INSTRUCTIONAL DESIGNERS' CONCEPTUALIZATIONS OF LEARNING OBJECTS

DAVID FRANCIS

INSTRUCTIONAL DESIGNERS' CONCEPTUALIZATIONS OF LEARNING OBJECTS

by

© David Francis

A thesis submitted to the School of Graduate Studies

in partial fulfillment of the requirements for the degree of

Master of Education

Faculty of Education

Memorial University of Newfoundland

November, 2006

St. John's Newfoundland

Your file Votre référence
ISBN: 978-0-494-31247-6
Our file Notre référence
ISBN: 978-0-494-31247-6

Abstract

The purpose of this multiple case study was to gain insight into how instructional designers conceptualize learning objects and their attributes. The 10 participants were instructional designers working in Canadian colleges and universities. Data were collected during two phases of semi-structured phone interviews. Open, axial and selective coding were used to analyze data. Designers identified the following attributes of learning objects: *adaptable*, *assessable*, *design accountable*, *digital*, *granular*, *interactive*, *interoperable*, *pedagogically assessable*, *pedagogically powerful*, *pedagogically purposeful*, *reliable*, *retrievable*, *reusable*, *scalable* and *usable*. Designers defined and conceptualized learning objects and their attributes with a focus on learning theory or pedagogical best practices rather than a focus on technical definitions of learning objects and their attributes. Video games were highlighted by some designers as appropriate analogies for learning objects as they feature interactivity, clearly stated objectives and assessment.

Acknowledgements

I would like to thank my family, colleagues and friends who provided me with the encouragement required to complete this work. In particular, I would like to thank the following individuals:

- The ten instructional designers who took time out of their busy schedules to participate in this study. Through the sharing of your conceptualizations of learning objects, you will positively influence the literature and development practices relating to learning objects.
- My thesis supervisor, Dr. Elizabeth Murphy for her tireless efforts, excellent guidance and patience in ensuring project success.
- Dr. Kevin Harrigan and Peter Goldsworthy from CLOE (Co-operative Learning Object Exchange, University of Waterloo).
- Heather Ross and Denise Nelson for their keen eyes and insights.

Table of Contents

List of Tables

Chapter One

Introduction

The phenomenon of instructional designers creating Web-based learning objects is increasingly popular (Barritt & Alderman, 2004; Downes, 2000; McGreal, 2004; Wiley, 2002a). In post-secondary education, this popularity is evidenced by the number of learning object repositories that have become available such as BC Campus (BC Campus Web site, 2005), CAREO (CAREO Web site, 2005), CLOE (CLOE Web site, 2005) and MERLOT (MERLOT Web site, 2005). This popularity continues to grow despite a lack of consensus on what exactly constitutes a learning object (Downes, 2003; Friesen, 2004; McGreal, 2004; Wiley, 2002a).

Many definitions of learning objects have been proposed. Wiley (2002a) defined a learning object as "any digital resource that can be reused to support learning" (p. 6). Alberta Learning defined a learning object as:

> ... one or more digital assets combined and sequenced to create or support a learning experience addressing a curricular outcome(s) for an identified audience(s). A learning object can be identified, tracked, referenced, used, and reused for a variety of learning experiences. (Alberta Learning, 2002, Online Glossary section)

Sosteric and Hesemeier (2004) defined a learning object as "a digital file (image, movie, etc.) intended to be used for pedagogical purposes, which includes, either internally or via association, suggestions on the appropriate context within which to use the object" (p. 40).

The IMS Global Learning Consortium, in their Learning Design (LD) Information Model, defined learning objects as "any reproducible and addressable digital or non-

digital resource used to perform learning activities or support activities" (IMS Global Learning Consortium, 2005, Conceptual Vocabulary of Learning Design section). The vagueness and openness of some of these definitions has led some authors (e.g., Downes, 2003; Friesen, 2001; Mortimer, 2002) to posit that, with at least some of these definitions, learning objects could in fact be defined as "anything and everything" (McGreal, 2004, p. 8) whether they were designed for educational use or not or whether or not the object is digital.

Learning objects are also defined by their specific attributes. Attributes describe the overall potential of learning objects as a list of "abilities"; that is, a commonly suffixed list of words describing the advantages of creating and using learning objects. Williams (2002) noted that the literature identified required "criteria for learning objects" (p. 19) such as *reusability*, *repurposability*, *granularity*, and the "ability to adjust to the needs of the context in which they are being used" (p. 19). McGreal (2004) expanded on these attributes, and a list initially proposed by Parmentier (1999), resulting in the additional learning object attributes of *accessibility, interoperability, adaptability, reusability, durability, affordability, assessability, discoverability, manageability, reliability* and *retrievability.* Further, the concept of *granularity* mentioned above (Wiley et al., 1999) must also be considered as an attribute in order to define the smallest unit of instruction that can be contained within a learning object. This diversity of learning objects definitions, attributes and meanings highlights their complexity. The diversity highlights the difficulties related to understanding what learning objects actually are. Part of this difficulty derives from the fact that the definitions proposed for objects have largely been derived theoretically. An alternative approach to defining and conceptualizing learning objects and their attributes would be to do so from a practical perspective rather than a theoretical perspective.

The purpose of this study was to gain insight into how instructional designers conceptualize learning objects and their attributes, not from a theoretical perspective, but from a design perspective. To achieve its purpose, the study focused on the meanings, understandings and interpretations of learning objects and their attributes from the perspective of instructional designers. The study aimed to identify the range and types of conceptualizations of learning object attributes held by a group of designers. The study also aimed to evaluate congruencies and incongruencies between the conceptualizations and interpretations of attributes held by designers with the literature relating to learning objects.

The remainder of this chapter describes the study in more detail. The chapter begins with a statement of the problem. The purpose and objectives of this study are then described followed by a description of the limitations. The significance of the study is outlined with respect to existing work relating to the experiences of instructional designers who have designed learning objects. The chapter concludes with an overview of the study as a whole as well as a summary of Chapter One.

Statement of the Problem

Many definitions of learning objects have been proposed. Wiley (2002a) defined a learning object as "any digital resource that can be reused to support learning" (p. 6). Alberta Learning defined a learning object as:

> ... one or more digital assets combined and sequenced to create or support a learning experience addressing a curricular outcome(s) for an identified audience(s). A learning object can be identified, tracked, referenced, used, and reused for a variety of learning experiences. (Alberta Learning, 2002, Online Glossary section)

Sosteric and Hesemeier (2004) defined a learning object as "a digital file (image, movie, etc.) intended to be used for pedagogical purposes, which includes, either internally or via association, suggestions on the appropriate context within which to use the object" (p. 40). The IMS Global Learning Consortium, in their Learning Design (LD) Information Model, defined learning objects as "any reproducible and addressable digital or non-digital resource used to perform learning activities or support activities" (IMS Global Learning Consortium, 2005, Conceptual Vocabulary of Learning Design section).

This diversity of learning objects definitions, attributes and meanings highlights their complexity as well as the lack of agreement in the literature. Further variation was found in the concept of learning object size. Jackson and Cooper (2004) noted:

> ... at one extreme is the 'publisher' view in which an object is little more than an asset to be incorporated in a larger piece of material; at the other extreme are practitioners who insist that a single learning object should completely address a specific learning objective, by delivering the learning AND assessing whether it has been achieved; in-between is a range of views that often take a pragmatic stance based on the size of the learning object and its practical ability to be reused in other contexts. Some argue that 'all of the above' are valid learning objects – which is philosophically generous, but does not provide content producers or VLE implementers with any help as to what they are supposed to be building and supporting. (p. 4)

Mortimer (2002) agreed that no single definition exists for a learning object and contended the term can hold different meanings for different people. Epsilon Learning noted:

> ... there are disparate definitions of learning objects. They may or may not include non-digital resources, be based on an explicit learning objective, or have

> internal structure. A pervasive conceptual confusion exists between learning objects as content for learning, as pointers to learning resources, or as metadata (data about data) about such resources. And is the metadata part of the object? Or does it reside in a separate database? One must sort through much jargon, specifications and standards (recognizing the difference between them), and an alphabet soup of technical TLAs (Three-Letter Acronyms). (Epsilon Learning Web site, 2005, Learning Objects section, para. 2)

The vagueness and openness of some of the proposed definitions has led some authors (e.g., Downes, 2003; Friesen, 2001; Mortimer 2002) to posit that, with at least some of these definitions, learning objects could in fact be defined as "anything and everything" (McGreal, 2004, p. 8) whether they were designed for educational use or not or whether or not the object is digital. Rehak and Mason (2003) reached the following conclusion regarding the diversity of and disagreement about definitions: "In this environment of uncertainly and disagreement, the various stakeholders are going off in all directions" (p. 20). Wiley (2006) reached a similar conclusion noting that "no one can agree about what a learning object is" ("RIP-ping on Learning Objects", para. 1).

Murphy (2004) argued that despite multiple definitions for learning objects and attributes, it is unclear how these concepts are operationalized in actual practice. Part of this difficulty is due to the fact that the definitions proposed for objects and attributes have largely been derived theoretically. She argued that an alternative approach to defining and conceptualizing objects and their attributes would be to do so from a practical and not a theoretical perspective.

Purpose and Objectives

The purpose of this study was to gain insight into how instructional designers conceptualize learning objects and their attributes, not from a theoretical perspective, but from a design perspective. To achieve its purpose, the study focused on the meanings, understandings and interpretations of learning object attributes from the perspective of instructional designers. It aimed to identify the range and types of conceptualizations of learning object attributes held by a group of designers. The study also aimed to evaluate congruencies and incongruencies between the conceptualizations and interpretations of attributes held by designers and the literature relating to learning objects. In summary, the specific objectives of the study were:

1. Identify the range and types of conceptualizations of learning object attributes held by a group of designers.
2. Compare designers' conceptualizations of learning object attributes with the literature relating to learning objects.

Overview of Methodology

This qualitative study followed a multiple case study methodology while open, axial and selective coding were used to analyze data. To achieve its objectives, the study invited participation from a group of 10 instructional designers. These designers all had experience designing learning objects and all received a common training experience related to developing learning objects for Web-based instructional projects. Specifically, the experiences of instructional designers who have participated in the Camp CLOE summer program at the University of Waterloo located in Ontario, Canada were considered for this study. CLOE is an acronym for The Co-operative Learning Object Exchange, which serves as a "collaboration between Ontario universities and colleges for

the development, sharing, and reuse of multimedia-rich learning resources. This occurs through the CLOE Learning Object repository" (CLOE Web site, 2005, Overview section).

Participants were selected from the groups of designers who attended Camp CLOE in different years for the following reasons. First, these designers were assured to have participated in at least one week of training in the design and development of learning objects during their attendance at Camp CLOE. They also designed and developed at least one learning object during this time, representing an authentic design situation. Also, these designers represented a diverse group with varied academic backgrounds, specialties, geographical locations and work settings (both university and college environments). Camp CLOE has delivered its learning objects' program over multiple years with a continuity of well-qualified leadership and facilitation. Finally, CLOE itself has an interest in further scholarly exploration of learning objects and expressed a willingness to help further the goal of enriching the literature relating to learning objects.

Designers participated in two phases of inquiry. The purpose of the first interview phase was to identify the range and types of conceptualizations for learning object attributes. To achieve this goal, each designer participated in an individual semi-structured interview in which they were prompted to articulate and make explicit their conceptualizations of learning object attributes based on their own experiences from a recent learning object design project. Designers were also asked to provide analogies for learning objects. They were also asked to state examples of what they thought would not constitute a learning object.

The purpose of the second interview phase was to validate findings from the first phase and to probe more deeply into common emergent categories and subcategories

derived and coded from the first phase. The second interview also served as a comparison point between designers' conceptualizations of learning object attributes and attributes of learning objects they did not design themselves. Designers were presented with two learning objects freely available from the Web that reflected a variety of possible learning object attributes. Each designer was presented with the same two objects and was asked to explain whether or not they believed it was a learning object and why. They were asked to detail which attributes they saw or did not see and how this related to their own conceptualization of learning object attributes.

Data analysis involved an iterative process of *open*, *axial* and *selective* coding phases (Strauss & Corbin, 1990). Open coding occurred first in order to break down, analyze, compare and categorize the data. Axial coding was then used to determine relationships between categories and subcategories. Finally, selective coding was used to relate the categories to core categories.

Significance of the Study

It is expensive to develop online learning materials and courses. Development costs for a single semester online course have been estimated at tens of thousands of dollars (Bates, 2005) to hundreds of thousands of dollars (Kruse, 2002) to the million-dollar range (Bok, 2003). Further, the costs of producing and maintaining online learning materials and courses are frequently underestimated (Bates, 2005). By extension, the design and implementation of learning objects and learning object repositories (containing large amounts of online materials) is necessarily a costly venture. If such online course development is not planned strategically, this additional amount of complexity and expense may not pay dividends on the original time and money that is invested. The success of online learning will depend partly on the ability of instructional

designers to be able to effectively design learning objects. This ability will depend on an understanding of what objects are and how their attributes can be effectively operationalized in actual design contexts. The knowledge and understanding of objects gained in this study can be used to help inform the practice of designers who are working with objects. As such, this study will indirectly contribute to the success of online learning.

Instructional designers have extensive pre-service and in-service training and educational requirements. They often hold or are working toward a graduate degree in a related discipline (Cox & Oglethorpe, 2003) and have widely defined professional responsibilities and obligations (Kenny, Zhang, Schwier & Campbell, 2005; Powell, 2004) that require them to routinely draw from a wide set of professional competencies (IBSTPI Web site, 2005). Therefore, professional development is a key activity for instructional designers (Liu, Gibby, Quiros & Demps, 2002; Powell, 2004). This study will help support professional development opportunities for instructional designers by promoting an understanding of learning objects and their attributes that are meaningful to the profession. From a practical perspective, insights gained from this study may be useful in the contexts of pre or in-service training and professional education for instructional designers.

This study will enrich the existing literature on learning objects by giving voice to those individuals involved in the actual design and creation of learning objects. Insight into their understandings and experiences may help clarify and extend our knowledge of objects and their attributes. Theoretical notions about learning objects can be informed by actual design practice, providing an opportunity to re-evaluate how learning objects and their attributes are conceptualized. From a theoretical perspective, this study may support

a deeper understanding of learning objects and complement the literature on learning objects.

Limitations of the Study

This study was concerned with the meanings and interpretations of learning objects held by instructional designers who work in post-secondary environments. It did not focus on instructional designers who work in corporate, military or government environments. Designers participating in this study were employed primarily by Canadian, publicly-funded universities and college systems that are members of the CLOE network. These universities and colleges are located in mainly urban areas across Canada. Participation from designers from other geographical areas and with different professional backgrounds might have yielded different perspectives on learning objects.

Soliciting participation from the group of designers involved with Camp CLOE presented the advantage that these designers had familiarity with learning objects and the advantage that these designers developed at least one object. However, it is possible that certain concepts relating to learning objects and their attributes presented by CLOE or the University of Waterloo's LT3 centre during Camp CLOE were reported with a greater frequency by this group.

Some learning objects considered in this study (e.g., objects from CAREO or MERLOT) were examined only from the perspective of the prospective user, not the original object developer. The source code of these learning objects and their associated data structures was not examined. The study did not consider other aspects of objects such as how they are metatagged or how designers interpret metatagging. The study did not directly consider the place of standards (e.g., CanCore, IMS-LD) as they relate to learning objects or how designers use learning object repositories.

Overview of the Study

Chapter One provided an introduction to the study, the statement of the problem, the purposes and objectives of the study, an overview of the methodology, the significance of the problem and the limitations of the study. Chapter Two presents a review of the literature about studies that have taken place related to the design and development of learning objects. The review of the literature conducted for this study did not reveal any studies directly related to instructional designers' conceptualizations about learning objects. The chapter concludes with a detailed overview of how this study will add to the existing body of knowledge. Chapter Three presents an overview of the research design and methodology. The chapter outlines how participants were selected, and describes the study's two interview phases. Chapter Four presents the study's findings. These are presented in terms of the learning object attributes and requirements that designers stated as mandatory for an educational resource to qualify as a learning object. Chapter Five presents a discussion and analysis of the study's findings. The chapter also presents the study's implications for practice and for future research. The chapter concludes with designers' reflections as well as my reflections on the study.

Summary

The phenomenon of instructional designers creating Web-based learning objects is increasingly popular. This popularity continues to grow despite a lack of consensus on what exactly constitutes a learning object. Despite this lack of agreement, many definitions of learning objects have been proposed and these definitions vary significantly. Learning objects are also defined by attributes. Attributes describe the overall potential of learning objects as "abilities" – a list of words that describe the advantages of using learning objects. This diversity of definitions, attributes and

meanings highlights the complexity of learning objects. Part of this difficulty arises from the fact that the definitions proposed for objects have largely been derived theoretically. An alternative approach to defining and conceptualizing objects and their attributes would be to do so from a practical and not theoretical perspective.

The purpose of this study was to gain insight into how instructional designers conceptualize learning objects and their attributes, not from a theoretical perspective, but from a design perspective. To achieve its purpose, the study focused on the meanings, understandings and interpretations of learning objects and their attributes from the perspective of instructional designers. It aimed to identify the range and types of learning object conceptualizations and learning object attributes held by a group of designers. The study also aimed to evaluate congruencies and incongruencies between the conceptualizations and interpretations of attributes held by designers and the literature relating to learning objects. In summary, the specific objectives of the study were:

1. Identify the range and types of conceptualizations of learning object attributes held by a group of designers.
2. Compare designers' conceptualizations of learning object attributes with the literature relating to learning objects.

This qualitative study followed a multiple case study methodology while open, axial and selective coding were used to analyze data. The purpose of the first interview phase was to identify the range and types of conceptualizations for learning object attributes held by the designers. The purpose of the second interview phase was to validate findings from the first phase and to probe more deeply into the common emergent categories and subcategories derived and coded from the first phase. The second interview also served to compare designers' conceptualizations about learning object attributes with the attributes of learning objects they did not design themselves.

This study was concerned with how instructional designers conceptualize learning object attributes. Designers in this study were employed by post-secondary institutions that were members of the CLOE (Collaborative Learning Object Exchange) network, and the study did not aim to address the experiences of instructional designers who work in the corporate, military or government sectors. These universities and colleges were located in mainly urban areas across Canada. Participation by designers from other geographical areas and with different professional backgrounds might have yielded different perspectives on learning objects.

This study may enrich the existing literature on learning objects by giving voice to those individuals involved in the actual creation of learning objects. Insight into their understandings and experiences can help clarify and extend our knowledge of learning objects and their attributes. The study may also enrich the literature on instructional design by providing further insight into the experiences of instructional designers.

Chapter Two

Literature Review

Introduction

While much has been written on the theory of learning objects, only a few studies were identified that investigated instructional designers' practices in creating them. No studies were identified that directly investigated the meanings and interpretations held by instructional designers about learning objects and their attributes. This chapter presents an overview of four studies about instructional designers who have developed learning objects or have assembled courses using existing learning objects. The purpose, methodology, findings, and conclusions of each study reviewed are presented. The chapter then describes how this study will add to the existing body of knowledge, outlining how its purpose and methodology are similar to, and different from, the studies reviewed.

From Theory to Practice: Instructional Designers Creating Learning Objects

Murphy (2004) conducted a study in which she investigated how certain attributes of learning objects might be operationalized when developing an online learning module. Her study was premised on the argument that, while learning objects and its attributes are defined in theory, it is unclear how, in practice, "they actually translate into courses or modules that can be used for instructional purposes" (Murphy, 2004, Introduction section). The following learning object attributes were the focus of the investigation: *granularity*, *reusability*, *interoperability* and *scalability* (Murphy, 2004, Design Framework section). Definitions for these attributes from the literature were provided and the author further described them in terms of the study's objectives:

> The objective was to create a granular learning module that constitutes a self-contained learning object but that can also be integrated with other objects. To ensure that the final product was interoperable required a selection of tools commonly found in learning management systems. Reuse required designing an experience that is sufficiently contextualized to be relevant and meaningful and yet sufficiently broad that it can be adapted for use in other contexts. Scalability required designing activities to accommodate a range of size of users or groups. (Murphy, 2004, The Design section)

The design involved two iterations with 11 teachers participating in the first round of testing and 30 in the second round. The module was redesigned in between test periods and "the testing process included online monitoring of participation in the experience by the researcher and her assistant, ongoing response to problems or questions that arose during the experience and follow-up, semi-structured interviews with the participants" (Murphy, 2004, Testing of the Design section). Users participated in the learning module for 12 hours over a four-week period. Components of the module included HTML pages, a discussion forum and streamed video segments.

Findings revealed that in terms of *granularity*, the module was an appropriate size that would allow it to be incorporated into multiple post-secondary teaching situations including self-paced study. For *reusability*, the module featured a design such that only certain components would have to be contextualized for teaching situations in different professional programmes. The instructional sequence would not have to be altered. For *scalability*, the module was successfully used in its second iteration with a group of participants three times the size of the initial group. One required design change was the creation of groups for the discussion board participants; as the size of the class increases, so would the number of groups. Finally, in terms of *interoperability*, video compatibility

was achieved by providing the same videos on CD-ROM as a backup strategy. The author concluded that this study served as a preliminary investigation into moving from theory to practice in the use of a learning object approach to designing instruction. This approach was successful in terms of the attributes that were examined.

Muzio, Heins, and Mundell (2002) reported on the experiences of instructional designers using learning objects at the Centre for Economic Development and Applied Research (CEDAR) at Royal Roads University (RRU), in Victoria, British Columbia. Instructional designers built courses using a database-driven tool to create, contribute and retrieve learning objects for the purposes of online course development. Learning objects were built using templates designed by instructional designers. The authors referred to learning objects as reusable e-learning objects (ELOs). This terminology was acknowledged as influenced by Cisco Systems, Inc.'s definition of a learning object: "a granular, reusable chunk of information that is media independent" (Muzio et al., 2002, p. 22). CEDAR further defined an ELO as "a small piece of text, visual, audio, interactive component, etc. that is tagged and stored in a database" (Muzio et al., 2002, p. 24).

Courses were designed using a learning outcomes' approach. The learning outcomes would define the means for designing appropriate instruction, a framework for evaluating learning, and a guide for the learner (Kemp, Morrison & Ross, 1994). Each learning outcome was assigned an appropriate level of instruction as per Bloom's Taxonomy (Bloom, Englehart, Furst, Hill & Krathwohl, 1956). Using this approach, courses were designed for linear delivery, although some of the learning objects themselves could be interacted with in a non-linear way. Some learning objects were designed to account for different learning styles (Gregorc, 1985). Designs for assessment and evaluation were not discussed in this study.

The authors concluded that, in terms of *granularity* of learning objects, the approach of their instructional designers was to make ELOs "as small as possible" (Muzio et al., 2002, p. 24). They decided that, in general, the amount of instruction that could appear on a computer screen should contain two or more ELOs. ELOs were kept small in order to enhance overall reusability and speed of creating new designs. The authors acknowledge that the definition of a granule is not clear in the literature and that while increased granularity increases usability, instructional context can sometimes be diminished. To promote *discoverability* of learning objects, instructional designers used their own user-defined keywords because no compelling standard existed at that time for applying metatags to ELOs. The authors claimed that, in future, they might retrofit their learning object database with an accepted metatagging standard.

The authors also found that creating sophisticated templates was costly in terms of time and money; however, the use of generalizable simple templates was effective in speeding development and lowering costs. If a template had reuse (or resale) potential, then it was created by designers. Despite a hope that subject matter experts (SMEs) at their institution would eventually create their own learning objects using this tool, SMEs were much more likely to simply edit existing objects. The authors confirmed that ELOs cannot be combined in myriad ways, as was originally suggested by Hodgins (2000), but rather only certain objects can be combined with other objects to form larger structures as suggested by Wiley (2002b).

Krauss and Ally (2005) conducted a study to examine the challenges and issues instructional designers face when developing a learning object. To achieve this purpose, they pursued a case study of developing and evaluating a learning object for a healthcare-related subject, namely the therapeutic principles of administering drugs. Their study examined theories of learning and cognition that may influence the design of learning

objects and used an available instrument and methodology for assessing the quality of learning objects.

A team approach was used to create the learning object. The team consisted of an instructional designer, a SME, a programmer and a media designer. Macromedia Flash™ was used as the development environment. Current theories of learning and cognition, as well as specific strategies recommended for teaching pharmacology, were used to guide the design. Faculty and students were asked to participate in the evaluation of the learning object using surveys and questionnaires.

Three approaches to assessing the quality of the learning object were employed. First, usability testing with students was conducted at an early design phase as a think aloud session to gauge students' impressions of interaction with the object. Second, peer reviewers were asked to evaluate the quality of the learning object using a slight modification of an existing instrument (LORI, or Learning Object Review Instrument) originally developed by Belfer, Nesbit and Leacock (2002). The criteria used were *content quality*, *learning goal alignment*, *feedback and adaptation*, *motivation*, *presentation design*, *interaction usability*, *reusability*, and *quality of accompanying instructor guide* (Krauss & Ally, 2005, adapted from Belfer et al., 2002). Each LORI criterion was judged on a five-point scale, and to mitigate subjectivity, a comments' section was employed. An instructor survey was used to collect further feedback. Finally, questionnaires were distributed over a two-week period to students to assess the learning impact of the learning object. The questionnaire items were grouped into four subcategories: *learning value*, *value added by the learning object*, *usability of learning object*, and *usability of technology* (Rose, 2003). An analysis was conducted of how theory guided the layout, presentation, and sequencing of the instruction.

The resultant learning object design employed a mixed approach drawn from cognitive and learning theory including behaviourism, constructivism, and generative learning theory. Behaviourist approaches focused on clinical activity that students would eventually have to perform in authentic situations. Constructivist approaches, as well as generative learning theory, were employed in order to promote better recall of information at a later time. Interactive simulations were used to gauge cause and effect of administration of drugs in various situations. A learning guide was also provided for the object to help learners plan their strategy for using the object. Similarly, an instructor's guide was made available to assist instructors with various means of employing the learning object.

Results from the evaluation of the learning object indicated that it was effective in meeting the instructional goals of the pharmacology unit. The highest ratings were found in *content quality,* including the student and instructor guides. Similarly, high ratings were applied to the *motivation* criterion, presumably reinforcing the instructional methodologies selected for the learning object. *Reusability* was also scored very highly, despite the fact that the object is very context-specific in the area of pharmacology and much rework would be required to gear it toward another discipline. In terms of the development process, the early think aloud session was found to be of highest value to the development team.

The authors concluded that it is important to ensure instructional design decisions are based on the scope of a learning object and the required sequence of instruction. It is also important to inform these decisions with related theories of learning and cognition. They argued that many who write about learning objects advocate a software engineering approach to development rather than one informed by instructional design or theories of learning and cognition. This approach advocates highly granular and decontextualized

learning objects in order to promote better reusability, which is contrary to instructional design best practices. The authors also concluded that if the LORI instrument were used in combination with the Convergent Participation Model (Nesbit, Belfer & Vargo, 2002) it would provide a great advance over the commonly used means of evaluating or peer reviewing learning objects (e.g., the MERLOT repository). The authors also concluded that these learning object evaluations should be viewed as scholarly activity.

Finally, the authors concluded more time should be devoted to exchanging best practices for designing and applying learning objects to instructional contexts than on developing the content itself. They advocated further inquiry into learning object implementation and state that "the systematic evaluation of learning objects must become a valued practice, the importance of which will grow with the expansion of existing repositories" (Krauss & Ally, 2005, p. 16).

Christiansen and Anderson (2004) conducted a study to determine how instructors and course designers typically use learning objects. Study participants designed post-secondary course content using as many publically available learning objects as possible to satisfy the course design. The study followed a development research design and presented three case studies from different academic subject areas. The content areas selected were Nursing, Business and English Writing. The course development teams were comprised of experienced distance education faculty members and course designers. The development efforts consisted of either new course development or major revisions to an existing course.

A group session was held to introduce the teams to the concept of learning objects and provide an introductory document that detailed locations of various learning object repositories and methods of evaluating learning objects. After this session, teams proceeded with their development of courses or course revisions. Monthly surveys were

conducted by e-mail and telephone to obtain thoughts and opinions on their emerging experience, specifically sources, assessment, benefits, barriers, and overall feasibility of the learning objects. Final interviews were conducted with all participants.

The three teams were able to ultimately produce full courses or revisions using the learning object approach. Despite persistent efforts and differing approaches, however, these development teams encountered many problems attempting to create these courses from learning objects. The context of the learning objects varied widely, and this created problems for designers trying to link them. Some learning objects were peer-reviewed (e.g., MERLOT), while others were not, and this created a variety of quality standards. Publisher content was sometimes used and sometimes created copyright concerns.

Of the three development teams, the Nursing and English Writing developers reported overall satisfaction with the approach while the Business team reported dissatisfaction. The Business team found the approach time consuming and costly. The Nursing team found success in the use of objects to manage their pedagogical approach of encouraging reflective practice (i.e., preparing, practice, reflection) while the Writing team found the use of objects worked well for supporting student dialogue through asynchronous discussion.

The Contribution of This Study

The current study features both similarities and differences to studies reviewed in this chapter with respect to the purpose, objectives, and methodologies for these studies. The purpose of this study is to gain insight into the meanings, understandings and interpretations of learning objects and their attributes, not from a theoretical perspective, but from a design perspective. The purpose of Murphy's study was to describe the

"design of a Web-based learning module where the concepts of granularity, reusability, scalability, and interoperability were operationalized as they relate to learning objects" (Murphy, 2004, Abstract section).

This purpose of this study differs from approach taken by Muzio et al. (2002), as their purpose and objectives were to examine the "philosophy, creation, and use of reusable eLearning objects from a practical application at the Centre for Economic Development and Applied Research (CEDAR) at Royal Roads University, BC, Canada" (Muzio et al., 2002, p. 2). The purpose and objectives of this study differ from that of Krauss and Ally (2005), as the purpose of their study was to "identify the challenges and issues that instructional designers face when designing learning objects and to evaluate the effectiveness of a learning object" (Krauss & Ally, 2005, p. 2). The objectives of their study were to "(1) to analyze and document the process of designing a learning object and (2) to evaluate the outcome of applying these practices" (Krauss & Ally, 2005, p. 1).

The purpose and objectives of Christiansen and Anderson's (2004) study also differ significantly from those of this study. Their purpose was to examine "the course development implications of a learning object approach to the design and production of online courses" (Christiansen & Anderson, 2004, Introduction section). Their objectives were to examine the "feasibility, pedagogy, and cost-effectiveness of searching, retrieving and integrating online learning objects into a post-secondary distance education course" (Christiansen & Anderson, 2004, Introduction section). They presented "three case studies that seek to maximize the use of freely available and reusable learning objects in their course design" (Christiansen & Anderson, 2004, Introduction section). Study participants documented and shared experiences and challenges in developing courses using this methodology.

There is a common theme to the purposes of the studies reviewed in this chapter. These studies involve reports (case study or experiential) on the experiences of instructional designers that have developed learning objects or courses that consist mainly of learning objects. The studies describe meanings and definitions of learning objects from the literature of learning objects as a fundamental starting point whereas the purpose of the present study is to gain insight into the meanings, understandings and interpretations of learning objects and their attributes from the reverse angle: not from a theoretical perspective but from a design perspective.

In terms of data collection and analysis, the study by Murphy (2004) was experiential from the point of view of the researcher. Krauss and Ally (2005) employed questionnaires and interviews during learning object development as well as at the completion of learning object use. Christiansen and Anderson (2004) collected monthly surveys from participants by e-mail and also held a final interview with study participants. Muzio et al. (2002) reported general observations from the researchers' point of view.

The current study's methodology differs from the methodology of the studies reviewed in this chapter as it uses a multiple case study with an inductive approach to data analysis. The studies reviewed in this chapter use either a case study method as a means of reporting experiences with learning objects or report from the individual experiences of a designer. This study aims to inductively probe into the meanings, understandings and interpretations of learning objects and their attributes as held by instructional designers not from a theoretical perspective but from a design perspective.

Summary

This chapter presented four studies about instructional designers who have either created learning objects or have used learning objects to create courses. While much has been written on the theory of learning objects, only a few studies were identified that investigated instructional designers' practices in creating them. No studies were identified that directly investigated the meanings and interpretations held by instructional designers about learning objects and their attributes. The purpose, methodology, findings, and conclusions of each study reviewed were presented.

Murphy (2004) conducted a study in which she investigated how certain attributes of learning objects might be operationalized when developing an online learning module. Her study was premised on the argument that while learning objects and its attributes are defined in theory, it is unclear how, in practice "they actually translate into courses or modules that can be used for instructional purposes" (Murphy, 2004, Introduction section). Findings revealed detail about how certain learning object attributes were operationalized. The author concluded that this study served as a preliminary investigation into moving from theory to practice in the use of a learning object approach to designing instruction. This approach was successful in terms of the attributes that were examined.

Muzio et al. (2002) reported on the experiences of instructional designers using learning objects a Canadian university. Instructional designers built courses using a database-driven tool to create, contribute and retrieve learning objects for the purposes of online course development. Learning objects were built using templates designed by instructional designers. The authors found that creating sophisticated templates was costly in terms of time and money; however, the use of generalizable simple templates was effective in speeding development and lowering costs. The authors confirmed that

ELOs cannot be combined in myriad ways, as was originally suggested by Hodgins (2000), but rather only certain objects can be combined with other objects to form larger structures as suggested by Wiley (2002b).

Krauss and Ally (2005) conducted a case study to examine the challenges and issues instructional designers face when developing a learning object for healthcare-related subject. Their study examined theories of learning and cognition that may influence the design of learning objects by using an available instrument and methodology for assessing the learning object quality. The authors concluded that it is important to inform instructional design decisions about the scope of a learning object and the sequence of instruction from users as well as theories of learning and cognition. The authors concluded that more time should be devoted to exchanging best practices for designing and applying learning objects to instructional contexts than on developing the content itself.

Christiansen and Anderson (2004) conducted a study to determine how instructors and course designers typically use learning objects. Study participants designed post-secondary course content using as many publically-available learning objects as possible. The study followed a development research design and presented three case studies from different academic subject areas. The three course development teams were able to ultimately produce full courses or revisions using the learning object approach despite encountering many problems attempting to create full courses from learning objects. There were varying levels of satisfaction with the learning objects approach to course design among the development teams.

This chapter outlined how this study will contribute to the existing body of knowledge, described how it is similar and different in its purpose, and presented the objectives and methodologies from the studies reviewed. The present study focused on a

group of instructional designers who have developed learning objects and have been through an equivalent training experience relating to the creation of learning objects. The present study used an inductive approach to identify how instructional designers understand and interpret learning objects and their attributes and therefore which attributes are most important to them in their professional practice.

Chapter Three

Methods

Introduction

This chapter presents an overview of the study's research design and methods. It begins with a general overview of the multiple case study method followed by a description of how designers were selected for participation in the study. The data collection process is then outlined in detail and described in terms of how the two interview phases were conducted. Finally, the chapter concludes with an explanation of how the data were analyzed and coded.

Multiple Case Study Method: Overview

This study followed a multiple case study method to gain insight into the meanings, understandings and interpretations of learning objects and their attributes from the perspective of instructional designers. Berg (2004) defined the goals of the case study method as "systematically gathering enough information about a particular person, social setting, event, or group to permit the researcher to effectively understand how the subject operates or functions" (p. 251). Yin (1994) stated that the case study method serves as a means of investigating a contemporary phenomenon within a real-life context, which is especially useful when the boundaries between phenomenon and context are not evident.

Yin (1994) also stated that the case study method is one in which multiple sources of evidence are used. The use of multiple sources of evidence is beneficial as this serves to enhance the validity of the results. The sources of evidence in this study were two phases of interviews with instructional designers. Details about these interviews, including the multiple means by which designers were asked to describe key learning

object concepts, are presented later in this chapter. Rather than presenting the results as individual cases, key responses from designers about specific learning object attributes and requirements are presented in Chapter Four as they relate to each learning object concept. Included in Chapter Four are the designers' responses relating to learning object attributes and requirements that emerged from the analysis of the study's data.

Selection of Participants

In order to obtain participation of designers for this study, I contacted Dr. Kevin Harrigan, CLOE Project Director at the University of Waterloo. He sent a brief description of my proposed study via an e-mail list comprised of former Camp CLOE participants in order to solicit designer participation. The potential population of participants was approximately 75.

The 10 designers selected to participate in the study were all instructional designers employed by universities or colleges in Canada. They all attended the Camp CLOE one-week summer workshop on learning objects and also have created learning objects as part of their professional practice. The designers volunteered to participate and signed a consent form (see Appendix B). Four of these designers had attained a Master's degree as their highest education level, two were enrolled in graduate programs in education, one had attained a Ph.D., two had non-education bachelor degrees and another without a degree learned instructional design on the job. Seven had been instructional designers for five years or more while three had only recently become instructional designers. With the exception of one of the designers who had experience as a corporate instructional designer, all had worked only at post-secondary institutions. Thus, the selection of participants reflected a sufficient variety and diversity of education and experience and allowed for insight into differences in individual context, style,

approaches and behaviours. At the same time, the common experience of having attended Camp CLOE training provided sufficient similarity between the designers given that they all designed online learning materials and courses at the post-secondary level.

Data Collection Process

I collected the study's data in Spring 2006 during two semi-structured interviews with each of the designers. I conducted all interviews at a distance by telephone. I recorded interviews using a portable MP3 recorder and later transcribed the interviews for coding using speech recognition software and some degree of text editing. Designers sent me an e-mail in advance of interviews in order to provide information about where a copy of a learning object they recently designed and/or produced could be retrieved and mutually viewed during interviews.

I scheduled no more than one interview per day to allow an analysis and coding of interview notes to take place before starting the next interview. I began coding and data analysis of the interview notes upon completion of the first interview. Interviews for both phases of the study were planned to be approximately one hour in length. I completed two pilot interviews with my thesis supervisor in advance of each data collection phase in order to test the interview protocol and interview guides. These pilot interviews allowed me to test the protocol and guide in the roles of interviewer and participant. I revised the interview guides upon completion of these pilot interviews based on pilot interview experiences.

Data collection: Phase I

The purpose of the first interview phase was to identify the range and types of conceptualizations for learning objects held by the designers by identifying how

designers conceptualized learning object attributes. To achieve this goal, each designer participated in a semi-structured interview in which they were prompted to articulate and make explicit their conceptualizations of objects and their attributes based on their own experiences from a recent learning object design project. If the designers had not developed an object themselves, I asked them to use an object for the interview that they had incorporated into their development projects that someone else created. Each interview was approximately one hour in length.

This phase served to identify the range and types of definitions for learning objects held by designers and how designers conceptualized the learning object attributes. I prompted designers to articulate and make explicit their understandings and interpretations of objects and their attributes. I asked designers how they qualified, characterized or defined a learning object. I asked them to clarify what they did not consider to be a learning object. I also asked designers to provide analogies for learning objects that represented the most important elements of how they conceptualize learning objects. The interview questions were designed to elicit their understandings and interpretations of each of the attributes.

Examples of questions used in this interview phase were: "Have you made this learning object available to your colleagues or a wider audience (for example, using the MERLOT repository?). If a learning object is unavailable to others, either at your institution or more widely, is it still a learning object?" and "Did your learning object undergo any kind of peer review? Does a learning object need to be validated by peers in order to be considered a learning object?" and "Is a book a learning object? What about a book that has been converted into a single PDF file? Why or why not?" The interview guide used in Phase I is provided in Appendix C.

Data collection: Phase II

I conducted Phase II interviews upon completion of all of the Phase I interviews. Phase II interviews served to validate results from Phase I interviews and to provide designers an opportunity to modify any of their responses from Phase I interviews. The Phase II interviews provided an opportunity to probe more deeply into common categories and subcategories derived and coded from the first phase. Phase II also served as a means of gaining insight into designers' conceptualizations of learning object attributes by discussing aspects of two freely-available learning objects on the Web. Phase II interviews were approximately one hour in length.

During Phase II interviews, I presented designers with two learning objects available from the Web that reflected a range and variety of attributes. I chose objects from the MERLOT repository, giving preference to objects that had ratings of higher use or recognition from the MERLOT organization itself. I chose MERLOT as it is a learning object repository that featured peer-reviewed content. I presented each designer with the same two objects and then asked them to explain what attributes they saw or did not see reflected in the objects. I prompted them to include in their descriptions and demonstrations any characteristics or attributes of the objects. I asked them what could be taken away from these learning objects in order to cause them to no longer be considered learning objects. I asked them to describe any existing attributes that were not mentioned by me as well as if they had any other thoughts on their experiences that were not covered by the two phases of data collection.

Examples of questions used in this interview phase were: "How important are learning object standards or technical guidelines to your design process for learning objects?" and "For the object that you designed that we talked about in the Phase I interview, what was the most satisfying element of the design; which element of the

design were you MOST pleased with?" Also during this phase, designers were presented with learning objects available on the Web and were asked: "Is this a learning object? Why or why not?" and "If this is not an object, what could be added to cause it to be an object? What's missing?" and "If this is an object, how could the design be improved?" Responses were compared directly with their responses from Phase I interviews, or prior responses during Phase II, and if there was disagreement designers were challenged to explain the difference. The interview guide for Phase II is provided in Appendix D.

Data Analysis

I coded the study's data through three phases using open, axial, and selective coding. Open coding was used to break down, analyze, compare and categorize the data. During open coding, observations were labelled and grouped together using constant comparisons in order to form categories and properties. Axial coding followed this and was used to derive relationships between categories and subcategories. Finally, selective coding was the used to determine which categories were related to the core category.

I used open coding first in order to break down, analyze, compare and create categories for the data. Coding began after the very first semi-structured interview in Phase I. Strauss and Corbin (1990) described the open coding approach in terms of conceptualizing the data, or "grouping similar items according to some defined properties and giving the items a name that stands for that common link" (p. 121). I used FreeMind, an open-source concept mapping software application (FreeMind Web site, 2006), to assist with coding. Concepts were managed using a tree structure in the FreeMind software. The initial branches of the tree were *attributes*, *granularity*, *analogies*, *additional comments* and *possible categories/memos* and these were tracked for each designer individually.

Next, I broke the *attributes* down further into the branches *required* and *not required.* This resulted in the following list of attributes and requirements: *interactive, manageable, reliable, digital, pedagogically purposeful, pedagogically assessable, reusable, pedagogically powerful, interoperable, retrievable, design accountable, accessible, adaptable, granular, flexible, durable, affordable, must address only one concept, discoverable, created for a specific context of use, created for educational purposes, requires a framework* and *scalable.*

Strauss and Corbin (1990) described three methods of using open coding, namely "line-by-line analysis, analyzing whole sentences or paragraphs, and perusing the entire document" (pp. 119-120). I used the latter two methods in this study to code the raw data. Whole sentences and paragraphs from the transcribed interviews were used to populate the branches of the tree with text to be used to support category development.

The open coding process involved an analysis of the keyword notes from the interviews one line at a time. I noted possible categories and related category properties from the keyword comments. Categories represented the recurrent concepts noted in interview responses while properties served as modifiers that described these categories. It was possible to code multiple prospective categories per keyword line, a single prospective category, or no categories at all. The categories were occasionally derived from specific words used by designers.

I then used axial coding to determine possible relationships between categories. Strauss and Corbin (1990) described axial coding as "The process of relating categories to their subcategories, termed 'axial' because coding occurs around the axis of a category, linking categories to the level of properties and dimensions" (p. 123). I completed axial coding using constant comparisons between the electronic interview notes (with the related coding) and the creation of specific "memos" (Strauss & Corbin,

p. 110) that delineated observed relationships between categories. Memos were tracked using the FreeMind software. Memos were not used simply to track ideas or serve as reminders; they were involved in the formulation and revision of theory during the coding process.

Finally, I used selective coding to relate the categories to the core category. The core category was connected to various related categories and served as the category found with greatest frequency, connectivity, and overall importance based on coding data. Once the core category emerged, coding ceased for sentences that did not relate to that category or any of its connected categories. Relationships were captured in a hierarchical, linked format (the core category serving as the top of the hierarchy) and served as the framework for reporting the findings of the research in terms of attributes, found in Chapter Four. These results were then compared with the learning object definitions, analogies, and attributes as found in the literature. These comparisons are presented in Chapter Five, which presents a discussion of the study's results.

Summary

This chapter presented an overview of the methods followed for this study. This study followed a multiple case study method. Berg (2004) defined the goals of the case study method as "systematically gathering enough information about a particular person, social setting, event, or group to permit the researcher to effectively understand how the subject operates or functions" (p. 251). Yin (1994) stated that the case study method serves as a means of investigating a contemporary phenomenon within a real-life context, especially useful when the boundaries between phenomenon and context are not evident.

The 10 designers selected to participate in the study were instructional designers employed by universities or colleges in Canada. They all attended the Camp CLOE one-

week summer workshop on learning objects and have created learning objects as part of their professional practice. Four of these designers had attained a Master's degree as their highest education level, two were enrolled in graduate programs in education, one had earned a Ph.D., two held non-education bachelor degrees and another without a degree learned instructional design on the job. Seven designers had been instructional designers for five years or more while three had only recently become instructional designers. With the exception of one of the designers who had experience as a corporate instructional designer, all had worked only at post-secondary institutions. Thus, the selection of participants reflected sufficient variety and diversity of education and experience and allowed for insight into differences in individual context, style, approaches and behaviours.

I collected data over two phases of semi-structured interviews in the Spring of 2006. The purpose of the first interview phase was to identify the range and types of conceptualizations for learning objects held by the designers by identifying how designers conceptualized learning object attributes. To achieve this goal, each designer participated in a semi-structured interview in which they were prompted to articulate and make explicit their conceptualizations of objects and their attributes based on their own experiences from a recent learning object design project. I also asked designers to provide analogies for learning objects that represented the most important elements of how they conceptualize learning objects. Interview questions were designed to elicit understandings and interpretations of each of the learning object attributes.

I conducted Phase II interviews upon completion of all of the Phase I interviews. Phase II interviews served to validate results from Phase I interviews and to provide designers an opportunity to modify responses from Phase I interviews. The Phase II interviews provided me an opportunity to probe more deeply into common emergent

categories and subcategories derived and coded from the first phase. Phase II also served as a means of assessing designers' conceptualizations about learning object attributes by discussing aspects of two freely-available learning objects on the Web. Phase II interviews were approximately one hour in length.

During Phase II interviews, I presented designers with two learning objects available from the Web that reflected a range and variety of attributes. I presented each designer with the same two objects and then asked them to explain what attributes they saw or did not see reflected in the objects. I prompted them to include in their descriptions and demonstrations any characteristics or attributes of the objects. I asked them what could be taken away from these learning objects in order to cause them to no longer be considered learning objects. I asked them to describe any attributes not found in the literature and asked them to describe any other thoughts on their experiences that were not covered by the two phases of data collection.

Data analysis involved the use of open, axial and selective coding (Strauss & Corbin, 1990). I used FreeMind (FreeMind Web site, 2006), a freely available concept mapping software package, through the coding phases in order to keep track of categories and track memos. Open coding occurred first in order to break down, analyze, compare and categorize the data. Axial coding was then used to determine possible relationships between theme categories and subcategories. Finally, selective coding was used to relate the categories to the core category.

Chapter Four

Findings

Introduction

This chapter presents the study's findings by addressing the study's first objective, which was to identify the range and types of conceptualizations of learning objects attributes held by a group of designers.

Descriptions of attributes and requirements are presented in this chapter in the order of prevalence by which designers expressed them. Section titles correspond to attributes or requirements suggested by designers. These were as follows: *interactive*, *usable*, *reliable*, *digital*, *pedagogically purposeful*, *reusable*, *pedagogically powerful*, *interoperable*, *pedagogically assessable*, *retrievable*, *design accountable*, *assessable*, *adaptable* and *granular*. Less prevalent attributes and requirements that were stated by designers are also included in this chapter as follows: *flexible*, *durable*, *affordable*, *discoverable*, and *scalable*. Less prevalent attributes and requirements not found in the literature but stated by designers were: *created for a specific context of use*, *created for educational purposes*, *must address only one concept* and *requires a framework.*

Descriptions of attributes and requirements are presented in this chapter in the order of frequency by which designers expressed them. Designers were also asked how they would describe learning objects through the use of analogies as an alternate means of expressing their understandings about learning objects. Pseudonyms are used in the chapter to help give voice to instructional designers who have created learning objects.

Interactive

Susan argued that *interactivity* is required for learning object designs in terms of teaching and learning best practices:

> Interactivity is a requirement for good teaching. It's a requirement for a good learning object ... the literature strongly supports the need for learning environments [that] are active, meaningful, and relevant and that provide opportunities for active engagement and cognitive reflection [that] stimulate interest and attentiveness.

Learning object interactivity was defined along a continuum from low to high-level interactivity. The ends of this continuum according to Susan were represented by the use of "engaging text" (lower level) in a learning object to the use of activities that promote "students actively doing something" (higher level) within an object. John elaborated on the differences between these types of interactivity: "if you watch a video clip and then do some multiple-choice questions [in a learning object, then] that would be low level. Higher level involves critical thinking." Richard commented that the degree of interactivity in a learning object may necessarily be low for objects that were designed for solitary use: "since a lot of learning objects would be done by people on their own, [achieving high-level interaction] will be hard."

Learning object interactivity was described as possibly occurring as cognitive actions rather than direct actions. John described this phenomenon as: "it's whether or not the learning object allows you to translate that mental activity into some type of challenge or response that's important ... interactive doesn't necessarily mean that you interact with somebody else; you can interact with the material." Alex also supported the existence of cognitive interactivity: "if students are engaged in a lecture, and actively thinking about what the speaker is saying, [is that] interactive? I think the answer to that is 'yes' if they're mentally interacting with the concept the speaker is presenting." Alex felt that digital graphics and videos do not qualify as learning objects since they are not interactive:

> The static graphic is not a learning object in my opinion. However, if you build an activity around a static image asking the students for critical analysis or observation, and the student does those activities and gets some feedback on those activities, then that serves as a learning object.

Usable

Usability was reported by designers as an important learning object attribute because it ensures that learners and faculty members will actually use objects. Joyce argued that if an object is not usable, it "won't be used to build or enhance courses; the same could be said of learning object repositories." Learning object usability was directly linked to technology adoption in educational institutions and Joyce emphasized that "If people have to go through a lot of hoops to use it, they won't use it." The usability of a learning object was linked to its potential to satisfy educational objectives and in order to create a usable learning object a designer must have a working knowledge of pedagogy and learning theory. Richard explained this importance in terms of meeting educational objectives: "If students are unable to easily work their way through objects, then this will negatively affect their ability to learn. As designers, we have to ensure that we follow principles of learning closely." When asked why usability is a required element of learning objects, Eileen noted:

> Motivation and frustration are very powerful factors in learning. If you demotivate a person, it will interfere with learning. Because I consider an essential component of a learning object to be producing a positive effect on learning the outcome of that part of my definition would mean that it has to be easy to use.

Reliable

The *reliability* of a learning object was linked to a student's ability to effectively learn a concept. If a learning object lacks reliability, then it is not possible to assess how effective the object is for instruction, remedial use or self-directed study. John described this effect as follows: "If I make a visit [to the learning object] today and it does 'A' and I visit tomorrow and it does 'B', I'm not sure what kind of impact that would have on learning." John added that, with learning object reliability, learners will not have the opportunity to "get the same educational results if the object doesn't function the same way each time."

Digital

Digital learning objects were described as being more easily accessed, used and shared by faculty members or learners. This means they are reused or adapted to new teaching and learning situations and instructors can use them more efficiently in their courses. The requirement that a learning object is digital provided an appropriate boundary to the definition of a learning object, as observed by Beatrice:

> There are lots of activities that promote learning that are not digital but in terms of the definition of learning objects, unless you want to open it up to any resource you can use for learning, that would be one of the things that would limit the definition of learning objects.

Supporting this observation, Sally noted that "it's helpful to draw a line somewhere when defining learning objects." She felt there was a consensus among designers that "at this point in time … when you use the term learning object, you're talking about a digital learning object." Deborah supported this perspective, stating that learning objects are "necessarily online so they have to be digital."

Eileen linked the requirement of a digital learning object to a pedagogical requirement rather than referring to the advantages of digital learning objects in terms of technological advantages:

> I think in the environment in which we live, the way education is evolving [and] given good pedagogy, allowing you a chance to revisit and rethink, if [a learning object] is mediated, it gives you that ability, conceivably, to do that.

Some designers in the study argued that a learning object need not be digital. In some cases, other learning object attributes and/or requirements take precedence over the digital requirement, as observed by Susan:

> I've used digital and non-digital learning objects in the classroom, and I don't see any distinction between them besides the fact that one is on the computer and one is not. A non-digital learning resource is an object if it's contextualized in some structure and organization.

Deborah provided a situational example to support the view that learning objects need not be digital: "a telephone book could be a learning object in certain circumstances ... if you are using it as a teaching tool in a life skills' course, for example."

Pedagogically Purposeful

Designers used the terms learning outcomes, learning objectives or purpose interchangeably when describing a requirement that learning objects reflect these elements. In this study, this attribute is described as *pedagogically purposeful.* Pedagogically purposeful objects were described as featuring either an explicit or implicit means of achieving this as explained by Alex: "explicit learning outcomes or purpose are clearly stated in the object while implicit outcomes or purpose means that the purpose or objectives of the object are obvious to most users." Some designers described learning

objectives as inherent to the learning object design. Susan argued that a well-designed learning object does not need "overt statements of learning outcomes; its whole instructional design is such that it screams the objectives of the activity." Avoiding the use of explicitly stated learning objectives in designs can provide a strategic advantage, as explained by John: "excluding the explicit learning objectives or learning outcomes actually makes the object more reusable."

Learning objectives were described as a component of an overall learning object framework that contains learning objectives, the content of the learning object and assessment. Beatrice described this framework as: "The part [of the learning object] between the assessment and the learning objectives is the interactivity or the content ... I see the learning objectives there but the assessment part could be after." Beatrice argued that learning objectives are an instructional design requirement, as objectives must "be stated during the design process and also to those who are going to use it." Beatrice also argued that additional advantages are realized by stating the learning objectives: "I do think the [learning] purpose has to be in there but it has to be taken into consideration on the design of the object. Flexibility has to exist in case a modification has to be done."

The importance of stating learning objectives in an object was emphasized as it serves a motivational purpose for learners. Richard argued that this motivation is especially important for learners who may be using learning objects in isolation or at a distance:

> My idea is that, especially if it's a multimedia environment, perhaps without the presence of an instructor ... the students need to understand why they're doing it. Thinking of learning theory, students are more likely to be interested in something and have deeper learning if it's something that's meaningful, interesting, and personally relevant.

Eileen argued that stating the learning objectives also allows learners an opportunity to better predict instructional events and better plan their learning:

> If someone is going to spend time interacting with a learning object, or learning resources of any sort, students need to know what to expect. Students also need a chance to demonstrate to themselves that they can do it.

Reusable

Alex argued that reusability is a central feature of learning objects: "It's why you make learning objects; otherwise you would hardcode them into a Web course or a learning management system ... the best reason for [ensuring reusability] is so they can be shared with other people." Employing instructional design for specific teaching and learning situations was described as important, however objects should work equivalently well in different contexts. Sally explained this link between design and context as follows: "[it's] important to allow learning objects to work in different learning contexts. For me, a learning object is a resource that people can adapt to customize to their own settings."

Some designers argued that reusability was not a required attribute. John noted that, for his learning object designs, reusability was "not a major goal ... but I always keep that in the back of my mind", and he emphasized that "the learning object has to work for the situation you're designing for and hopefully it will work for other situations too." John explained that the need to consider the pedagogical use of learning objects justifies not considering reusability as a required attribute:

> My position would be that we not sacrifice the needs of the course or the program for reusability. Reusability would be a great thing and we try to accommodate this

> ... if we're building an object for psychology, then we don't put the course name in code in that object; we are cognizant of reuse.

John also commented on the philosophy of his design practices as they relate to reusability:

> The learning object should work for the situation it has been designed for. If I design something for a particular situation with the goal that it works for other situations, then I still think that qualifies as a learning object.

Pedagogically Powerful

The use of learning objects to address a difficult curricular area (sometimes described as a "course bottleneck") was described by designers as offering primarily a pedagogical or motivational advantage for learners. This concept is described as *pedagogically powerful* in this study. Objects that are pedagogically powerful create an advantage for learners, as Richard observed:

> If there's an identified bottleneck, [then] a learning object can allow students to better learn about the concept, student performance will improve and possibly instructor time devoted to the concept will be diminished because the object is available for people when they want, as many times as they want.

Richard further elaborated on the financial advantages of using pedagogically powerful learning objects:

> It makes the most sense to invest money into something that's difficult to teach but also [student] motivation comes into play ... if I had to put my money on which learning object to build, I would put it into one that addresses the need but also serves to motivate students.

Designers stated that learning objects can offer a unique potential to teach concepts that would be difficult to teach in other ways. Alex provided situational examples to support this argument:

> If you take something that's really hard to explain in words or hard to explain by drawing on a two-dimensional surface, maybe a movie or a 3-D animation or some other way of showing it, and then they really get [it] and that's really worthwhile.

Susan linked the advantages of pedagogically powerful learning objects with pedagogical best practices:

> Because I think the primary function of the learning object is to enhance teaching and not replace what can already be accomplished using traditional means, technology needs to be used for a clear end and rather than just because it's there.

Jim considered both the economic and pedagogical advantages of pedagogically powerful learning objects as follows:

> We can't necessarily build a lot of these, so the ones we do build we want to make sure they are helpful to students and especially if we can help them get through something that is normally difficult for them. It can really help for certain topics, like, for example, molecules or things that are happening simultaneously on a map.

Interoperable

Interoperability was described as a learning object attribute that ensures access to objects by a wider audience. Joyce argued that interoperability is "important because you want to be able to use them in any learning management system or on multiple platforms

or browsers." Supporting the concept of enhanced access to learning objects by a wider audience, she added:

> If it doesn't work on different systems, that means that fewer users can make use of it. An important aspect of the learning object is that it can be used by numerous people in numerous ways; interoperability is important as this can expand your potential audience.

When asked, "how important is the technology behind the use of learning objects; for example, standards like IMS standards?" Jim responded with the following:

> In terms of learning object design, standards like CanCore are not very important. We generally develop for Web delivery, so we use Flash™ or PHP. We make sure they work in browsers; standards become more important when we put these things into repositories or integrate them with learning management systems.

Joyce supported this claim that technical or interoperability standards for learning objects are less of a concern for designers than Web standards. She noted that adherence to technical requirements and standards are not the concern of the designer but rather the institution's information technology department:

> Our technical staff here are involved with making sure we adhere to standards, but from our point of view as designers, we design for Web standards. If it works on the Web then we're happy with that; if new standards appear, then we will adapt to that.

Pedagogically Assessable

Designers who stated that learning objects must be *pedagogically assessable* typically cited reasons of instructional design or pedagogy. Richard supported the requirement of an assessment function in a learning object: "Part of the learning

paradigm is helping students find ways to check their understanding. I think it has to be some kind of feedback to help guide them; I think there is value in explicitly stating what the key things are that they should be learning." Eileen also supported this assertion, stating "learning objects should minimally offer an opportunity for self assessment."

Designers were asked the question, "If I had a learning object and took away the assessment would that no longer be a learning object?" Responses indicated that designers felt the object would either cease to qualify as a learning object or would be reduced to partial learning object status. Deborah commented: "it would be a partial learning object ... how would you be sure that students actually learned something?" Sally stated that assessment "is important from where I'm coming from ... let's put it this way; it could be a learning object [without assessment] but I don't think it would be a very good one."

Retrievable

In order to determine conceptualizations for the attribute of *retrievability*, designers were asked: "if a learning object were available only on a laptop computer available for sign-out purposes, would that still be considered a learning object?" The question implied that, in this scenario, the object was not truly retrievable because it was not available in a networked environment as it could only be used on a single computer. Alex stated that, even with this restriction in place, the object would still constitute a learning object:

> Yes. It would be a learning object. I'm going back to what seems to be developing consistently as my working definition for learning objects: that it is reusable, that it is shareable, that it has a positive effect on learning, and in fact a demonstrated positive effect on learning.

Reflecting on why retrievability was not part of her definition of learning objects, Joyce explained: "this seems to be more important for learning objects that would be pulled from a repository."

Design Accountable

Sally stated instructional *design accountability* in a learning object as a requirement. She described this importance in the following statement:

> Good design for me, depending on the context, means that it's meaningful, it's relevant to the individual, it makes their experience a chance to think, it gives them a chance to revisit, it has a purpose, it's situated ... from the point of view of the user, the student, there is meaning.

When designers were asked "in the learning object you described earlier, what would you take away from it to cause it to cease being a learning object?" Susan responded to the question with: "in a really simplistic way, the instructional design: the process that takes a student from shaping the formulation of the cognitive steps through the cognitive activity that results in learning. That's kind of taking everything away." Richard supported the same view, claiming "there should be someone with an instructional design background, if not involved in the process, than at least overseeing the process observing and looking in, or at some point peer reviewing it."

Assessable

Richard equated the importance of learning object assessability with the importance of assessing scholarship:

> If a learning object is reusable, it can be shared outside of one institution and is supposed to be peer reviewed. Also, the peer-review process is attached to

scholarship recognition for instructors. It is a win-win situation that learning objects undergo peer review.

Susan extended this requirement beyond a need for content accuracy to include assessable teaching and learning strategies:

> I think the content has to be accurate. At the university level, I think it's fair to say there are a variety of competencies in teaching ability, so I think it's important to have peer review in the area of teaching and learning as well as content.

Alex argued that assessability was not a necessary learning object attribute by articulating his thoughts about how post-secondary faculty members are motivated:

> For one's motivation to develop a learning object in higher education setting I think it's indispensable. After doing about 30 or 40 of these, I know how faculty members tend to view the time that they're going to put into this ... and peer recognition is the usual payoff.

Alex described how peer review affects the quality of a learning object:

> The peer review process enhances the learning object; certainly the recognition in that tenure and promotion process. If I look at all the reviews of the learning objects that we've built, they have given us invaluable information on how to improve the object.

John explained how assessability is more important when contributing learning objects to a repository:

> If the object is in a repository, then that represents the institution. An institution has its reputation to protect. On the other hand, pieces that were not peer reviewed might be useful and valid to another educator. In a way, they do a peer review before they choose to use it.

The importance of assessability related to both the functional and instructional design points of view. Eileen emphasized that assessability is more important in scenarios where learning objects are used more widely:

> If the learning object is to be used for widespread distribution, then it should be peer reviewed. The content should undergo some scrutiny, as well as the overall functionality of the object, to make sure but it is working and also from the instructional design standpoint.

Adaptable

When asked about the importance of learning object *adaptability*, designers stated they focus primarily on project design requirements when designing and creating objects. John claimed that, in his object designs, he tends to "focus primarily on the context of use that is intended in the original design." Commenting on the importance of context, Deborah observed:

> It's for consistency. If I'm looking for a learning object that is shareable ... even if it is exactly the same course, [for] any two teachers that create that course, even if it is an online course, it will have different contexts. Therefore, the ability to adapt the materials to a new teaching situation will not necessarily be there.

Granular: Maximum Size

The designers typically expressed *maximum learning object size* in terms of curricular size (learning objective, section, or a course) or the time required to use the object. They did not use a technical definition of size, such as in terms of file size or requirements for electronic storage or retrieval. Deborah claimed that a learning object could be as big as a learning objective or objectives, as she typically "builds learning

objects to address one learning objective at a time. It could be more than one learning objective depending on the audience." Alex stated that a learning object could be as big as a course:

> I think there is a trade-off between size and reusability. It gets much more difficult to reuse in total as it gets bigger. A course is possible to serve as a learning object, but unlikely. I think the general notion is that they're smaller than a course.

In response to the question "how large can a learning object be?" Alex defined acceptable learning object size in terms of a typical attention span for adults, linking the definition with learning theory and pedagogical best practice. Alex also described learning object size in terms of curricular structure, such as learning outcomes:

> My view of a learning object is something that a learner will interact with in a period from 15 to 45 minutes; therefore, the scope of a learning object has a temporal component. You can put together the components of a learning object around a goal or a few goals or an outcome or a few outcomes. I'm okay with a learning object being an hour long. I think I said last time a learning object could be as short as a few seconds; I now think a few seconds is too short for a learning object. If it goes beyond an hour then maybe it's a more of a course or a tutorial.

Two designers expressed the view that a learning object could be, in some cases, as large as a degree program. When asked if they thought a degree program would be too large to constitute a learning object, Eileen argued:

> It can be as big as a degree program. [It] is rarely that big because it's hard to get that many people to agree on something. The medical school and the nursing school here do a very good job of staying on top of that. A program can be [a

learning object] if it's planned appropriately, and it boils down to design, it's certainly easier to design in smaller chunks.

When asked for a real-world example of a degree program serving as a learning object, Joyce offered the following:

I'll give you an example: we have advanced eLearning materials in our medical program. We're seeing a lot of requests from third world countries for reuse of the program. I have no problem thinking that a large-scale learning object can be reused elsewhere, just in this case it might be limited as reusability is not as high … there are very many learning objects within that very large learning object.

Deborah used the term "chunk" to describe learning object size but had some difficulty describing how big a chunk could be:

I don't know, but maybe for the students that would use this it's an appropriate sized chunk. It's a lot to take in; the size of the chunk depends on the preparedness of the people who want to use it.

Sally stated that an appropriately sized learning object has to address a single theme. She elaborated on the concept of a theme as follows:

Structured with a very careful intention and instructional design leading to a specific outcome or outcomes. I don't think it can be as big as a course. It has to have a single theme. It could, however, cover more than one learning outcome.

Beatrice described the required time to use a learning object as the ability to use the object in one sitting:

You should be able to deal with this learning object in one sitting. Students should be able to sit down, review the objectives, [and] go through the content and do a self-assessment in one sitting, whether or not that sitting is 30 seconds, a minute or two hours.

Granular: Minimum Size

Descriptions for the *minimum required size of a learning object* were expressed in terms of various aspects of learning theory or instructional design. Joyce defined minimum object size in terms of evaluation: "there has to be enough substance to it to permit some form of evaluation." Alex defined minimum object size in terms of the presence of interactivity in a learning object:

> I don't think text or a graphic or a single flat piece is a learning object; where is the interactivity that's involved with that? If I [include] questions that relate to that text or use hypertext then I'm getting pretty close to a learning object.

Supporting this concept of the presence of interactivity to define minimum learning object size, John stated:

> In the digital realm, I don't consider a picture or a sound file to be a learning object; [students] lack an opportunity to interact, an opportunity to self-assess, [and] they lack defined outcomes.

Some designers emphasized the requirement of overall learning design rather than object size. Beatrice summarized this perspective by stating that it "depends on what you're trying to achieve; that's the primary driver. I don't know if I can quantify size." Arguing that granularity can be mapped to a level of content that addresses specific concepts, Richard stated:

> You could boil that one down to a hyperlink on a page [if] it's tied to the concept. Can you illustrate a concept, a learning challenge with a paragraph, a hyperlink; can it be solved using [an] animation? I don't know.

Less Prevalent Attributes and Requirements Described By Designers

Less prevalent attributes and requirements stated by designers are presented in this section. Attributes that were less prevalent but found in the literature were *flexible*, *durable*, *affordable*, *discoverable*, and *scalable*. Less prevalent attributes and requirements not found in the literature were *created for a specific context of use*, *created for educational purposes*, *must address only one concept* and *requires a framework.* Sally defined this framework for learning objects as "exactly what we've been talking about: learning objectives, reusability, assessment, [and] stating the purpose" while Beatrice argued it consisted of:

> Purpose, direction, context, something that situates it and gives it meaning and relevance. It could be something very small in something very complex and multistage; that's the thing I like about learning objects, you can layer things depending on how deep you want to go, or you can keep it very simple.

Sally effectively bridged the concept of the framework with the requirement that a learning object must be situated in a context, noting that "the framework would provide a context; to let them know what they're going to do and why it's been set up, so it's situating it." Other designers emphasized the importance of context in the following statements: "when I design an object, I'm only worried about one context only", "good teaching requires that you use context" and "context is everything".

Learning Object Analogies

Designers were asked the question: "if you were to describe learning objects to a colleague who was unfamiliar with the concept what type of analogy might you use?"
One half of the study's 10 designers stated that video games (two designers used the term "educational video games") would be a useful analogy for learning objects. Designers

argued this was a useful analogy for learning objects since video games contain *interactivity*, *clearly stated objectives* and *assessment*.

Alex explained the usefulness of clearly stated objectives and assessments in the analogy of video games for learning objects as:

> Video games certainly tell you what you need to do in order to succeed. There is self-assessment in those games; [it's] whether or not you get blasted or get through. The feedback is immediate [and] very engaging; highly interactive.

Focusing on interactivity, Sally added that the analogy of video games for learning objects is a useful one:

> There is a high degree of interactivity. The nice thing about video games is that the path through the video game is influenced by the decisions you make. The newer games are responsive to your decision-making that will modify what you do based on past decisions. I don't think learning objects are there yet.

Sally also argued that some degree of learning is happening for video game users:

> For video games, no one is saying that they should last more than 45 minutes; some of those games last for days or weeks. Some people are arguing that some of these video game environments are learning environments [because] people learn negotiation skills [and] problem-solving skills. So there is some residual learning happening, although it may not be the primary focus of the game.

Beatrice equated a series of learning object properties with educational video games:

> It's mediated, I can go back to it, there is purpose in its design, and it has been set up to meet a very specific learning need. It's purposeful, it's not just there to entertain you; if it does great, and it will make sure that you don't tune out. It's tangible … it's certainly interactive.

Other analogies for learning objects that were suggested by designers were a *tutorial*, a *textbook* or a *section of a textbook*, a *non-digital learning activity*, a *tutorial built using Flash*™, and a "digital self-contained learning activity, a stand-alone learning activity." Joyce described the learning object analogy of a "toolset/power tool set" as follows: "It has all the things we talked about before. The target learner and the learning objectives are tools. Evaluation, that's also an important tool. If you could include feedback, that would also be a tool."

Summary

This chapter presented the study's findings by addressing the study's first objective, which was to identify the range and types of conceptualizations of learning objects attributes held by a group of designers.

The attributes presented in this chapter were as follows: *interactive*, *usable*, *reliable*, *digital*, *pedagogically purposeful*, *reusable*, *pedagogically powerful*, *interoperable*, *pedagogically assessable*, *retrievable*, *design accountable*, *assessable*, *adaptable* and *granular*. Less prevalent attributes and requirements stated by designers were included in this chapter. Attributes that were less prevalent but present in the literature were *flexible*, *durable*, *affordable*, *discoverable*, and *scalable*. Less prevalent attributes and requirements not found in the literature but stated by designers were *created for a specific context of use*, *created for educational purposes*, *must address only one concept* and *requires a framework*. Descriptions of attributes and requirements were presented in this chapter in the order of prevalence by which designers expressed them.

Pseudonyms were used to represent designers in this chapter in order to give voice to instructional designers who have created learning objects. Detail was provided about which attributes designers felt were required learning object attributes along with

arguments and rationale. Rationale provided by designers about why an attribute would not be a required learning object attribute was also included in this chapter.

Analogies for learning objects provided by designers during interviews were presented in this chapter. One half of the study's 10 designers stated the common analogy of video games (two designers used the term "educational video games") for learning objects. Designers stated that this was a useful analogy for learning objects due to the presence of *interactivity, clearly stated objectives*, and *assessment* in video games. Other analogies offered by designers were those of a tutorial, a textbook or a section of a textbook, a non-digital learning activity, a tutorial built using Flash™, a "digital self-contained learning activity, a stand-alone learning activity" and a "toolset/power tool set".

Chapter Five

Discussion of the Findings

Introduction

This chapter addresses the study's second objective, which was to compare designers' conceptualizations of learning object attributes with the literature relating to learning objects. Descriptions of attributes found in the literature but not mentioned by designers in this study are also presented. Attributes are presented in alphabetical order in this chapter. An analysis is then presented of the categories of meaning associated with learning objects used by designers to conceptualize learning object attributes. Learning object analogies found in the literature are presented and compared with analogies stated by designers. Implications of this study for the practice of instructional design and further research on learning objects are presented and discussed. Finally, the chapter presents the interviewees' and interviewer's reflections on the interviews.

Learning Object Attribute Summary

This section presents a summary of learning object attributes discussed in this chapter with a brief description for each. Subsequent sections present more detailed analyses of attributes as described in the literature in comparison with descriptions provided by designers. Attribute names preceded with an asterisk represent attributes that were reported in the study but not found in the literature relating to learning objects.

Table 5.1

Learning Object Attributes and Descriptions

Attribute	Description
Accessible	Users should be able to access objects from any physical or virtual location.
Adaptable	Objects can be easily changed for use in new instructional situations or contexts.
Affordable	Using objects creates an economic savings for users and/or institutions.
Assessable	An object's pedagogical efficacy can be measured.
*Design accountable	Objects reflect the expertise of an instructional designer.
Digital	Objects must function on digital devices, such as computers or PDAs.
Discoverable	Users can search for and discover objects for purposes of teaching and/or learning.
Durable	Objects should be useful for a number of years as technology changes.
Granular	Objects have a minimum and maximum allowable size.
Interactive	Users will actively participate in learning experiences presented by the object.
Interoperable	Objects should function on different computing platforms.

*Pedagogically Assessable	Objects feature a means for learners' understandings to be checked.
*Pedagogically Purposeful	Objects state their learning outcomes, objectives and/or purpose.
*Pedagogically Powerful	Objects address concepts that are challenging for learners or difficult to teach with conventional instruction.
Reliable	Objects should function equivalently well every time they are used.
Retrievable	Objects are available when the user wants them.
Reusable	Objects and/or their components can be used multiple times in different objects or teaching and learning contexts.
Scalable	Objects can be used with audiences of varying size.
Usable	Objects should be easy to use.

Accessible

Accessibility was not reported by designers as a required learning object attribute. It is possible that some designers assumed that objects will necessarily be accessible over digital networks and therefore did not discuss the attribute. In this sense, designers may have associated the concept of accessibility to the concept of a digital learning object. According to definitions found in the literature, the learning objects that were viewed at a distance during the Phase II interviews were accessible learning objects.

In the literature relating to learning objects, the concept of accessibility refers to a user's ability to access learning objects from any physical or virtual location. This accessibility includes both faculty members and instructional designers who wish to work on learning objects or use them in their teaching as well as learners who endeavour to access learning objects for their own learning purposes. Learning objects may be accessible by one user or multiple users at a time via distributed networks. McGreal (2004) described accessibility as: "instructional components can be accessed from one remote location and delivered to many other locations" (pp. 1-2). Typically, accessibility requires that a learning object be a digital resource, and the nature of digital content enables distribution across digital networks.

The concept of accessibility relates both to learning objects that can be accessed from a learning object repository or learning objects that are found outside of repositories. Often, objects would be accessed using a Web browser, but this is not a requirement. The concept of accessibility as it relates to learning objects should not be confused with accessibility initiatives designed to help people with sensory impairment use electronic content on computer systems or the Web.

Adaptable

Adaptability was reported by some designers as a required learning object attribute. In the literature on learning objects, the concept of adaptability refers to a user's ability to customize an existing object to meet specific instructional requirements. It is not clear from the literature whether or not this adaptation would take place in advance of instruction or if it would be something that could be enacted "real-time" during instruction by either teachers or learners.

Longmire (2000) referred to this attribute as *flexibility*, stating that "learning objects are simple versus aggregate elements, resulting in the ability to contextualize at the time of use" (Why develop content as learning objects? section) implying that objects could be used for real-time instruction or just-in-time learning requirements. McGreal (2004) described adaptability as "instruction can be tailored to individual and situational needs" (pp. 1-2). This attribute was alternately stated by Longmire (2000) as *customizability*:

> the use of annotation tools and placement of objects within teacher-created Web pages allows teachers to customize the object by focusing attention, rewarding certain practices, changing sequences and other ways of contextualizing the learning object content to the needs of a defined class of learners. (Why develop content as learning objects? section)

Ally (2004) used *applicability* as an another alternate term for adaptability, stating that learning objects "should be applicable in different instructional settings. These settings include learning, remediation, just-in-time learning, job aids and enrichment" (p. 88).

When designers were asked about the importance of adaptable learning objects they emphasized that they focus primarily on the design requirements relating to a specific development project when designing and creating learning objects. Designers stated that adaptability is a desirable learning object attribute from their point of view; however, the specific teaching and learning requirements of development, as well as the instructional context, are much more important to them than the requirement that a learning object feature adaptability as an attribute.

Affordable

Affordability was not reported by designers as a required learning object attribute. It is possible that designers did not report this attribute as they were typically assigned learning object development projects within their institutions relating to the production of objects for specific courses. Therefore, the concept of realizing economic savings by reusing objects or components of objects among various courses was not a priority for these designers.

In the literature on learning objects, the concept of affordability refers to the economic (or cost) savings that can result from the use of learning objects. These savings could presumably be passed on to whoever is participating in the learning experience or could be realized overall by an institution. An inherent linkage to other learning object attributes is implicit within affordability, for example, the attribute of *reusability*. Reusability is an enabling attribute for affordability, as objects that are reused do not have to be designed and built again, thus saving overall development costs. It is possible that designers did not discuss this attribute as they generally were designing and creating objects for existing online or classroom based courses rather than building objects that would be used on their own or licensed and sold for profit.

McGreal (2004) described affordability as "learning effectiveness can be significantly increased while reducing time or costs" (pp. 1-2). Longmire (2000) took a more general approach, suggesting that there could be an overall increased value of content or certainly more possible offerings by using learning objects: "the commercial exchange of learning objects is enabled through a learning object economy" (Why develop content as learning objects? section).

Assessable

Assessability was reported by some designers as a required learning object attribute. In the literature on learning objects, *assessability* refers to the ability of interested parties to assess important aspects of a learning object's overall properties. These aspects could relate to an object's pedagogical effectiveness, adherence to technical standards or even its price. Some organizations that represent learning object repositories (e.g., CLOE, MERLOT) defined assessability in their requirements for peer review; that is, peer review will be used to assess the important properties of a learning object and peer review may be a requirement for inclusion in a learning object repository.

McGreal (2004) referred to assessability in terms of a variety of aspects that could be considered assessable for a learning object such as "pedagogical effectiveness, price, and usability" (pp. 1-2). Longmire (2000) addressed assessability by referring to a learning object's ability to facilitate competency-based learning: "core competency skills, knowledge, attitudes and measurable outcomes can be achieved" (Why develop content as learning objects? section).

In some contrast with the literature, but in agreement with the approaches of MERLOT and CLOE, designers generally referred to assessability in terms of the use of peer review as a means of ensuring learning object quality. Some designers equated the importance of peer review as a required learning object attribute to the importance of peer review as it relates to the production of scholarly work. Designers stated that peer review is most important in cases where a learning object is anticipated to be used more widely or contributed to a learning object repository. Some designers stated that peer review of learning objects was important to protect an institution's reputation.

Design Accountable

Some designers reported that learning objects must exhibit *design accountability*. This attribute was not commonly found in the literature on learning objects. An exception to this was found in the work of Wiley (2002c):

> Instructional design theory, or instructional strategies and criteria for their application, must play a large role in the application of learning objects if they are to succeed in facilitating learning. That is, learning objects can't just be treated as pretty clip art – they have to be used in a principled way to support learning. (p. 119)

In a more subtle reference to design accountability as a learning object attribute, Longmire (2000) asserted that the allowable size of a learning object (*granularity*) is partly determined by instructional design specifications.

Designers argued that design accountability helps ensure the best possible learner experiences. According to designers, without instructional design it would be difficult to ensure that the educational objectives of the learning object would be met. Designers acknowledged that, in many cases, faculty members could serve as the instructional designer for a learning object, but minimally, to ensure project success, there should be someone with an instructional design background involved with every learning object development project.

Digital

The literature on learning objects does not directly include *digital* as a learning object attribute; rather, this attribute is more often accounted for in the attribute of *reusability*. Therefore, for the purposes of this study, the attributes of reusability and digital will be discussed concurrently. Designers argued that the digital requirement for

learning objects serves as a useful boundary to the definition of a learning object (i.e., non-digital resources cannot be learning objects). Designers emphasized that digital learning objects are more easily accessed, used and shared by faculty members and learners. This means they can be more easily reused or adapted to new teaching and learning situations and instructors can use them more efficiently in their courses.

In the literature, reusability has been leveraged to justify why learning objects must be digital. McGreal (2004) stated that reusability means "instructional components can be incorporated into multiple applications" (pp. 1-2). This importance was also emphasized in Wiley's (2002a) influential definition of a learning object: "any digital resource that can be reused to support learning" (p. 6). Designers stated that reusability should be considered in instructional designs so that objects can be used in as many teaching and learning situations as possible. However, some designers noted that even though they try to design reusable objects, the specific instructional contexts of a project prevent them from fully realizing the attribute. They consider reusability to be a desirable attribute but they primarily focus on the instructional context they are designing for. This represents a difference from the literature; for example, Wiley (2002b) described reusability as "the fundamental idea behind learning objects" emphasizing the primacy of the concept in the literature. Despite this primacy of the reusability and digital attributes in the literature, one designer in this study argued that a print-based phone book could serve as a learning object in certain circumstances, for example, the teaching of a life skills' course. She argued that is was a reusable learning object as it could be used again each time the course was taught.

Discoverable

Discoverability was found in the literature on learning objects but was not reported by designers as a required attribute. It is possible that designers did not talk about discoverability as they generally were solely responsible for the production of objects in their institutions and did not have to search for outside applications to support learning. Additionally, in the Phase II interviews, objects were directly presented to designers and did not have to be discovered through the use of the Internet. The use and planning of learning object repositories was not considered in this study.

The concept of discoverability refers to the ability of prospective learning object users to be able to find a certain learning object. This would typically involve an electronic means to allow prospective users to search for learning objects using keyword searches (e.g., author, title, subject matter) based on ancillary information stored with the learning object, such as in metatags. If the learning objects are digital, then they can be stored and retrieved from an electronic learning object repository. It is also possible to enable an electronic means of allowing discoverability for non-digital objects, much like an electronic library system can store information about print materials. McGreal (2004) described discoverability in relation to the notion that "components can easily be found using simple understandable search terms" (pp. 1-2). Downes (2004) further qualified how discoverability could work by stating that a learning object should be "located in a reasonable amount of time by a person who is not necessarily an expert at searching the Internet" (p. 29).

Durable

Durability was found in the learning object literature but was not reported by designers as a required attribute. It is possible that the evolution of computing platforms

over the last five years may have resulted in this attribute not being reported by designers. For example, computing platforms tend not to change as rapidly as they did at the turn of the century and exhibit more stability. Proprietary content standards, such as Flash™, are unlikely to be unsupported in future. Learning objects that are built today will likely last a long time, and some designers reported they believe that learning objects they have recently built will still work 10 years from now.

In the literature, the concept of durability refers to how well a learning object holds up over time given changes in either technology or the environment in which a learning object is used. This concept typically relates to digital learning objects, where durability is especially important given rapid technology changes in educational technology and digital networks. McGreal (2004) referred to an example of durability as follows: "instructional components can be used when base technology changes, without the need for redesigning or recoding" (pp. 1-2). Barritt (2002) described the term durability in its more conventional sense, stating that learning objects must be designed so that they can be reused many times without becoming obsolete.

Granular

The concept of *granularity* was both found in the literature and mentioned by designers. This attribute refers to how large or how small a learning object may be. Wiley et al. (1999) illustrated this by describing a course hierarchy where a full course represents the largest possible grain size contrasted with a single image that would constitute the smallest possible grain size. McGreal (2004) also related granularity with curriculum size, stating that content, information or knowledge objects represent a basic level of granularity, while modules, courses and programs can represent less granular learning objects.

Wiley (2002b) noted there is an inverse relationship between the size of a learning object and its overall prospect for reusability. Smaller learning objects could feature greater reuse potential in new design or teaching applications. Quinn and Hobbes (2000) supported this assertion: "... by keeping objects smaller, they are more likely to be able to be reused in different contexts" (p. 15). Yet other authors have linked granularity with factors outside of the learning object itself. For example, Longmire (2000) asserted that the size of a learning object is partly determined by instructional design specifications.

Designers typically expressed granularity as either curricular size (learning objective, section, or a course) or the time required for learners to use the object. They did not define size technically such as in terms of file size or requirements for electronic storage or retrieval. Some designers focused on principles of learning theory when describing how large a learning object may be. For example, some designers stated that a learning object should not take longer than 45 minutes to use or, alternately, that the object should be usable in "one sitting". They stated that this time constraint was important in order to ensure that the object would accommodate a typical adult's attention span. In terms of minimum allowable learning object size, one designer stated that it would have to be large enough to permit some form of evaluation of learners. Following Longmire's assertion, designers stated that instructional design requirements would define the acceptable size of learning objects.

Interactive

Some designers reported that learning objects must be *interactive*. In the literature on learning objects, interactivity has been described as follows: "each learning object requires that students view, listen, respond or interact with the content in some way." (Wisconsin Online Resource Center Web site, 2006, About Learning Objects section). In

the quality standards produced by the Wisconsin Online Resource Center, interactivity is referred to as: "requires interaction on the part of the learner with the learning materials, i.e., responding and acting to apply higher-order thinking skills" (Wisconsin Online Resource Center Web site, 2006, About Learning Objects section). The *CLOE Peer Review Committee Learning Object Submission Guidelines for Authors* (See Appendix A) also includes the concept of interactivity. In the CLOE guidelines, Interactivity is referred to as follows: "the technology helps learners to engage effectively with the concept/skill/idea" (CLOE Web site, 2005, Documents section).

Some designers noted that interactivity was a required attribute because it promotes good pedagogical approaches to the design of learning objects. Some designers reported that interactivity can be measured along a continuum from the use of "engaging text" to "students actively doing something". Some designers noted that interactivity can be a cognitive activity in addition to an activity where users directly interact with a learning object in either learner-to-learner and teacher-to-learner activity.

Interoperable

Interoperability was reported by some designers as a required learning object attribute. In the literature on learning objects, the concept of interoperability refers to a learning object's ability to be used with different delivery, development or storage systems. Interoperability is often described with respect to digital learning objects and refers to an object's ability to be used on different computer platforms, for example, Apple Macintosh™ and PCs, or with different learning management systems, for example, WebCT™ and Blackboard™. Murphy (2004) describes interoperability as follows: "it should function across a wide variety of hardware, operating systems and Web browsers" (Interoperability section).

McGreal (2004) referred to interoperability as follows: "instructional components can be developed in one location with one set of tools (or platform) or in another location with a different set of tools (or platform)" (pp. 1-2). Longmire (2000) stated that a learning object's greatest strength is "the ability to be applied in multiple uses as they flow freely between learning systems and a variety of contexts" (Why develop content as learning objects? section). Porter (2001) described interoperability as a major concept contributing to the overall value of learning objects: "It is the retrieval and transfer of the media assets from within the systems to new delivery environments and to learners and customers that adds value to them" (p. 50). Downes (2004) qualified interoperability by stating that "learning objects produced by different publishers, or available through different repositories, may be packaged together into a single course" (p. 29) or they are "capable of being used by different educational institutions using different systems" (p. 29). Hamel and Ryan-Jones (2002) also supported this notion, defining interoperability as meaning that objects are accessible using different systems working across the Internet.

Designers in this study stated the importance of interoperability in terms of ensuring that a learning object is available to the widest possible audience. Instead of focusing on technical standards that relate to learning objects (e.g., CANCORE, IMS) to promote interoperability, designers talked about the use of open Web standards (e.g., HTML) or commonly used proprietary formats (e.g., Flash™) and ensuring that learning objects work in different browsers. Designers argued that understanding and working with technical standards should be the preoccupation of the technical services division of their institutions rather than individual instructional designers.

Manageable

Manageability appears in the literature but was not reported by designers as a required attribute. It is possible that designers did not talk about manageability as they tended to work on learning object projects that they conducted themselves and managed all of the required assets themselves. In general, they did not use or contribute objects to learning object repositories.

In the literature, the concept of manageability refers to the ability for those who work with learning objects to easily use them. This use would typically refer to the overall ease with which they are created, stored, versioned and repurposed. McGreal (2004) referred to manageability as follows: "components can be handily found, inserted, relocated and substituted" (pp. 1-2). Longmire (2000) described manageability as "ease of updates, searches, and content management (metadata tags can facilitate filtering, selecting, updating, and managing objects)" (Why develop content as learning objects? section). The *CLOE Peer Review Committee Learning Object Submission Guidelines for Authors* (see Appendix A) referred to manageability as follows: "The learning object is easy to use (i.e., navigation, user control), the author indicates whether the learning object is accessible for learners with diverse needs, and technical requirements for the learning object are provided" (CLOE Web site, 2006, Documents section).

Pedagogically Assessable

Some designers reported that learning objects must be *pedagogically assessable*. This attribute was not found in the literature. Designers who argued that this was a required learning object attribute stated reasons of instructional design or pedagogy. Designers who argued that objects must be pedagogically assessable emphasized that learners need to be provided with a means of checking their understanding of concepts

learned from learning objects. One designer stated that, minimally, learning objects must provide a means of self-assessment to satisfy this requirement. Some designers reported that, to satisfy this requirement, assessments had to be included inside the learning object itself while others stated that assessments could be external to the object.

Pedagogically Powerful

Some designers reported that learning objects must be *pedagogically powerful*, meaning that learning objects should be built that address a difficult part of a curriculum or parts of a curriculum that contain components that are difficult to teach. This attribute was not commonly found in the literature on learning objects, but appears in supporting materials from CLOE. Designers stated that learning objects must address course areas that are known to be difficult to teach using conventional methods. This attribute was alternately stated as addressing a "course bottleneck". Given the presence of the term "course bottleneck" in the CLOE materials, it is possible that the designers' involvement with Camp CLOE encouraged them to state this attribute as a requirement.

Designers described the economic and pedagogical advantages related to this attribute. In terms of economic advantages, designers stated that it is logical to dedicate limited financial resources to developing learning objects that address parts of a curriculum that learners traditionally find the most difficult to learn by conventional teaching and learning methods. The pedagogical advantages of addressing difficult parts of a curriculum with learning objects include the ability of learners to practice working with difficult concepts by interacting with learning objects and the use of objects for remedial purposes. Designers also stated that learning objects could provide an alternate means of teaching concepts that are difficult to demonstrate in the classroom, such as presenting visualizations of molecules using computer animations.

Pedagogically Purposeful

Some designers reported that learning objects must be *pedagogically purposeful*, meaning that objects must contain stated learning outcomes, learning objectives, or a learning purpose. This attribute was not found in the literature. Designers who stated this as a required learning object requirement argued that it allows learners to better predict upcoming instruction and therefore better plan their learning experience. Designers also claimed that stating educational objectives also serves to reinforce learner motivation. Designers felt the statement of learning objectives can either be done explicitly or implicitly within the design of the object.

Reliable

Reliability was reported by some designers as a required learning object attribute. In the literature on learning objects, the concept of *reliability* means that a learning object's attributes will function equivalently well irrespective of when or how it is used. That is, a learning object that is reliable will function per its original design each time it is used. This attribute typically refers to a learning object that is digital, and its importance is linked to the overall pedagogical effectiveness of the learning object (i.e., a malfunctioning learning object would be detrimental to teaching and learning). McGreal (2004) described reliability as: "the other 'abilities' can be counted on to work when needed" (pp. 1-2).

Designers associated reliability with the potential for students to learn effectively using a learning object. Designers linked this concept to assessing the overall pedagogical efficacy of a learning object. If a learning object is not reliable, then it is not possible to assess how effective the object is for instruction, remedial use or self-directed study. Designers conceptualized reliability in a manner consistent with the literature but

extended this conceptualization to account for the importance of creating designs that include learning theory and good pedagogical strategies.

Retrievable

Retrievability was reported by some designers as a required learning object attribute. In the literature on learning objects, the concept of *retrievability* refers to the ability for a prospective learning object user to access the object. This could mean that someone is trying to retrieve it for instructional, development, or learning purposes. This retrieval could, as in the case of accessibility, relate to using a learning object for teaching or for design or repurposing. Typically, this would refer to retrieving digital learning objects either directly from the Web or from a learning object repository. McGreal (2004) added a requirement that the retrieval happens in a timely way such that "components can be retrieved when and where you want them" (pp. 1-2).

In contrast with the literature, some designers stated that if a learning object were not immediately available to prospective user over a digital network then it still could be considered a learning object from their point of view. Some designers stated that this was not a required learning object attribute and would be more relevant for cases where learning objects are to be contributed to or retrieved from a learning object repository.

Reusable

The concept of *reusability* was both found in the literature and discussed by designers. In the literature, the concept of reusability often serves as a central tenet of learning objects. Wiley (2002b) described this centrality as "the fundamental idea behind learning objects: instructional designers can build small (relative to the size of an entire course) instructional components that can be reused a number of times in different

learning contexts" (p. 3). This importance was also emphasized in Wiley's influential definition of a learning object as "any digital resource that can be reused to support learning" (p. 6). The concept of reuse is commonly used to justify why learning objects must be digital. There is a natural linking between learning object reuse and learning object granularity, as the "reusability paradox" (Wiley, 1999) states that as a learning object becomes less granular, its overall potential for reuse is diminished. McGreal (2004) explained that reusability means "instructional components can be incorporated into multiple applications" (pp. 1-2).

In contrast with the literature, designers reported that learning object reuse was a desirable learning object attribute but the specific design context for instruction was the primary driver for them when designing and creating learning objects. That is, designers will not sacrifice the specific context required for the instruction to ensure objects are reusable.

Scalable

Scalability was found in the literature; however, it was reported infrequently by designers as a required attribute. It is possible that this attribute was underreported by designers as they typically adhere to stringent specifications when creating learning objects, meaning that they designed their objects either for learner groups of a certain size or objects that would be used individually by learners.

In the literature, the concept of scalability refers to a learning object's ability to be used in different sizes of groups for teaching and learning purposes. For example, a highly scalable learning object could be used in a teaching situation with three individuals or with 50 individuals. Scalability can be linked to the attribute of affordability or the concept of using economic models. For example, learning object

scalability has been described as the "... production of quantity at specified levels of quality within specified time and resource constraints. It also requires an increase in productivity without a proportional increase in production cost" (Gibbons, Nelson & Richards, 2002, p. 49). Similarly, learning object scalability has been described as "the property of reducing or increasing the scope of methods, processes, and management according to the problem size" (Laitinen, Fayad & Ward, 2000, p. 107). Ally (2004) described scalability as learning objects that can "build on each other to form an instructional sequence" (p. 89).

Usable

Some designers reported that learning objects must exhibit a degree of *usability*. In the literature, usability has been included in learning object evaluation frameworks. For example, usability was included in a list of aspects of learning objects to be evaluated by learners proposed by Howard-Rose and Harrigan (2006) consisting of learning value, added value, usability of the learning object itself and usability of technology. The *CLOE Peer Review Committee Learning Object Submission Guidelines for Authors* (see Appendix A) refers to usability as ease-of-use that ensures "the learning object is easy to use (i.e., navigation, user control), the author indicates whether the learning object is accessible for learners with diverse needs [and] technical requirements for the learning object are provided" (CLOE Web site, 2005, Documents section).

Some designers stated usability as a learning object requirement that helps ensure learners and faculty members will actually use learning objects. Designers directly linked usability to the potential for adoption of the use of learning objects within an institution. Designers stated that they can best promote usability through a working understanding of pedagogy and learning theory with the overall goal of satisfying educational objectives.

Designers' Conceptualizations of Learning Object Categories and the Literature

As a comparison point with designers' conceptualizations of individual learning object attributes with the literature, it useful to consider how designers conceptualize *categories* of learning object attributes versus those found in the literature. McGreal (2004) proposed four general categories of meaning associated with learning objects: *anything*, *anything digital*, *anything for learning*, or something that requires a *specific learning environment* (p. 8). These types are not mutually exclusive and can overlap.

None of the designers who participated in this study felt their definition of a learning object would be open enough to include *anything*, although one designer defended her view that, in some circumstances, a print-based phone book could be viewed as a learning object if it were to be used in a life skills' course to teach learners how to use a phone book. Most designers argued that learning objects had to be *digital*, but none felt that the digital requirement serves as a sufficient condition for a resource to qualify as a learning object. None of the designers in this study reported that *anything for learning* was an acceptable type for learning objects, with the possible exception of the designer who argued that a phone book could be a learning object. The *specific learning environment* type was by far the most prevalent type found among designers, and this is essentially combined with the requirement that a learning object must be digital. The prevalence of this type is supported by two important themes found in the responses of designers in the two interviews: the concept of a proposed *framework* that surrounds a learning object and the importance of the concept of *context* as it relates to where a learning object may be used or reused.

Designers argued there is much more involved in the production of a learning object than bringing educational content together in a convenient way for electronic delivery or storage. They noted that it was important that required elements from the

sequence of instruction be followed, and many of these elements would constitute a framework for learning objects. Examples of these framework elements are *stating the learning outcomes/purpose* for a learning object and offering *assessments* after presenting content. Some designers felt that the learning object itself had to feature these required elements while others believed that a learning object could simply be part of a larger instructional framework that instructors would manage themselves; the learning object in such a case would then simply consist of the content. This focus on the importance of context by designers is quite important to the learning object debate as it has recently evolved. Commenting on the impact that context delivers to the concept of a learning object, Wiley (2006) noted that learning objects have failed to meet their anticipated promise partly because "the role of context is simply too great in learning, and the expectation that any educational resource could be reused without some contextual tweaking was either naive or stupid." ("RIP-ping on Learning Objects", para. 1). Sosteric and Hesemeier (2004) also argued that context is a required element in their definition of a learning object: "a digital file (image, movie, etc.) intended to be used for pedagogical purposes, which includes, either internally or via association, suggestions on the appropriate context within which to use the object" (p. 40).

Designers' Conceptualizations of Learning Object Analogies and the Literature

The literature relating to learning objects presents four analogies for learning objects. The analogy of learning objects as Lego™ blocks (Harnett, 2002; Hodgins & Conner, 2000; Sheperd, 2000) suggested that blocks of learning content (objects) could be combined in multiple ways to form new constructions, or learning content. Every Lego™ block could, in theory, be combined with any other Lego™ block. Critics of the Lego™ block analogy focused on the argument that it is hard to imagine that learning

content could be combined and recombined in unrestricted ways. However, the Lego™ block analogy featured the advantage of simplicity.

The analogy of learning objects as building materials (Duval & Hodgins, 2004) suggested that, as one would observe during the construction of a new home, there are standard components that one can incorporate into different areas of a house. For example, there are standard sizes for fixtures such as doors/doorknobs, light bulbs, and faucets. Proponents of the analogy suggested that up to 85% of components for home construction are of standard dimension (Duval & Hodgins, 2004) and the same could hold true in theory for components of learning, or learning objects. Certain jobs (such as kitchen countertops) require customization, and as such, few standard components would exist for these jobs. Proponents argued that this analogy is stronger than that of Lego™ blocks as it demonstrates that not all components are combinable. Accommodation exists for granularity (i.e., small parts of learning (e.g., faucets) can be objects; larger components (e.g., rooms) are not objects) and it includes the implication that skilled professionals would be required for implementation or modification of objects.

The analogy of learning objects as atoms or molecules (Wiley, 1999) accommodated a greater complexity that relies on some familiarity with chemistry. Certain learning objects cannot be divided into smaller parts (atoms), while others are divisible (molecules). Only certain learning objects would be combinable, and groupings of these structures can combine to form larger structures. Similar to the building material analogy, skilled professionals would typically be required to combine and modify these objects.

Finally, the analogy of learning objects as organic entities (Paquette & Rosca, 2002) suggested that some objects (cells) could be combined to form either simple or complex learning content (organisms). An object (organism) would be comprised of

sufficient elements to be a supportable, independent learning object/experience (life form). In some cases, learning objects/experiences (life forms) could combine to become larger learning objects/experiences (life forms) where the whole could hold greater promise than the sum of its parts.

As reported in the previous chapter, none of the learning object analogies stated by designers matched the analogies found in the literature. The analogies from the literature generally relate to how learning objects or their components might be reused or reassembled in different teaching and learning situations or contexts. Instead, one half of the designers stated that *video games* would serve as a useful analogy for learning objects. Designers argued this was a useful analogy for learning objects as video games contain *interactivity*, *clearly stated objectives*, and an *assessment component*. It is possible that designers had not considered analogies as useful or required for explaining learning objects. It is also possible that the common training experience that designers in this study participated in did not use analogies to describe learning objects and that designers had not been exposed to literature that related to analogies for learning objects.

Conclusions

There exists a wide range of definitions for learning objects held by instructional designers participating in this study. This range was evidenced by highly divergent statements made by designers relating to what they believe a learning object could or could not be, based on their interpretations of attributes and requirements or which attributes must be present in their definition of a learning object. This perspective is consistent with the literature on learning objects, as there is no commonly accepted definition for a learning object (Downes, 2003; Friesen, 2004; McGreal, 2004; Wiley,

2002a). Mortimer (2002) also agreed that no single definition exists for a learning object and contended the term can hold different meanings for different people.

Instructional designers are designing and creating things that they are calling learning objects. The designers in this study have participated in equivalent training on learning object design and development and have created at least one learning object as a result of that training. Designers in this study have similar academic and professional preparations for the instructional design profession and work in similar professional settings with similar demands. Despite this equivalent training and development experience, and professional/academic backgrounds, even the meanings, understandings and interpretations of learning objects and their attributes held by designers in this study are divergent.

The following observations from this study are provided as examples of the divergent views of designers about how they conceptualize learning objects. Some designers in this study believe that learning objects must be digital; others believe it is not a requirement. Some designers believe that assessment has to be part of a learning object; some believe it is not required. Some designers believe that a learning object must be peer reviewed in order for it to be considered a learning object; some do not. Especially striking is the fact that only one-half of the study's 10 designers consider reusability as a requirement of learning objects despite the prominence in the literature of the importance of learning object reusability.

Examples of the predominance of the concept of object reuse are easily found in the literature. Wiley (2002a) defined a learning object as "any digital resource that can be reused to support learning" (p. 6) while Alberta Learning (2002) stated that a learning object can be "identified, tracked, referenced, used, and reused for a variety of learning experiences." (Alberta Learning, 2002, Online Glossary section). The IMS Global

Learning Consortium (2005) also includes reuse as a required element of learning objects, stating that a learning object is "any reproducible and addressable digital or non-digital resource used to perform learning activities or support activities" (Conceptual Vocabulary of Learning Design section). Other definitions that do not explicitly include reusability as a requirement for learning objects suggest reuse as a requirement by linking with the argument that learning objects must be digital.

While designers generally defined most learning object attributes in a manner consistent with definitions from the literature, interesting variances were noted in how they approached their definitions. For example, when asked, "how large may a learning object be" (in order to assess a designer's view of the acceptable granularity of a learning object) many designers referred to the amount of time required for a learner to use the object (e.g., "no longer than 45 minutes" or "must be used in one sitting"). They justified their claim by highlighting what a reasonable attention span would be based on adult learning principles. In contrast, the literature on granularity refers mainly to curricular structure or technical detail, for example, the size of a course, learning objective or learning outcome (e.g., Downes, 2003). In other cases, it refers to what level of granularity would allow a learning object to be best housed and retrieved from searchable databases. While the concepts of learning principles and required structure are linked, it is of interest that designers chose to express their views of acceptable granularity with a focus on learning theory or pedagogical best practice rather than any mention of technical definitions of learning objects and their attributes.

These observations from the study's data and the comparisons of designers' statements about learning object attributes, categories and analogies suggest that the designers in this study define and conceptualize learning objects and their attributes with a focus on learning theory or pedagogical best practices rather than a focus on technical

definitions of learning objects and their attributes. Alternately stated, when designing or creating learning objects, the designers appeared to focus more on the *learning* aspect of the term "learning object" rather than the *object* part of the term. This bias toward technical definitions for learning objects has been previously noted in the literature by authors who maintain that the use of the term *object* was originally borrowed from computer science, specifically the concept of object-oriented programming (Robson, 1999; Bratina, Hayes & Blumsack, 2002).

When designers were asked about interoperability as a required learning object attribute, they focused almost exclusively on the learner experience in their statements. They stated that learning objects should be created to function on as many browsers and computing platforms (e.g., Macs and PCs) as possible. Designers explicitly stated that they had no knowledge of (or interest in) interoperability standards (e.g., IMS-LD) or metatagging standards (e.g., CANCORE) and relied mainly on the IT function of their institutions or delivery platforms (e.g., WebCT) for such issues. Designers stated explicitly that they are much more interested in the use of open Web standards in their learning object designs than standards relating to learning objects. Their perspective contrasts with the literature about learning objects and with the theory related to the technical aspects of learning objects, learning object repositories and technical standards (e.g., IMS, SCORM). However, designers in this study explicitly reported that they do not find these to be of importance in their designs and/or development work. They generally never have to deal with issues relating to standards or technical definitions.

None of the analogies stated by designers matched the analogies for learning objects found in the literature. Analogies from the literature generally relate to how learning objects or their components might be reused or reassembled in different teaching and learning situations or contexts. Instead, one half of the designers stated that *video*

games would serve as a useful analogy for learning objects. Designers argued this was a useful analogy for learning objects as video games contain *interactivity*, *clearly stated objectives*, and *assessment*. Each of these concepts in more closely aligned with the importance of pedagogical best practice or learning theory rather than technical details of how objects could be deployed, stored or indexed in a technical fashion.

Implications for Practice

There are several implications resulting from this study for the practice of instructional design as it relates to the current design and production of learning objects. Professional development has been identified as a key activity for instructional designers (e.g., Liu, Gibby, Quiros & Demps, 2002; Powell, 2004). Those who prepare instructional designers to design and create learning objects may wish to consider the importance of adopting a pedagogical and not a technical perspective in their conceptualization of learning objects. Further, when introducing the concept of learning objects to designers, it may be more effective to use analogies that better resonate with designers (i.e., learning objects as video games) rather than commonly found analogies from the literature (i.e., learning objects as Lego™ blocks).

In this study, designers reported that they approach learning object design and development by focusing primarily on the instructional context in which the object is to be used rather than considering possible future object reuse. Only five of the 10 designers participating in this study stated that *reusability* was a required learning object attribute despite its prominence in the literature. Additionally, the study's designers seldom reported *affordability* as a required learning object attribute because they tend to design learning objects primarily for the requirements of a specific development project. Differentiating which projects are standard online development projects versus learning

object projects will be important in order to manage expectations of faculty, staff and students as well as the institution. In fact, in many cases it may be more cost effective to design customized materials for each specific teaching and learning application than to consider the development of learning objects. It may be the case that institutional resources would be better allocated by focusing on reusing components of online exercises and simulations and online courses rather than on the design and creation of reusable learning objects.

It is important that technical staff, instructional designers and faculty members have similar notions about what constitutes a learning object. This study has examined some of the difficulties associated with establishing such common notions. However, it is useful for practitioners to consider alternate perspectives of what learning objects attributes could mean from the perspective of designers. For example, designers in this study defined the maximum allowable learning object size (granularity) in terms of a typical adult's attention span (according to one designer, approximately 45 minutes). Instead of adhering solely to what is stated in the literature when specifying design standards for learning objects, these additional interpretations of learning object attributes could be valuable for learning object development projects in terms of setting more robust standards for their design. Alternate frameworks for defining learning objects that relate more closely to what designers believe the requirements to be for learning objects could also be considered. For example, designers in this study proposed frameworks for learning objects that include the use of explicitly stated learning objectives and learner assessments, and the use of such frameworks may result in the development of more effective learning objects.

Finally, designers in the study proposed *design accountability* as a possible learning object attribute. Project leaders at institutions engaged in learning object

development projects may wish to consider how this attribute could be operationalized in their setting. It may be the case that designers should be involved with the design and production of learning objects throughout the full lifecycle of such projects or they may only need to be involved at certain stages of design, development and evaluation.

Implications for Research

The role of this study was not to examine definitions from the literature about learning object attributes in order to suggest alternate definitions. However, it is possible that the study's results could encourage investigation of alternate learning object frameworks that more closely represent what designers believe the requirements to be for learning objects in authentic design situations. One hypothesis that emerged from this study can be summarized as follows: instructional designers adopt a pedagogical and not a technical perspective in their conceptualization of learning objects. If this is the case, then we might inquire into the aspects of pedagogy in general and the learning theories in particular that designers implicitly or explicitly draw from when designing and creating learning objects. With respect to the learning object attributes that were stated by designers but not found in the literature (i.e., *design accountable*, *pedagogically assessable*, *pedagogically purposeful*, *pedagogically powerful*), it would be of interest to explore these further in order to understand whether other designers in other contexts consider these to be important.

Whereas the data collection method for this study consisted of two semi-structured interviews, a study that directly observes designers in practice would provide further insight into how designers conceptualize learning objects in an authentic production environment. This approach could follow designers through the full instructional design process and determine how each stage of the process contributes to

the development of learning objects. Talk-aloud or walkthrough techniques could be used to help designers detail what they are doing and thinking as they move through the instructional design stages to determine why designers make certain decisions in the design of objects. This approach might provide a more in-depth analysis on how designers design and create learning objects.

This study was concerned with the meanings and interpretations of learning objects held by instructional designers who work in post-secondary environments. It did not focus on instructional designers who work in corporate, military or government environments. The designers in this study were employed primarily in Canadian, publicly-funded universities and college systems that were members of the CLOE network. These universities and colleges are in mainly urban areas across Canada. Participation by designers from other geographical areas and with different professional backgrounds might have yielded different perspectives on learning objects. For this reason, researchers could investigate the meanings and interpretations of learning objects held by designers who work in non post-secondary environments.

Interview Reflections

Some designers chose to offer reflections on their interview experiences. Many of these reflections related to an expression of the difficulties they experienced when talking about learning objects. For example, Jim noted: "It's very difficult to think about this stuff - to give answers that you can stand behind". Richard offered:

> This is good because this is making me really have to think about these different things. Because learning objects are so new there doesn't appear to be a hard and fast definition about them and I can certainly see why; you are making that eminently clear today.

Other comments relating to designers' interview experiences included: "I think the whole process was valuable for me. It let me rethink, reconsider, confirm and raise a few questions for me it was a very positive experience" and "It's certainly got me thinking here. I'm glad I participated because it even got me to write down what I believe aspects of learning objects are."

Finally, emphasizing the complexity inherent to discussions involving learning objects, Alex noted:

> I would add that even though I have really strong opinions, sometimes they change from week to week or from year to year. Probably a year from now I may have a very different notion of how we build resources. Maybe in the future the term learning objects will be archaic; maybe we will move on to something else with a different set of characteristics.

Interviewee fatigue was noted during interviews with instructional designers, primarily during Phase I interviews. This fatigue may have been caused by the sustained intensity of the interview; that is, I helped build and also challenge a designer's view of what a learning object was by stating and restating aspects and attributes that were noted by them during earlier parts of the interview. Some designers likened the process to that of a "cross-examination" despite my best efforts to avoid this effect and impression.

Summary

This chapter presented a discussion of the study's findings and conclusions by addressing the study's second objective, which was to compare designers' conceptualizations of learning object attributes with the literature relating to learning objects. The specific attributes presented and discussed in this chapter were *accessible*, *adaptable*, *affordable*, *assessable*, *design accountable*, *digital*, *discoverable*, *durable*,

granular, *interactive*, *interoperable*, *pedagogically assessable*, *pedagogically purposeful*, *pedagogically powerful*, *reliable*, *retrievable*, *reusable*, *scalable* and *usable*.

Designers' views of learning objects were compared with an existing learning object typology. McGreal (2004) detailed four general categories of meaning for objects: *anything*, *anything digital*, *anything for learning*, or something that requires a *specific learning environment* (p. 8). None of the designers in this study reported that their definition of a learning object would be open enough to include *anything*. Most participants reported that learning objects had to be *digital*, but none stated that this would serve as a sufficient condition for an object to qualify as a learning object. None of the designers in this study reported *anything for learning* constituted a learning object type. The *specific learning environment* type was the most prevalent type reported by participants, and participants combined this type with a requirement that learning object must be digital.

A comparison of designers' views on learning object analogies was presented an compared with the literature. Designers did not report any analogies found in the literature. These analogies were learning objects as *Lego™ blocks*, *building materials*, *atoms or molecules*, or *organic entities*. The most common analogy reported by designers was *video games*. Participants argued video games are a useful analogy for learning objects as they contain *interactivity*, *clearly stated objectives*, and *assessment*.

The study concluded that the designers in this study define and conceptualize learning objects and their attributes with a focus on learning theory or pedagogical best practices rather than a focus on technical definitions of learning objects and their attributes. Alternately stated, when designing or creating learning objects, the designers appeared to focus more on the *learning* aspect of the term "learning object" rather than the *object* part of the term.

The study's implications for the practice of instructional design and those who create learning objects were presented and discussed. Those who prepare instructional designers to design and create learning objects may wish to consider the importance of adopting a pedagogical and not a technical perspective in the conceptualization of learning objects. It may be more cost effective to design customized materials for specific teaching and learning applications than to consider the development of learning objects.

The study's implications for research were presented and discussed. It is possible that the study's results could encourage an investigation of alternate learning object frameworks that more closely represent what designers believe the requirements are for learning objects in authentic design situations. We might inquire into the aspects of pedagogy in general and the learning theories in particular that designers implicitly or explicitly draw from when designing and creating learning objects. With respect to attributes that were stated by designers but not found in the literature (i.e., *design accountable*, *pedagogically assessable*, *pedagogically purposeful*, *pedagogically powerful*), it would be of interest to explore these further in order to validate whether or not they could be of use in future learning object frameworks. A study that directly observes designers in practice would provide further insight into how designers define and conceptualize learning objects in an authentic production environment.

Some designers offered reflections on their interview experiences. Many of these reflections related to an expression of difficulties they experienced when talking about learning objects. Interviewee fatigue was noted during interviews with instructional designers, primarily during Phase I interviews. This fatigue may have been caused by the sustained intensity of the interview; that is, I helped build and challenge a designer's view of what a learning object was by stating and restating aspects and attributes that were noted by them during earlier parts of the interview.

References

Alberta Learning (2002). *Learn Alberta glossary*. Retrieved November 21, 2005, from http://www.learnalberta.ca/Browse.aspx?View=Glossary

Ally, M. (2004). Designing effective learning objects. In McGreal, R. (Ed.), *Online education using learning objects*. London: Routledge/Falmer.

Barritt, C. (2002). Learning objects and ISD. *Performance Improvement, 41* (7), 28-32. Retrieved June 18, 2006, from http://ispi.org/pdf/barritt.pdf

Barritt, C., & Alderman Jr., F.L. (2004). *Creating a reusable learning objects strategy*. San Francisco: Pfeiffer.

Bates, A.W. (2005). *Technology, e-Learning and distance education* (2nd ed.). New York: Routledge.

BC Campus Web site. (2005). Retrieved November 25, 2005, from http://www.bccampus.ca

Belfer, K., Nesbit, J., & Leacock, T. (2002). *Learning object review instrument (LORI)*. Version 1.5. Retrieved October 29, 2006, from http://www.elera.net/eLera/Home/Articles/LORI%201.5.pdf

Berg, B. L. (2004). *Qualitative research methods for the social sciences* (5th ed.). Boston: Allyn & Bacon.

Bloom, B., Englehart, M., Furst, M., Hill, W., & Krathwohl, D. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain*. New York, Toronto: Longmans, Green.

Bok, D. (2003). *Universities in the marketplace*. Princeton: Princeton University Press.

Bratina, T. A., Hayes, D., & Blumsack, S. L. (2002). Preparing teachers to use learning objects. *The Technology Source*. Retrieved July 4, 2006, from http://technologysource.org/article/preparing_teachers_to_use_learning_objects/

CAREO Web site. (2005). Retrieved November 26, 2005, from http://www.careo.org

Christiansen, J. A., & Anderson, T. (2004). Feasibility of course development based on learning objects: Research analysis of three case studies. *International Journal of Instructional Technology and Distance Learning*. March 2004. Retrieved September 22, 2005, from http://www.itdl.org/Journal/Mar_04/article02.htm

CLOE Web site. (2005). Retrieved November 26, 2005, from http://cloe.on.ca

Cox, S., & Osguthorpe, R.T. (2003). How do instructional design professionals spend their time? *TechTrends*, *47*(3), 46-7.

Downes, S. (2000). *Learning Objects.* Retrieved October 22, 2005, from http://www.downes.ca/files/Learning_Objects.htm

Downes, S. (2003). *Paper tissue argument.* Stephen's Web. Retrieved November 21, 2005, from http://www.downes.ca

Downes, S. (2004). Learning objects: Resources for learning worldwide. In McGreal, R. (Ed.), *Online education using learning objects*. London: Routledge/Falmer.

Duval, E. & Hodgins, W., (2004). Learning objects revisited. In McGreal, R. (Ed.), *Online education using learning objects*. London: Routledge/Falmer.

Epsilon Learning Web site. (2005). Retrieved December 5, 2005, from http://www.epsilonlearning.com/objects.htm

Friesen, N. (2001). What are educational objects? *Interactive learning environments*, *9* (3), 219-230.

Friesen, N. (2004). Three objections to learning objects. In McGreal, R. (Ed.), *Online education using learning objects*. London: Routledge/Falmer.

FreeMind Web site. (2006). Retrieved May 21, 2006, from http://freemind.sourceforge.net/wiki/index.php/Main_Page

Gibbons, A., Nelson, J., & Richards, R. (2002). The nature and origin of instructional objects. In D. A. Wiley (Ed.), *The Instructional Use of Learning Objects.* Bloomington, IN: Agency for Instructional Technology and the Association for Educational Communications and Technology.

Gregorc, A.F. (1985). *Gregorc style delineator: A self-assessment instrument for adults.* Columbia, CT: Gregorc Associates.

Hamel, C. J., & Ryan-Jones, D. (2002). Designing instruction with learning objects. *International Journal of Educational Technology (IJET), 3*(1). Retrieved January 31, 2006, from http://www.ao.uiuc.edu/ijet/v3n1/hamel/index.html

Harnett, J. (2002). Where have all the Legos™ gone? *Online Learning Magazine,* Retrieved July 4, 2006, from http://www.onlinelearningmag.com/training/search/search_display.jsp?vnu_content_id=1278802

Hodgins, W. (2000). *Reusable learning objects – building blocks of the new learning economy.* Retrieved January 15, 2006, from http://www.learnativity.com/speaking.html

Hodgins, W., & Conner, M. (2000). Everything you wanted to know about learning objects but were afraid to ask, *LineZine.* Retrieved July 4, 2006, from http://www.linezine.com/2.1/features/wheyewtkls.htm

Howard-Rose, D., & Harrigan, K. (2006). *CLOE learning impact studies LITE: Evaluating learning objects in nine Ontario university courses.* Retrieved October 9, 2006, from http://lt3.uwaterloo.ca/cloe/MERLOTConferencePaper10.doc

IBSTPI Web site. (2005). Retrieved September 29, 2005, from http://www.ibstpi.org

IMS Global Learning Consortium (2005). *IMS Learning Design Information Model.* Retrieved November 26, 2005, from http://www.imsglobal.org/learningdesign/ldv1p0/imsld_infov1p0.html

Jackson, C., & Cooper, A. (2004). *Learning object structure: A discussion paper.* Tribal Technology. Retrieved December 5, 2005, from http://www.tribaltechnology.co.uk/pdfs/papers/Learning%20Object%20Structure.pdf

Kemp, J.E., Morrison, G.R., & Ross, S.M. (1994). *Designing effective instruction.* New York: Merrill.

Kenny, R.F., Zhang, Z., Schwier, R.A., & Campbell, K. (2005). A review of what instructional designers do: Questions answered and questions not asked. *Canadian Journal of Learning and Technology, 31*(1), 9-16.

Krauss, F., & Ally, M. (2005). A study of the design and evaluation of a learning object and implications for content development. *Interdisciplinary Journal of Knowledge and Learning Objects, 1*(1). Retrieved October 29, 2006, from http://www.ijklo.org/Volume1/v1p001-022Krauss.pdf

Kruse, K. (2002). *Measuring the total cost of e-learning.* Retrieved January 29, 2006, from http://www.e-learningguru.com/articles/art5_2.htm

Laitinen, M., Fayad, M., & Ward, R. (2000). The problem with scalability. *Communications of the ACM,* Vol. 43, No. 9.

Liu, M., Gibby, S., Quiros, O., & Demps, E. (2002). Challenges of being an instructional designer for new media development: A view from the practitioners. *Journal of Education Multimedia and Hypermedia, 11*(3), 195-219.

Longmire, W. (2000). A primer on learning objects. *Learning Circuits, 1*(3). Retrieved January 31, 2006, from http://www.learningcircuits.org/2000/mar2000/longmire.htm

McGreal, R. (Ed.). (2004). *Online education using learning objects*. London: Routledge/Falmer.

MERLOT Web site. (2005). Retrieved November 26, 2005, from http://www.merlot.org

Mortimer, L. (2002). (Learning) objects of desire: Promise and practicality. *Learning Circuits*. Retrieved November 23, 2005, from http://www.learningcircuits.org/2002/apr2002/mortimer.html

Murphy, E. (2004). Moving from theory to practice in the design of Web-based learning using a learning object approach. *E-journal of Instructional Science and Technology, 7*(1). Retrieved November 23, 2005, from http://www.usq.edu.au/electpub/e-jist/docs/vol7_no1/content.htm

Muzio, J., Heins, T., & Mundell, R. (2002). Experiences with reusable e-learning objects: From theory to practice. *Internet and Higher Education, 5*(1), 21-34.

Nesbit, J., Belfer, K., & Vargo, J. (2002). A convergent participant model for evaluation of learning objects. *Canadian Journal of Learning and Technology, 28* (3). Retrieved December 31, 2005, from http://www.cjlt.ca/content/vol28.3/nesbit_etal.html

Parmentier, M. (1999). The ABILITIES list of content enablers. *Internet Time*. Retrieved October 2, 2005, from http://www.internettime.com/itimegroup/astd_web/capture.htm

Paquette, G., & Rosca, I. (2002). Organic aggregation of knowledge objects in educational systems. *Canadian Journal of Learning and Technology. 28*(3). Retrieved October 29, 2006, from

http://www.cjlt.ca/content/vol28.3/paquette_rosca.html

Porter, D. (2001). Object lessons from the Web: Implications for instructional development. In G. Farrell (Ed.), *The Commonwealth of Learning: The Changing Faces of Virtual Education.* The Commonwealth of Learning: Vancouver, BC.

Powell, T. (2004). *The experiences of instructional designers of Web-based learning at the post-secondary level.* Unpublished Master's thesis, Faculty of Education, Memorial University of Newfoundland.

Quinn, C., & Hobbs, S. (2000). Learning objects and instructional components. *Educational Technology and Society, 3*(2). Retrieved May 7, 2006, from http://ifets.ieee.org/periodical/vol_2_2000/discuss_summary_0200.pdf

Rehak, D., & Mason, R. (2003). Keeping the learning in learning objects. In Littlejohn, A. (Ed.), *Reusing online resources: A sustainable approach to e-learning.* Kogan: London.

Robson, R. (1999). *Object-oriented instructional design and Web-based authoring.* Retrieved July 4, 2006, from http://citeseer.nj.nec.com/327280.html

Rose, D. (2003). *CLOE learning impact studies lite: Evaluating learning objects in nine Ontario university courses.* Report presented to the Office of Learning Technologies, Human Resources Development Canada. Retrieved December 31, 2005, from http://lt3.uwaterloo.ca/CLOE/MERLOTConferencePaper10.doc

Sheperd, C. (2000). *Objects of interest.* Retrieved July 4, 2006, from http://www.fastrak-consulting.co.uk/tactix/features/objects/objects.html

Sosteric, M., & Hesemeier, S. (2004). A first step toward a theory of learning objects. In McGreal, R. (Ed.), *Online education using learning objects.* London: Routledge/Falmer.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. London: Sage Publications.

Wiley, D.A., South, J.B., Bassett, J., Nelson, L.M., Seawright, L.L., Peterson, T., & Monson, D.W. (1999). Three common properties of efficient online instructional support systems. *The ALN Magazine*, *3*(2). Retrieved November 26, 2005, from http://www.sloan-c.org/publications/magazine/index.asp

Wiley, D. A. (Ed.). (2002a). *The instructional use of learning objects*. Bloomington, IN: Agency for Instructional Technology and the Association for Educational Communications and Technology.

Wiley, D. A. (2002b). Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy. In Wiley, D.A. (Ed.), *The instructional use of learning objects.* Bloomington, IN: Agency for Instructional Technology and the Association for Educational Communications and Technology.

Wiley, D. A. (2002c). Learning objects need instructional design theory. In Rossett, A. (Ed.), *The ASTD e-learning handbook.* New York: McGraw-Hill.

Wiley, D. A. (2006). RIP-ping on learning objects. *Iterating toward openness: Wiley Blog*. Retrieved February 2, 2006, from http://opencontent.org/blog/

Williams, D. (2002). Evaluation of learning objects and instruction using learning objects. In D. Wiley (Ed.), *The Instructional Use of Learning Objects.* Bloomington, IN: Agency for Instructional Technology and the Association for Educational Communications and Technology.

Wisconsin Online Resource Center Web site. (2006). Retrieved October 9, 2006, from http://www.wisc-online.com

Yin, R. K. (1994). *Case study research: Design and methods* (2nd ed.). Beverly Hills, CA: Sage Publishing.

Appendix A – CLOE Peer Review Guidelines

CLOE Peer Review Committee
Learning Object Submission Guidelines for Authors (evaluation standards)

When a learning object is submitted it will undergo an initial functionality review. After passing this first level of functionality testing,[1] the learning object is reviewed on the following criteria:

N.B. Normally a rating of "not at all" on any question by the reviewers will require that the author provide additional information or revision of the learning object before the learning object is accepted.

Learning Object: _____ **Reviewer:**_____

Quality of Content		not at all	somewhat	definitely
1.	The content of the learning object is accurate.			
2.	The use of technology is appropriate for this content.			
3.	The content is presented clearly and professionally (spelling/grammar, etc).			
4.	Appropriate academic references are provided.			
5.	Credits to creators are provided.			
Effectiveness as a Teaching/Learning Tool				
6.	There are clear learning objectives.			
7.	The learning object meets the stated learning objectives.			
8.	The target learners are clearly identified (academic level addressed/technical ability/demographics).			
9.	There are clear instructions for using the learning object.			
10.	The technology helps learners to engage effectively with the concept/skill/idea.			
11.	The learning object provides an opportunity for learners to obtain feedback within or outside the learning object.			
12.	The author provides evidence that the learning object enhances student learning.[2]			
13.	Pre-requisite knowledge/skills, if needed, are identified.			
14.	The learning object stands alone and could be used in other			

[1] Initial functionality testing will be conducted by the CLOE gatekeeper and will include checking to ensure that links work, plug-ins are available, platform and browser compatibility are identified, *et cetera.*

[2] Acceptable evidence could be anecdotal comments, student perception questionnaires, or more formal learning impact studies.

	learning environments.			
Ease of Use				
15.	The learning object is easy to use (i.e. navigation, user control).			
16.	The author indicates whether the learning object is accessible for learners with diverse needs.			
17.	Technical requirements for the learning object are provided.			

Additional Comments:_____

_____

_____

_____

_____

Appendix B: Participant Consent Form

February 2nd, 2006

Dear _____:

I am contacting you to invite you to volunteer to participate in a study related to the definitions and conceptualizations of learning objects. You were chosen because I believe that the combination of your experience and the context in which you work will provide particular insights on this topic. I believe that this study will introduce an interesting dialogue on the theory and practice of the use of learning objects and how they are used in instructional design. Your contribution will affect how instructional designers think about and use learning objects now and in the future.

This opportunity will take place as part of my thesis in the Masters program in Education (Information Technology) at Memorial University. The aim of the study is to identify and understand their range and types of definitions for learning objects held by instructional designers, how designers conceptualize attributes of objects, and how designers operationalize these attributes in authentic design situations. These definitions of objects and their attributes will then be compared with those found in the theoretical literature on learning objects.

This information will enrich the existing literature on learning objects by giving voice to individuals involved in the actual creation of the objects themselves. Insight into your understandings and experiences will help clarify and extend our knowledge of learning objects and their attributes. This study will also add to the literature on instructional design by providing further insight into the experiences of instructional designers.

The study will take place between the months of February and March, 2006 and will require approximately two hours of your time. Your participation would involve one interview in which you will be shown some learning objects and asked to provide your perspectives on their attributes-e.g. do you think that this object is reusable? How? In a second interview, you will be asked to show the researcher some of the objects that you have used or designed and explain the attributes reflected in the objects e.g. Tell me how you designed the object to make it granular?

The proposal for this research has been approved by the Interdisciplinary Committee on Ethics in Human Research at Memorial University of Newfoundland. Participation is **not required** and refusal to participate will contain no penalty. If you decide to read to the end of this information, you may then decide whether you wish to participate or not.

Consent form to be provided to instructional designers (in duplicate so that they can retain a copy for their records)

I understand that:

- By agreeing to participate in this study, I am providing consent to publication of my comments in anonymous format in part or in whole in subsequent research reports and papers that may be published in relation to the study.
- I understand that confidentiality of comments cannot be guaranteed and that readers of reports based on this study may be able to associate comments with individuals.
- I understand that my participation in this study will require approximately two hours of my time over a two-month period from February - March 2006.
- I understand that the activities in which I will be involved include participating in two interview sessions.
- Only the researcher and his supervisor will have access to data. All data will be destroyed after five years.
- My participation is voluntary and I can withdraw from the study at any time and can decline from answering any questions.
- Refusal to take part in the study involves no penalty or loss of benefits to which I am otherwise entitled.

I have read the information about this study and provide my consent to participate in the project as described in the information section and the consent form provided to me.

Participant's Name (Please Print)	**Date**
Participant's Signature	**Date**
David Francis	**Date**

Please return via fax to David Francis at (306) 933-8403 by February 15th, 2006.

Appendix C – Phase I Semi-Structured Interview Guide

Phase I - Semi-Structured Interview Guide

Setup and Organization

Participants were asked in advance to provide Web access to learning object(s) they created. If Web access not possible, object was e-mailed or otherwise transmitted.

Required Materials for Interviewer

Note-taking/coding paper

Semi-Structured Interview Questions

Introduction

Thank you for agreeing to participate in this study – today I hope to have a conversation with you about projects that you have worked on involving learning objects.

In this study, I am trying to gain insight into what learning objects are from the perspective of designers themselves, so in your responses I want you to focus on your own definitions and understandings of objects rather than definitions that you may have heard or read about.

Participant Background

To begin, I have some basic questions about your background as an instructional designer:

1. How many years have you been an instructional designer?
2. Have you always worked in post-secondary environments or have you worked in other environments as an instructional designer?
3. Did you attend Camp CLOE? How many times did you attend?
4. What other training in creating learning objects have you participated in?
5. What other reading on learning objects have you done?
6. What educational preparation led you to the instructional design profession?

This interview should take approximately one hour - do you have any questions before we start?

Project Description / Touch on Learning Object Definitions, Attributes

Could you briefly, in a couple of minutes, describe the project that you worked on

resulting in this/these learning object(s)? What were the goals of the project and why did you use learning objects?

(Based on designer's responses, summarize or paraphrase any definition items they give, do not introduce terms from the literature. Summarize and challenge them to explain the concepts further building on ideas of learning object definitions and attributes.)

(If designer did not actually build learning object, then adjust text below to read "if you had designed and developed this learning object")

Attributes

(This ordering will vary depending on how ideas are emerging, but approaches to lead toward examining attributes here are listed without naming the attributes themselves per the literature.)

Possible Directions

Question	Attribute
Have you made this learning object available to your colleagues or a wider audience (for example, MERLOT?). If a learning object is unavailable to others, either at your institution or more widely, is it still a learning object?	Accessibility
Did you design this learning object to function on more than one type of computer (for example, PC and Mac?) If a learning object does not function on multiple systems is it still a learning object?	Interoperability

Could you use this learning object in more than one teaching and learning situation or context? Does a learning object have to be usable in more than one teaching and learning situation or context to be considered a learning object?	Adaptability
Can this learning object be incorporated into multiple applications? If it could not, would it still be a learning object?	Reusability
How long into the future do you think this learning object will be used given changes in technology? If a learning object requires frequent updates as technology changes does is it still a learning object?	Durability
Do you know of other institutions (or simply students) that are using this learning object you created? Is there any licensing or financial element involved? Is it important the learning objects we available to a wider audience and does this reduce their cost for using it?	Affordability
Did your learning object undergo any kind of peer review? Does a learning object need to be validated by peers in order to be considered a learning object?	Assessability
Did you "tag" this object with any information that would make it easier to find by designers (or anybody) searching the Web for something like this? Does a learning object have to have this type of extra information in order to be considered a learning object?	Discoverability

Do you find it easy to work with this object to insert it into different teaching situations? How much time would be involved? How could that time be minimized? What if a designer who was unfamiliar with the object were to use it? Is this ease of use required for this to be considered a learning object?	Manageability
Given the properties of this learning object – do they always work for all users? Do all of the learning object's properties have to work consistently in order to consider it a learning object?	Reliability
Do you and prospective users find it easy to access this learning object? Does a learning object have to be available when and how you want it in order to be a learning object?	Retrievability
Could this learning object be used for teaching in both small and large class sizes? If the object cannot be used with different sized audiences is it still a learning object?	Scalability
With this learning object, does the user(s) have the ability to decide what it is to be used for at the time of use? Or does it have to be determined/configured in advance? If the user(s) cannot decide at time of use what it is to be used for is it still a learning object?	Flexibility

How would the learning object(s) we are discussing today NOT be a learning object(s)? What could you take away from it to cause it to no longer be a learning object?	General Approach to LO Definition, Attributes
Is a book a learning object? What about a book that has been converted into a single PDF file? Why or why not?	Granularity, LO Definitions
In what ways is a book NOT a learning object?	LO Definitions, Attributes
Does a book have to be in a public library to be considered a learning object?	Repositories, Multiple Attributes
Could songs on a cassette tape be considered learning objects? Why or why not? What if they were on a CD?	LO Definitions, Multiple Attributes
Does a learning object have to be something that has been created for educational purposes?	LO definitions
Does a learning object have to be something that was created for use in a certain learning environment? For example, a high-school classroom or a university laboratory?	LO definitions
How big can a learning object possibly be? Can it be a course? Can it be a degree program? What is the limit?	LO Definitions, Granularity

How small can a learning object be? A unit of study? A paragraph? What is the limit?	LO Definitions, Granularity
Does an object have to stand alone or can it be a collection of things, for example digital files?	LO Definitions, Granularity
Does a learning object have to be designed by a designer in order to be a learning object?	LO Definitions

Learning Object Definition(s)

Based on what was talked about in interview, summarize points made using participant's own language to verify the concept of a learning object that has been built up. This will ease writing up section of thesis and verify that participant indeed would defend the emergent definition of learning object from their point of view

Analogies

If you were to describe learning objects to a designer who was unfamiliar with the concept, what type of analogy would you use (i.e., learning objects are a bit like ____)

What would you consider the limitations of such an analogy to be?

Ending

Is there anything you wish to add to any of the comments you made today?

Thanks very much for making time available to speak with me today.

Appendix D – Phase II Semi-Structured Interview Guide

Phase II - Semi-Structured Interview Guide

Setup and Organization

A pre-interview phone call was held to ensure that learning objects functioned on participants' computers. Telephone was used to capture MP3 audio to create audio files.

Required Materials for Interviewer

Note-taking/coding paper

Semi-Structured Interview Questions

Introduction

Thank you again for agreeing to participate in this study, today will serve as a follow up interview to our discussion last month about learning objects. The first part of this interview will function to ensure that I correctly captured your thoughts on what learning objects are from your point of view during our last conversation. In the second part, we will mutually review two learning objects that are available on the Web.

As I mentioned last time, in this study, I am trying to gain insight into what learning objects are from the perspective of designers themselves, so in your responses I want you to focus on your own definitions and understandings of objects rather than definitions that you may have heard or read about.

This interview should take approximately one hour - do you have any questions before we start?

Recap Discussion on Learning Objects (Approx. 30 minutes)

(With use of concept mapping software, revisit categories and major themes expressed by participant sequentially and ensure they still agree with these points. Probe where appropriate on terminology used, any concepts that may have been missed, any items that seem contradictory. This can be done in any sequence; best would be to enter via main categories listed below)

- *Interactivity / Range of interactivity*
- *Manageability*
- *Reusability*
- *Frame/Framework*
- *Design requirements trump affordability*

- *Use of learning objects to address difficult curricular areas*
- *Common analogy of video game*
- *Different requirements for LO, LOR*

And overall possible emergent theme

- *Learning objects defined from pedagogical requirements or learning theory rather than technical definition. Notable absence of comments on technology or standards.*

While avoiding learning object attributes or definitions that were not either viewed as requirements (e.g. affordability) or associated questions ("Does a learning object have to be designed by a designer?)

Based on designer's responses, probe, summarize or paraphrase any definition items they give, can introduce some terms from the literature. Summarize and challenge them to explain the concepts further building on ideas of learning object definitions and attributes.)

Other Useful Questions That Are Emerging From Phase II Interviews

- For the object that you designed that we talked about in the Phase I interview, what was the most satisfying element of the design -or- the element of the design you were MOST pleased with?

- For the object that you designed that we talked about in the Phase I interview, what was the most satisfying element of the design -or- the element of the design you were LEAST pleased with?

- How important are standards or technical guidelines to the development of learning objects at your institution? How often do you consider this during the design of learning objects?

Analysis of Two Web-based Learning Objects (Approx. 30 minutes)

1) http://www.wfu.edu/physics/demolabs/demos/avimov/bychptr/chptr1_motion.html

Please click on one of the physics demonstrations and view the short video (for example, the "Rocket Cart" video or "Trash Can Throw").

Possible questions:

- Is this a learning object? Why or why not? (Compare with what they said in first interview)

- If not an object, what could be added to cause it to be an object? What's missing?
- If an object, how could the design be improved?

2) http://www.wisc-online.com/

Title: Protein Synthesis
Author: Barbara Liang
School: Fox Valley Technical College
Description: Every protein molecule of an organism is synthesized by that organism in a prescribed process.

Possible questions:

- Is this a learning object? Why or why not? (Compare with what they said in first interview)
- If not an object, what could be added to cause it to be an object? What's missing?
- If an object, how could the design be improved?

Analogies (if time permits, 5 minutes)

Would you like to revisit the analogy for learning objects you presented during our last conversation (remind them of their analogy from concept map). Do you think this still serves as a useful analogy?

Ending

Is there anything you wish to add to any of the comments you made today?

Thanks very much for making time available to speak with me today.