defined learning object (Cheal & Rajagopalan, 2007). The granularity level identified by the definition of learning objects within an organization lead to variations in information and steps needed within the development process. Although each case reviewed within this study subscribed to a variation of the ADDIE model of instructional design, significant differences were noted between the cases. The variations in instructional design process found between the cases were a derivative of the variations identified in the definition of learning objects. Each process was designed to meet the needs of the defined learning object. Literature has not identified a specific process or instructional design model that is most appropriate for all learning object development process. Therefore, the ADDIE model was customized in each of the three to meet the specific needs of the leaning object development process.

In addition to variations in the development process, content delivery and repositories are affected by the definition of learning objects (Weller, 2004). Within this study, LMS systems were used to deliver the instructional content to the learner regardless of the learning object definition. However, variations were noted in the LMS systems functionality. The literature states that LMS systems lack integrated tools to support teachers in the management of learning objects and learning object content (Fulantelli, et al., 2008). LMS systems are sufficient in the delivery of complete instructional units, but in cases of more granular learning objects, such as assets, the LMS

systems may have the need to be combined with an LCMS to aid in functionality and documentation. The use of an LCMS in conjunction with an LMS in this study allowed organizations to gather, tag, and organize the data surrounding learning objects.

When considering or developing an instructional design framework in the development of the learning objects, the functionality and interoperability of the repository and delivery system should be considered (Cheal & Rajagopalan, 2007). With increased focus on the potential benefits of learning objects, the effectiveness of a learning object approach to instructional development will rely heavily on the organization of data, storage of data, and delivery of the information. Various definitions of learning objects currently in practice require the features of repositories and delivery systems also vary. Prior to selection or the development of instructional repositories or delivery tools, an organization should consider how they wish to define learning objects. This study found that the definition, including intended use and granularity, dictate the requirements and needs of the delivery tools. As organizations determine their learning object definition, it will be advantageous to consider the features of the delivery tools to ensure the feasibility and efficiency of the overall development.

Literature has identified reuse is one of the major advantages to adopting learning objects (Nurmi & Jaakkola, 2006, Parish, 2004). In this study, research found that reuse is also related to how learning objects are defined. If learning objects are defined as very granular assets, then reuse describes the ability to combine the granular assets to create single instructional units. When learning objects are defined as complete self contained instructional units, reuse is often refers to the ability to combine the learning object with other self contained units of instruction to create entire curricula.

The idea of reuse also permeates throughout the entire instructional design process (Weller, 2004). Once a definition of a learning objet is provided by an organization, each phase of the instructional design process is potentially affected. For example, previously created learning objects are evaluated differently given the definition. If the previously created learning object is simply an asset, then evaluation of reuse may only be a portion of the design phase of instructional design. However, if the previously created learning objects are entire units of instruction evaluation of reuse may only take place in the analysis phase of instructional design. As instructional materials are designed in a learning object format, it is important to consider how they will be used and reused in future development. This consideration is evident in every phase of the instructional design process.

As the field of instructional design attempts to move closer to an understanding of learning objects, effective discussions should begin with clear definitions of learning objects. This study does not suggest that one definition is better than another; it simply suggests that there are very distinct differences in learning objects in various settings. Improvements and progress in the development of learning objects should begin with the common definitions. It is very likely that multiple definitions are required to accurately capture all of the potential uses of learning objects. Difficulties associated with comparative conversations around learning objects stem from the very broad definition of learning objects currently used. Moving forward, the field of instructional design should first clearly define learning objects granularity level and practical uses prior to attempting to have any comparative conversations. Future research and conversations about learning

objects under the current definition could potentially lead to further confusion and less validity in future learning object related studies.

References

Ally, M., Cleveland-Innes, M., Boskic, N., & Larwill, S. (2006). Learners' use of learning objects. *Journal of Distance Education, 21*(2), 44-57.

Alonso, F., Lopez, G., Manrique, D., & Vines, J. M. (2008). Learning objects, learning objectives and learning design. *Innovations in Education and Teaching International, 45*(4), 389-400.

ASTD. (2011). *The American Society for Training & Development.* Retrieved from http://search.astd.org/Search.aspx?csquery=gap%20analysis

Barker, P., & Banerji, A. (1995). Designing electronic performance support systems. *Innovations in Education and Teaching International, 32*(1), 4-12.

Berge, O., & Slotta, J. (2007). Learning technology standards and inquiry-based learning. In A. Koohang & K. Harman (Eds.), *Learning Objects and Instructional Design* (pp. 327-358). Santa Rosa, CA: Informing Science Press.

Cameron, T., & Bennett, S. (2010). Learning objects in practice: The integration of re-usable learning objects in primary education. *British Journal of Educational Technology, 41*(6), 897-908.

Carnevale, A. P., Gainer, L. J., & Meltzer, A. S. (1990). *Workplace basics training manual.* San Francisco, CA: Jossey-Bass Publishers.

Cechinel, C., Sanchez-Alonso, S., & Garcia-Barriocanal, E. (2011). Statistical profiles of highly-rated learning objects. *Computers & Education, 57*(1), 1255-1269.

Cennamo, K., & Kalk, D. (2004). *Real world instructional design.* Belmont, CA: Thomson Learning, Inc.

Cheal, C., & Rajagopalan, B. (2007). *A taxonomy showing relationships between digital learning objects and instructional design learning objects and instructional design* . Santa Rosa, CA: Informing Science Press.

Collis, Peters, O., & Pals, N. (2001). A model for predicting the educational use of information and communication technologies. *Instructional Science, 29*(2), 95-125.

Collis, & Strijker, A. (2001). New pedagogies and re-usable learning objects: Toward a new economy in education. *Journal of educational technology systems, 30(*2), 137-157.

Dabbagh, N. (2001). Authoring tools and learning systems: A historical perspective. Paper presented at the annual convention of the Association for Educational Communications and Technology, Atlanta, GA.

Dick, W., Carey, L., & Carey, J. (2005). *The systematic design of instruction* (6th ed,). Boston, MA: Pearson Education, Inc.

Dijkstra, S. (2005). *Cognition and instructional design for problem-based learning Innovation in instructional technology.* Mahwah, NJ: Lawrence Erlbaum Associates.

Dorsey, L., Goodrum, D., & Schwen, T. (1997). *Rapid collaborative prototyping as an instructional development paradigm.* Englewood Cliffs, NJ: Educational Technology

Douglas, I. (2001). Instructional design based on reusable learning objects: Applying lessons of object-oriented software engineering to learning systems design. Paper presented at the Frontiers in Education Conference, Reno, Nevada.

Edwards, D., Rai, S., Phillips, & R., Fung, L. (2007). *A framework for interoperable learning objects for e-learning. Learning objects and instructional design*. Santa Rosa, CA: Informing Science Press.

El Saddik, A., Ghavam, A., Fischer, S., & Steinmetz, R. (2000). Metadata for smart multimedia learning objects. Paper presented at the Australasian Computing Education Conference, New York, NY.

Farha, N. W. (2009). An exploratory study into the efficacy of learning objects. *Journal of Educators Online, 6*(2), 32-47.

Fletcher, J., Tobias, S., & Wisher, R. A. (2007). Learning anytime, anywhere: Advanced distributed learning and the changing face of education. *Educational Researcher, 36(*2), 96.

Fulantelli, G., Gentile, M., Taibi, D., & Allegra, M. (2008). The open learning object model to promote open educational resources. *Journal of Interactive Media in Education., 2008*(01). Retrieved April 16, 2012, from http://jime.open.ac.uk/article/2008-9/343

Gagné, R. M. (1985). *The conditions of learning: A theory of instruction* (4th ed.). New York, NY: Holt, Rinehart & Winston

Geissinger, H. (2001). Re-use of current teaching resources at a dual-mode university: Campus-wide information systems. *Bradford, 18*(3), 120-124.

Gettman, D., McNelly, T, Muraida, D. (1999). The guided approach to instructional design advising: A case-based approach to developing instructional design expertise. *Design approaches and tools in education and training.*

Dordrecht, Netherlands: Kluwer Academic Publishers.

Griffith, R. (2003). Learning objects in higher education. Academic Advanced Distributed Learning Co-Lab publication,. Retrieved from http://www. academiccolab.org/resources/webct_learningobjects. pdf

Guler, C., & Altun, A. (2010). Teacher trainees as learning object designers: Problems and issues in learning object development process. *Turkish Online Journal of Educational Technology, 9*(4), 118-127.

Gustafson, K. L., & Branch, R. (2002). *Survey of instructional design models* (4th ed.). Syracuse, NY: ERIC Clearinghouse on Information Technology

Heinich, R., Molenda, M., Russell, J. D., & Smaldino, S. E. (1999). *Instructional media and technologies for learning.* Upper Saddle River, NJ: Merrill.

Hodgins, H. W. (2004). The future of learning objects. *E-Technologies in Engineering Education: Learning Outcomes Providing Future Possibilities*, 11.

Holton III, E. F. (1996). The flawed four level evaluation model. *Human Resource Development Quarterly, 7*(1), 5-21.

Hudak, C. (2007). Linking instructional theories and instructional design to learning objects: A proposed conceptual framework. In A. Koohang & K. Harman (Eds.), *Learning Objects and Instructional Design* (pp. 1-38). Santa Rosa, CA: Informing Science Press.

IEEE. (2011). Learning technology standards committee. Retrieved from p://ltsc.ieee.org/wg12/index.html

Ilomäki, L., Lakkala, M., & Paavola, S. (2006). Case studies of learning objects used in school settings. *Learning, Media & Technology, 31*(3), 249-267. doi: 10.1080/17439880600893291

Intulogy. (2011). ADDIE implementation phase .Retrieved from http://www.intulogy.com/addie/implementation.html

Kasowitz, A. (2000). Tools for automating instructional design. *Educational Media and Technology Yearbook, 25*, 49-52.

Kim, S. (2009). The conceptualization, utilization, benefits and adoption of learning Objects (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.

Kinshuk, T., & Patel, A. (2005). Supporting the mobility and the adaptivity of knowledge objects by cognitive trait model. *Innovation in instructional technology.* Mahwah, NJ: Lawrence Erlbaum Associate

Kirkpatrick, D. L. (1975). *Evaluating training programs*. New Delhi: Tata McGraw-Hill Education.

Kurilovas, E., Bireniene, V., & Serikoviene, S. (2011). Methodology for evaluating quality and re-usability of learning objects. *Electronic Journal of e-Learning,9*(1), 39-51.

Laffey, J. (1995). Dynamism in electronic performance support systems. *Performance Improvement Quarterly, 8*(1), 31-46.

Larson, M., & Lockee, B. (2004). Instructional design practice: Career environments, job roles, and a climate of change. *Performance Improvement Quarterly, 17*(1), 22-

40.

Larson, M. B., & Lockee, B. B. (2009). Preparing instructional designers for different career environments: A case study. *Educational Technology Research and Development, 57*(1), 1-24.

Lau, S.-H., & Woods, P. C. (2008). An investigation of user perceptions and attitudes toward learning objects. *British Journal of Educational Technology, 39*(4), 685-699. doi: 10.1111/j.1467-8535.2007.00770.x

Lau, S.-H., & Woods, P. C. (2009). Understanding learner acceptance of learning objects: The roles of learning object characteristics and individual differences. *British Journal of Educational Technology, 40*(6), 1059-1075.

Lee, C. (2007). Ontological sharing, granular visualization and re-usability of learning objects. In A. Koohang & K. Harman (Eds.), *Learning objects and instructional design* (pp. 197-218). Santa Rosa, CA: Informing Science Press.

Lim, G. (2007*).* Instructional design and pedagogical considerations for the ins-and-outs of learning objects. In A. Koohang & K. Harman (Eds.), *Learning objects and instructional design (*pp. 115-137*).* Santa Rosa, CA: Informing Science Press.

Mager, R. F. (1997*). Preparing instructional objectives: A critical tool in the development of effective instruction.* Atlanta, GA: Center for Effective Performance.

Mason-Mason, S. D., & Tessmer, M. (1999). Expert systems as a mindtool to facilitate mental model learning. *Educational Technology Research & Development, 48*(4), 43-62. doi: 10.1007/BF0230049

McCombs, B. L. (1986). The instructional systems development (ISD) model: A review

of those factors critical to its successful implementation. *Educational Communications and Technology Journal, 34*(2), 67–81.

McCormick, R., & Li, N. (2006). An evaluation of European learning objects in use. *Learning, Media & Technology, 31*(3), 213-231.

McGreal, R. (2004). Learning objects: A practical definition. *International Journal of Instructional Technology and Distance Learning 1*(9), 21.

Mei, Q., & Boyle, T. (2010). Dimensions of culturally sensitive factors in the design and development of learning objects. *Journal of Interactive Media in Education, 2010*(01). Retrieved April 1, 2012, from http://jime.open.ac.uk/jime/article/view/2010-6

Merrill, M. D., Li, Z., & Jones, M. K. (1999). Instructional transaction theory. In C. Reigeluth (Ed.), *Instructional design theories and models: A new paradigm of instructional theory* (pp. 397-424). Mahwah, NJ: Lawerence Erlbaum Associates, Inc.

Milheim, W. (1997). Instructional design issues for electronic performance support systems. *British Journal of Educational Technology, 28*(2), 103-110.

Morrison, G. R., Ross, S. M., Kemp, J. E., & Kelman, H. (2009). *Designing effective instruction.* Hoboken, NJ: Wiley.

Muzio, J. A., Heins, T., & Mundell, R. (2002). Experiences with re-usable e-learning objects: From theory to practice. *The Internet and Higher Education, 5*(1), 21-34. doi: Doi: 10.1016/s1096-7516(01)00078-1

Nash, S. S. (2005). Learning objects, learning object repositories, and learning theory: Preliminary best practices for online courses. *Interdisciplinary Journal of*

Knowledge and Learning Objects, 1, 217-228.

Nixon, E. K., & Lee, D. (2001). Rapid prototyping in the instructional design process. *Performance Improvement Quarterly, 14*(3), 95-116.

Nkambou, R., Gauthier, G., Frasson, C., & Antaki, M. (1995). *Integrating expert system in authoring systems for curriculum and course building.* Montreaal, Canada: Universite de Montreal.

Noe, R. (2002). *Employee training and development,* (2nd ed.). New York, NY: McGraw-Hill.

Nurmi, S., & Jaakkola, T. (2006). Promises and pitfalls of learning objects. *Learning, Media & Technology, 31*(3), 269-285.

Olivier, B., & Liber, O. (2003). Learning content interoperability standards. In A. Littlejohn (Ed.), *Reusing online resources: A sustainable approach to e-learning* (pp. 146–155). Sterling, VA: Kogan Page Limited.

Park, S.-H., Kim, Y. H., & Byun, Y. K. (1999). Dual structured instructional systems approach: An integration of systemic and systematic approaches for instructional design. Paper presented at the annual convention of the Association for Education Communication and Technology, Houston, TX.

Parrish, P. E. (2004). The trouble with learning objects. *Educational Technology Research and Development, 52*(1), 49-67.

Passerini, K., & Granger, M. J. (2000). A developmental model for distance learning using the internet. *Computers & Education, 34*(1), 1-15.

PMI, P. M. I. (2011). Project management standards Retrieved from http://www.pmi.org/

Poldoja, H., Leinonen, T., Valjataga, T., Ellonen, A., & Priha, M. (2006). Progressive inquiry learning object templates (pilot). *International Journal on E-Learning, 5*(1), 103-111.

Press, E., & Kemp, S. (2006). *Project management made easy.* Madison, WI: CWL Publishing Enterprises.

Quinn, C., & Hobbs, S. (2000). Learning objects and instruction components. *Educational Technology & Society, 3*(2), 13-20.

Rehak, D., & Mason, R. (2003). Keeping the learning in learning objects. In A. Littlejohn (Ed.), *Reusing online resources: A sustainable approach to e-learning* (pp. 20-34). Sterling, VA: Kogan Page Limited.

Reid, I. (2007). Embedding instructional design with learning objects. In A. Koohang & K. Harman (Eds.), *Learning objects and instructional design* (pp. 39-58). Santa Rosa, CA: Informing Science Press.

Reigeluth, C. M. (1999). The elaboration theory: Guidance for scope and sequence decisions. *Instructional-design theories and models, 2,* 425-453.

Reiser, R., & Dempsey, J. (2007). *Trends and issues in instructional design and technology* (2nd ed.). Upper Saddle River, NJ: Merrill Prentice Hall.

Reiser, R. A. (2001). A history of instructional design and technology: Part II: A history of instructional design. *Educational Technology Research and Development*, *49* (2), 57-67.

Richey, R. (2005). Validating instructional design and development models. In J. Spector, C. Ohrazda, A. Schaack, & D. Wiley (Eds.), *Innovations in instructional*

technology (pp. 171-186). Mahwah, NJ: Lawrence Erlbaum Associates.

Richey, R., Morrison, G., & Foxon, M. (2002). Instructional design in business and industry. *Trends and issues in instructional design and technology*, 197-210.

Robles, M. (2007). Applying instructional design theory when using learning objects. In A. Koolhang, & K. Harman (Eds.), *Learning objects and instructional design* (pp. 407-436). Santa Rosa, California: Informing Science Press.

Roschelle, J., DiGiano, C., Chung, M., Repenning, A., Tager, S., & Treinen, M. (2000). Re-usability and interoperability of tools for mathematics learning: Lessons from the ESCOT project. In Proceedings of Intelligent Systems & Applications at University of Wollongong, NSW Australia. ICSC Academic Press, Wetaskiwin, AB, Canada, pp. 664-669.

Rossman, G. B., & Rallis, S. F. (2003). *Learning in the field: An introduction to qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.

Rossett, A. (1987). *Training needs assessment*. Englewood Cliffs, NJ: Educational Technology Publications.

Salas, E., & Cannon-Bowers, J. A. (2001). The science of training: A decade of progress. *Annual Review of Psychology, 52*(1), 471.

Sancho Gil, J. M. (1995). Looking for the "right" answers or raising the "right" questions? A dialogical approach to automating instructional design. *Automating instructional design: Computer-based development and delivery tools*. Berlin, Germany: Springer-Verlag.

SCORM. (2011). Shareable content object reference model. Retrieved from http://www.adlnet.gov/Technologies/scorm/default.aspx

Shih, W.-C., Tseng, S.-S., & Yang, C.-T. (2008). Wiki-based rapid prototyping for teaching-material design in e-learning grids. *Computers & Education, 51*(3), 1037-1057.

Silveira, I., Fernando de Araujo, C., Amaral, L., Alcantara de Oliveir, A., Fernandez-ParadelaLedon, M., & Fierreira, M. (2007). Granularity and reusability of learning objects. In A. Koolhang, & K. Harman (Eds.), *Learning objects and instructional design* (pp. 139-170). Santa Rosa, California: Informing Science Press.

Smith, P., & Ragan, T. (2005). *Instructional design* (3rd ed.). Hoboken, N.J.: J. Wiley & Sons.

Sosteric, M., & Hesemeier, S. (2002). When is a learning object not an object: A first step toward a theory of learning objects. *The International Review of Research in Open and Distance Learning, 3(*2), Article 3.2. 8.

South, J., & Monson, D. (2002). A university-wide system for creating, capturing, and delivering learning objects. In D.A. Wiley (Ed.), *The instructional use of learning objects: Online Version.* Bloomington, Indiana: Agency for Instructional Technology..Retrieved from http://reusability.org/read/chapters/south.doc.

Spector, J., & Ohrazda, C. (2003). Automating instructional design: Approaches and limitations. *Educational Technology Research and Development, 26(2)* 685-700.

Spector, J. M., & Edmonds, G. S. (2002). *Knowledge management in instructional design.* Syracuse, New York: ERIC Clearinghouse on Information and Technology.

Stake, R. (1995). *The art of case study research*. Newbury Park, CA: Sage Publications.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research techniques and procedures for developing grounded theory* (2nd ed.). London: Sage Publications.

Surry, D. W., & Robinson, M. A. (2001). A taxonomy of instructional technology service positions in higher education. *Innovations in Education & Teaching International, 38*(3), 231-238. doi: 10.1080/14703290110051406

Tennyson, R. (1995). Instructional system development: The fourth generation. In R.D. Tennyson, & A. E. Barron (Eds.), *Automating instructional design: Computer-based development and delivery tools* (pp. 33-78). Berlin, Germany: Springer-Verlag.

Tessmer, M., & Wedman, J. F. (1990). A layers-of-necessity instructional development model. *Educational Technology Research and Development, 38*(2), 77-85.

Van Merrienboer, J., & Boot, E. (2005). A holistic pedagogical view of learning objects: Future directions for re-use. In J. M. Spector, C. Ohrazda, A. Van Schaak, and D. A. Wiley (Eds.), *Innovations in instructional technology* (pp. 43-64).. Mahwah, NJ: Lawrence Erlbaum Associates.

Weller, M. (2004). Learning objects and the e-learning cost dilemma. *Open Learning, 19*(3), 293-302.

Wentland, D. (2003). The strategic training of employees model: Balancing organizational constraints and training content. [Article]. *SAM Advanced Management Journal 68*(1), 56.

Weston, C., McAlpine, L., & Bordonaro, T. (1995). A model for understanding formative evaluation in instructional design. *Educational Technology Research and Development, 43*(3), 29-48.

Wiley, D. A. (2002). Learning objects. In A. Kovolchick & K. Dawson (Eds.), *Educational Technology: An Encyclopedia*. Santa Barbara, CA: ABC-CLIO. Retrieved from http://wiley.ed.usu.edu/docs/encyc.pdf.

Wiley. (2005). Learning objects in public and higher education (pp. 7-21). In J. M. Spector, C. Ohrazda, A. Van Schaak, and D. A. Wiley (Eds.), *Innovations in instructional technology.* Mahwah, NJ: Lawrence Erlbaum Associates.

Wiley, D. A. (2000). Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy. *The instructional use of learning objects, 2830*(435), 1-35.

Appendix A – IRB Approval Letter

VirginiaTech

Office of Research Compliance
Institutional Review Board
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Blacksburg, Virginia 24060
540/231-4606 Fax 540/231-0959
e-mail irb@vt.edu
Website: www.irb.vt.edu

MEMORANDUM

DATE: April 23, 2012

TO: Barbara B. Lockee, Brian Moseley

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires May 31, 2014)

PROTOCOL TITLE: Description of Instructional Design Framework Usage in the Development of Learning Objects

IRB NUMBER: 12-420

Effective April 20, 2012, the Virginia Tech IRB Chair, Dr. David M. Moore, approved the new protocol for the above-mentioned research protocol.

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

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

All investigators (listed above) are required to comply with the researcher requirements outlined at http://www.irb.vt.edu/pages/responsibilities.htm (please review before the commencement of your research).

PROTOCOL INFORMATION:
Approved as: **Expedited, under 45 CFR 46.110 category(ies) 6, 7**
Protocol Approval Date: **4/20/2012**
Protocol Expiration Date: **4/19/2013**
Continuing Review Due Date*: **4/5/2013**
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

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

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

Date*	OSP Number	Sponsor	Grant Comparison Conducted?

*Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.

cc: File

Appendix B – Interview Protocol

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Participants in Research Projects Involving Human Subjects

Title of Project: Description of Instructional Design Framework Usage in the Development of Learning Objects

Investigator: Brian Moseley

I. Purpose of this Research/Project

The purpose of this study is to identify the current processes used by IDT practitioners in the development of instructional materials that include learning objects. This studies aims to understand IDT practitioner's process of learning object development and identify the instructional design strategies implemented in the instructional material development process. The study will examine the process of how IDT practitioners construct learning materials that include learning objects. Patterns that emerge in the process of learning object development will be studied as well.

In 2002, Wiley stated that the resources that could help learning object developers were very limited. This study will also examine the documentation used to aid learning object developers in the development of instructional materials that include learning objects.

Through in-depth interviews with IDT practitioners and document analysis, the study aims to acquire an in-depth understanding of the current practices used in the development of instructional materials using learning objects and IDT practitioner's perceptions and experiences in learning object development.

II. Procedures

Study participants will be interviewed one-time for approximately 45-60 minutes about their experiences. The interview will be recorded on a digital audio recorder and notes will be taken during the interview. The interviews will take place at a location specified by the research participants.

The participants are asked to be open and honest about their experiences in the development of learning objects. The following guiding questions will be asked:

1. What is your instructional design background?
2. What is your current role in your organization?
3. What are the stages of the instructional design process

4. How do you define learning objects?
5. At what stage in the instructional design process are learning objects developed?
6. Does the learning object development process subscribe to an instructional design strategy?
7. How are learning objects delivered to learners?
8. How are learning objects identified (tagged)
9. At what stage in the development process are existing learning objects analyzed and evaluated for reuse?
10. How are multiple learning objects combined to create instruction?
11. What documentation is used in the development of instructional materials?
12. What advantages do you realize with the implementation of learning objects?
13. What challenges do you face with the development of learning objects?
14. What is your organizations future direction in the use of learning objects?

After the interview, the researchers will type a transcript of the interview. All transcripts of the interviews will be stored on the interviewing researcher's computer in a password-protected file. After the transcripts have been typed, each researcher will contact the participant he or she interviewed individually in order to have them check the transcript. You will have rights to make any changes and comments on the transcript. For this member-check process, at least two kindly reminders will be sent out to you via email.

III. Risks to Confidentiality

This paragraph is to inform you that the access to transcripts of the interviews will only be allowed to primary investigator and co-investigators. Pseudonyms will be used to identify each participant in all interviews and written materials. Participants will be told that they may decline to answer any questions that they don't feel comfortable with. All consent forms and data resulting from this study will be kept in a locked file cabinet in Brian Moseley's home as well as all the data will be digitized and stored on Brian Moseley's computer with a password. All data will be coded with labels and numbers. No personal identifying marks will be present on any data forms. Data will be analyzed without personal identification.

IV. Benefits and Compensation

You will receive no compensation for you participation in this study. However, identifying themes and patterns can inform possible improvements of the learning community. This study may help improve understanding of the characteristics of effective Math Emporium and help faculty design and develop CBI math class requirements to support students' learning.

V. Freedom to Withdraw

You are free to cease the participation at any time without prejudice, penalty, or any other negative consequence.

VI. Subject's Responsibilities

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

- I agree to answer questions honestly.
  Initial_____

- I agree to allow the researcher to record the interview on digital recording device. Initial _____

- I agree to allow the researcher to use a non-identifying direct quote.
  Initial _____

VII. Subject's Permission

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

_____ Date_____
Subject signature

Brian Moseley …….
moseleb@vt.edu
Investigator

[NOTE: Subjects must be given a complete copy (or duplicate original) of the signed Informed Consent.]

Appendix C – Recruitment Email

Recruitment E-mail

You are being invited to participate in this research study to collect data about learning object development procedures. The purpose of this study is to identify the current processes used by IDT practitioners in the development of instructional materials that include learning objects.

If you agree to participate in the study, your participation will involve a 45 – 60 minute interview. If you decided not to participate in this study, you may leave the study at any time. Your participation in this study is completely voluntary.

If you are interested in participating, may we set up a mutually agreed-upon time to meet to discuss the study in more detail?

Thank you,