

**THE DEVELOPMENT OF REUSABLE ONLINE LEARNING RESOURCES FOR
INSTRUCTIONAL DESIGN STUDENTS BASED ON THE PRINCIPLES OF
LEARNING OBJECTS**

by

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B.S., Abha Teachers' College, 1995

M.S., Kansas State University, 2001

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfilment of the
requirements for the degree

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Department of Secondary Education
College of Education

KANSAS STATE UNIVERSITY
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ABSTRACT

The purpose of this research and development study was to design, develop, evaluate and revise reusable online learning resources based on the principles of learning objects that would support instructional design students' learning and performance in the context of ATC in Saudi Arabia.

Using a research and development model (Borg and Gall, 1989), Instructional Design reusable online learning resources (ID-RORs) were iteratively and collaboratively developed and revised based on feedback gathered through formative evaluation. Between each round of qualitative formative evaluation, the ID-RORs were revised based on analysis of the data. Seven main research and development phases were carried out: research and information collecting, a needs assessment, prototype development, expert evaluations, redesign, target user evaluations and redesign.

The formative evaluation of ID-RORs consisted of three phases. The first evaluation group was comprised of four experts. The purpose of this evaluation was to conduct a needs assessment. The second phase, which used feedback from two experts and two instructional design teachers, was the expert evaluation. The purpose of this evaluation was to examine the validity of the ID-RORs. The third phase, based on feedback from 11 students, was the user evaluation. The purpose of this evaluation was to examine the practicality of the ID-RORs.

The overall results of the needs assessment evaluation showed that the

ID-RORs prototype met an important need at ATC. The overall result of the expert evaluation showed that the ID-RORs prototype were valid for the context of ATC. Finally, the result of target user evaluation showed that the ID-RORs as revised with expert and user input were practical for the intended target users. Based on the results of this R & D study, it was concluded that the answer to the research question is yes, it is possible to develop the ID-RORs to meet the specifications of the needs assessment. The characteristics of ID-RORs are very similar to the characteristics of successful (valid and practical) reusable online resources. The final version of the ID-RORs were found to be needed, valid and practical, in the context of ATC.

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Chapter One: Introduction

"The paradigm of instruction has to change ...from a focus on presenting material to a focus on making sure that learners' needs are met,; a "learning-focused" paradigm. ... But to change the paradigm of instruction in this way, the teacher can't teach the same thing to a whole "class" at the same time. This means the teacher has to be more of a "guide on the side" rather than a "sage on the stage." So, if the teacher is a facilitator rather than the agent of most of the learning, what other agents are there? Well-designed resources are one, and instructional-design theory and instructional technology can play particularly large roles in developing these" (Reigeluth,1999b p.19).

Internet technologies have changed many of our life activities. Learning is one such activity that is currently being revolutionized by access to and use of online resources. However, existing online learning resources were created to address specific situational needs and to be used largely intact. Increasingly, the need and demand for the flexible use of resources grows as the creation of digital resources continues to evolve. Furthermore, individuals must find and adapt resources to meet training and learning needs that may be unlike those for which the resources were initially created (Hannafin, Hill, & McCarthy, 2000).

“Our challenge in teaching students is not to identify key information they need to know and sequence it for delivery; instead, our challenge is to provide an environment that is rich with learning experiences and resources” (Orrill, 2001 p.9).

The Context of the Study

The current state of higher education system in Saudi Arabia reveals a number of problems significantly affecting the outcomes and confidence of higher education students. One of those problems is the use of a teacher-centered model. The teacher-centered model has influenced higher education in Saudi Arabia for many years to such a degree that it is almost the only approach used. Increasingly, Saudi educators acknowledge that there is a need for shifting the higher educational philosophy to a more learner-centered model to meet the needs of today's learners.

This study took place in the context of Abha Teachers' College, Saudi Arabia. ATC was founded in 1984 as one of 18 teachers colleges established in different parts of Saudi Arabia. The ATC has an enrolment of over 2800 students. ATC is supervised and funded by the Ministry of Education. The duration of studies is four years for the Bachelor's Degree. After graduating, the ACT students teach a variety of subjects at the elementary school level.

Instructional design is one of the ATC required courses offered by the Department of Educational Technology. The goal of the Instructional Design course is to introduce the systems approach to Instructional Design students and to provide them with both introductory information and application of skills and techniques necessary in the design, development, and evaluation of instructional products.

The researcher chose ATC for his research for a couple of reasons. First of all, the school is conveniently located just a couple of miles from where the

researcher lives. This location makes it feasible for him to participate daily in the research. Secondly, the researcher taught at the ATC for three years. As a result, the researcher was familiar with the workplace of the ATC as well as the social and cultural context within the ATC. Additionally, the researcher has access to the faculty and students in the college.

Problem and Need

The problem around which this research is centered is that Instructional Design students in Abha Teachers' College (ATC) did not have access to Arabic reusable online resources to support their learning and enable them to address their unique learning interests and needs. Consequently, there appeared to be a need for reusable online resources. Storyboard templates, glossaries, evaluation tools, and tutorials are just a few examples of those needed resources.

Another related problem is that creating well-designed online resources is very costly and time-consuming. Using the principles of *learning objects* in designing what I will call the Instructional Design reusable online resources (ID-RORs) is a way to increase content value, lower development costs, and shorten development time. I will use this term throughout to describe RORs that are particularly useful to Instructional Design students.

Research Purpose

The purpose of this research and development study was to design,

develop, evaluate and revise reusable online resources based on the principles of *learning objects* that would support Instructional Design students' learning and performance in the context of ATC.

Research and Development Objectives

The objectives of this research and development study were:

- To examine the literature for determining essential components of successful reusable online learning resources.
- To conduct a needs assessment.
- To develop an ID-ROR prototype.
- To evaluate the validity of the prototype by the experts.
- To revise the prototype based on the results of the expert evaluation.
- To evaluate the practicality of the prototype by the intended users.
- To revise the prototype based on the results of the user evaluation.

Research Questions

This study is based on two research questions:

- What characteristics should valid and practical reusable online resources for Instructional Design students have in the context of Abha Teachers' college?

- Can a set of learning objects be developed that meets these criteria for ATC Instructional Design students?

The following sub-questions were derived from the research questions above:

- Does the proposed product meet an important educational need for Instructional Design students, in the context of ATC? Why?
- Are the ID-RORs valid for the intended target users? If not, what needs to be done to improve them?
- Are those Instructional Design resources working/practical for the target users? If not, what needs to be done to improve them?

Significance of the Study

The ID-RORs have significance for the following reasons:

- Students should find ID-RORs helpful for supporting their learning and performances in a just-in-time manner.
- Instructional Design teachers, who have been looking for any type of support for their students' learning and performance, should find ID-RORs useful.
- The learning objects, to be developed in this study, will be reusable, and accessible in multiple contexts and a variety of ways.
- Using the ID-RORs in the context of ATC should support shifting the

paradigm of instruction from teacher-centered to student-centered.

- One of the outcomes of this study will be the construction of a body of design principles that can guide future development of similar projects.

Scope and Limitations of the Study

The scope of this study was limited to research, design, development, and evaluation of Instructional Design reusable online resources to support student learning and performance in the context of ATC. There are several limitations with this study:

- The ID-RORs is not intended to teach; rather, it will be structured to support students' learning and performances in a just-in-time manner.
- This study will be limited to Instructional Design students in the context of Abha Teachers' College; however, the resources could be adaptable to a variety of contexts.
- The determination of the effectiveness of student learning using this product, or of a change in paradigm in teaching at ATC as a result of using this product, are beyond the scope of this dissertation. Also, distribution of this product is beyond the scope of this research.
- Even though the research and development of this study is context specific, it is possible to provide direction to others who are confronting similar design and development projects.

Definition of Terms

Applets: A small computer program that is intended not to be run on its own, but rather to be embedded inside another application (Sun Microsystems, 2004).

Constructivism: A theory about knowledge and learning; it describes both what “knowing” is and how one “comes to know” (Fosnot, 1996).

Contextual inquiry: A field study method developed by Beyer & Holtzblatt in which a researcher observes and interviews users performing their usual job tasks in the context of their actual work situations.

Development Research: The systematic study of designing, developing, and evaluating instructional programs, processes and products that must meet the criteria of internal consistency and effectiveness.

Effectiveness: The extent to which experiences and outcomes with the prototype are consistent with the intended aims (van den Akker, 1999).

EPSS: (Electronic Performance support system) “An integrated electronic environment that is available to and easily accessible by each employee and is structured to provide immediate, individualized on-line access to the full range of information, software, guidance, advice and assistance, data, images, tools, and assessment and monitoring systems to permit job performance with minimal support and intervention by others” (Gery, 1991. p. 21).

Granularity: The size of a learning resource. The smaller the resource, the

higher the level of granularity (Littlejohn, 2003).

Instructional Design: The systematic and reflective process of translating principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation (Smith & Ragan 1999 p. 2).

Instructional-Design theory: A theory that offers explicit guidance on how to better help people learn and develop (Reigeluth, 1999).

Interoperability: The ability of a learning object created on one computer platform to actually be presented on another platform (SCORM).

Learning objects: Any digital resource that can be reused to support learning (Wiley, 2000).

Main field test: A test used to determine the degree to which the educational product under development meets its performance objectives (Borg & Gall, 1989).

Metadata: Data about a digital object. The metadata are usually provided by the creator or distributor of the object, and often either accompany the object or are embedded in the file header. As such, metadata can be very useful as the basis for information storage and retrieval systems (ALA, 2003).

Practicality: The extent to which users consider the prototype as appealing and usable in 'normal' conditions (van den Akker, 1999).

Preliminary field test: An evaluation by a small group used to obtain initial evaluations of the new prototype (Borg & Gall, 1989).

Prototype: A preliminary version for of the educational product that can be

field tested (Borg, 1987).

Research and development: The process of validating usable education products which are based of basic and applied research (Borg & Gall, 1989).

Resource-based learning: “A philosophy of education and a methodology for teaching and learning. It involves the achievement of both subject and information literacy objectives through exposure to and practice with diverse resources making students active learners” (Lavery, 2001, What is RBL? section, para.1).

Resources: Source materials that support learning (Hill & Hannafin, 2001).

SCORM: A collection of specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility and reusability of Web-based learning content (ADL, 2001).

Usability: A multidimensional property of a system or user interface (Nielsen,1993).

Validation: The process of determining the extent to which competencies and performance statements are supported by the profession.

Validity: The extent to which the design of the prototype is based on state-of-the-art knowledge (content validity) and the various components of the prototype are consistently linked to each other (construct validity) (van den Akker, 1999).

Abbreviations

XML: eXtensible Markup Language

ADL: Advanced Distributed Learning

ATC: Abha Teacher College

CedMA: Computer Education Management Association

CLOE: the Co-Operative Learning Object Exchange

EOE: the Educational Object Exchange

EPSS: Electronic Performance support systems

GEM: Gateway to Educational Materials

ID: Instructional Design

ID-RORs: Instructional Design- Reusable Online Resources

IEEE: Institute of Electrical and Electronics Engineers

IMS: Instructional Management Systems

LOM: learning object metadata

LOs: learning objects

MERLOT: the Multimedia Educational Repository for Learning and Online

Teaching

MOODLE: Modular Object-Oriented Dynamic Learning Environment

R & D: Research and Development

RBL: Resource-Based Learning

SCORM: Sharable Content Object Reference Mode

Chapter Two: Literature Review

In this chapter, the purpose of examining related literature and review related to reusable online resources was to help to answer the research question by the determining the characteristics of successful online resources.

The review of related literature is comprised of five main sections; resource-based learning, learning objects, Electronic Performance Support Systems (EPSSs), review of selected Instructional Design theories and review of existing reusable online resources.

As this study deals with the design and development of reusable online resources, the first section of this chapter investigate resource-based learning.

Resource-Based Learning (RBL)

Both the amount of information and access to it have grown exponentially; hence, a significant potential for using varied resources in numerous ways for instruction and learning has emerged (Hill & Hannafin, 2001). Lavery (2001) defined resource-based learning as both a philosophy of education and a methodology for teaching and learning. She added, "It involves the achievement of both subject and information literacy objectives through exposure to and practice with diverse resources making students active learners." (Lavery, 2001, What is RBL? section, para.1).

Resources range from electronic (e.g., databases, web pages, computer

tutorials, video), to print (e.g., textbooks, original source documents, journal articles), to human (e.g., experts, parents, teachers, peers).

According to Hill & Hannafin (2001) resource-based learning is not tied to any one learning theory or to any specific pedagogy. Moreover, RBL does not teach, but rather supports the learner's inquiry or performance (Savory, & Duffy, 2001).

Traditionally, resource-based learning materials have been limited to where they physically existed and used in a linear fashion, as for instance books in a library. Moreover, RBL has traditionally been used to supplement more teacher-centered methods. However, the volume of digital resources available and the ability to transmit those resources in multiple formats has refocused attention on the potential of resource-based learning to support emerging inquiry-based models of learning (Hill & Hannafin, 2001; Campbell, Flageolle, Griffith & Wojcik, 2002).

Hill and Hannafin, (2001) have identified four core design components of resource-based learning:

- Contexts: contexts are the settings, real and virtual, in which learning and/or performing circumstances are framed.
- Resources: Resources are source materials that support learning.
- Tools: Tools provide the overt means through which individuals engage and manipulate resources as well as their own ideas. Tools also aid in locating, accessing, and manipulating, interpreting,

evaluating resources, and enable learners to organize and present their understanding in concrete ways (Jonassen & Reeves, 1996).

- Scaffolds: Scaffolding is the process of supporting learners' performances while they are engaging in using the resources.

Scaffolds are the means used for this support.

The potential of resource-based learning for instruction and learning is considerable. RBL can be implemented in highly regulated environments as well as in open-ended constructivist environments (Hill & Hannafin, 2001; Hannafin, Hill, & McCarthy, 2002; Hannafin, Land & Oliver, 1999). The following are some benefits of RBL:

Resource-based learning provides students with opportunities to take a more active role in their learning by shifting the responsibilities of organizing, analyzing, synthesizing, and evaluating content from the teacher to the student (Means, 1994). Resource-based learning promotes problem-solving and higher-order thinking skills and can be used effectively as a component of project-based learning, or as a complement to other inquiry learning models (Campbell, Flageolle, Griffith, & Wojcik, 2002).

RBL supports the individual's effort to locate, analyze, interpret and otherwise adapt information to meet particular learning needs (Hill & Hannafin, 2001). Resource-Based Learning accommodates individual differences in learning styles, abilities, needs, interests and prior knowledge (Campbell, Flageolle, Griffith, & Wojcik, 2002). Resources can be used as objects to think with and through as well as the vehicles for representing knowledge (Hannafin,

Hill, & McCarthy, 2002).

Online resources offer considerable promise for educators due to technological developments and the ability to catalog, reuse and classify digital resources (Hill & Hannafin, 2001). However, current practices may prove insufficient in optimizing available resources and preparing individuals to learn in resource-rich environments. Therefore, educators should look for ways to enhance and extend existing approaches to meet the demands of the digital era (Hill & Hannafin, 2001).

According to many researchers in the field of instructional technology (Hill & Hannafin, 2001; Littlejohn, 2003; Hannafin, Hill, & McCarthy, 2002; Hannafin, Land & Oliver, 1999; Campbell, Flageolle, Griffith, & Wojcik, 2002) online learning resources should be designed based on the principles of *learning objects* technology (see the next section) to support Individuals in finding and adapting resources to meet unique learning needs.

Learning Objects

Creating digital learning resources requires considerable investment (Littlejohn, 2003). Additionally, existing online learning resources were created to address specific situational needs and used largely intact (Hannafin, Hill, & McCarthy, 2000). Design thinking needs to move from an approach that is oriented towards creating large integrated packages (Douglas, 2001) to one that breaks down the content packages into smaller chunks of assets. An asset could

be a picture, audio or video clip, text, or applets. The goal of this process of breaking down the content into small chunks is to make those objects reusable in many different contexts and for a variety of purposes.

Wiley (2000a) illustrates 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 contexts. Additionally, learning objects are generally understood to be digital entities deliverable over the Internet, meaning that any number of people can access and use them simultaneously (as opposed to traditional instructional media, such as an overhead or video tape, which can only exist in one place at a time). Moreover, those who incorporate learning objects can collaborate on and benefit immediately from new versions. This is a significant difference between learning objects and other types of instructional media that have existed previously” (p. 2).

Responding to the need for more flexible resources, numerous national and international initiatives have been funded to investigate ways in which digital learning resources might be developed, shared and reused by teachers and learners around the world. Behind these initiatives lies a vision of a future in which reusable resources or 'learning objects' as they are called (Littlejohn, 2003).

Learning objects became of interest because the Web made it possible to easily distribute learning resources that were in a digital format. Once digitized, visuals, audio clips, text, or applets can be easily transmitted for re-use in another place or instructional context (Richards, 2002).

“Learning objects currently lead other candidates for the position of technology of choice in the next generation of Instructional Design, development, and delivery, due to its potential for reusability, generativity, adaptability, and scalability” (Wiley, 2000a p.3).

What is Learning Object (LO)?

Confusion continues to exist in practice about what a learning object is (Johnson, 2003). This concept has its origin in object-oriented programming. The term *learning object* was “first popularized by Wayne Hodgins in 1994, when he named the CedMA [sic; Computer Education Management Association] working group ‘Learning Architectures, APIs and Learning Objects’ has become the Holy Grail of content creation and aggregation in the computer-mediated learning field” (Polsani 2003, Abstract section, para.1).

A *learning object* is defined as “any entity, digital or non-digital, that may be used for learning, education or training” (IEEE, 2001 p. 6). In the context of this study, a *learning object* is “any digital resource that can be reused to support learning” (Wiley, 2000 p.7).

Examples of *learning object* include digital images, video or audio clips, small bits of text, animations. In an ideal world, these resources would be designed so that they could be adapted to fit different educational models, subject disciplines and reused a number of times in different contexts (Wiley, 2001; Littlejohn, 2003).

Learning Object Reusability

Reusability serves as the foundation for defining learning objects (Polsani, 2003). Ideally, once developed, a learning object can be re-used for a variety of courses, in multiple contexts for multiple purposes. Reusability is achieved through separation of object creation from its use to facilitate free exchange of learning object assets among developers, organizations and institutions (Polsani, 2003). To be reused in new situation, and brought together in a variety of ways, the learning object should be stand-alone and not tied to a given course or lesson plan.

Although the learning object approach might not be the answer for every learning situation, successful demonstration projects such as MERLOT (the Multimedia Educational Repository for Learning and Online Teaching), CLOE (the Co-Operative Learning Object Exchange), and the EOE (the Educational Object Exchange) have shown that learning objects can be usefully reused in a large number of contexts (Johnson, 2003).

Learning Object Metadata

Metadata, literally “data about data”, is descriptive information about a learning object (Wiley, 2000a) such as title, author, area of knowledge, date, language, etc.—that is, information to support sharing, reusing and finding of learning objects (Douglas, 2001).

In the traditional context, a library catalog contains a set of metadata records that describe a book or other library item: author, title, date of creation or

publication, subject coverage, and the call number specifying location of the item on the shelf (Hillmann, 2003).

In the Internet context, metadata is data about a digital object. The metadata is usually provided by the creator or distributor of the object, and often either accompanies the object or is embedded in the file header (ALA, 2004). Whether in the traditional context or in the Internet context, the key purpose of metadata is to facilitate and improve the retrieval of information.

Several agencies have been working on developing learning object metadata standard to facilitate the adoption of the learning objects approach including (IEEE) Institute of Electrical and Electronics Engineers, (ADL) Advanced Distributed Learning, (ARIADNE) Alliance of Remote Instructional Authoring and Distribution Networks for Europe and others.

Finally, it is important that the developers agree to a set of specifications for development of learning objects covering such areas as technology, editorial requirements, and stylistic considerations (Polsani, 2003) to help students, instructors and designers to find electronic resources to fit their needs, to share these resources with others or to implement them in different electronic learning environments (Littlejohn, 2003).

Challenges

The following outline some of the challenges that act to constrain the achievement of the full potential of learning objects.

Standards.

The idea that different kinds of resources are reusable in many contexts implies some degree of standardization. Without standardization it would be exceedingly difficult for teachers and students to find electronic resources to fit their needs, to share these resources with others or to implement them in different electronic learning environments (Wiley, 2000a; Littlejohn, 2003).

Currently there is a significant ongoing dialogue on standards. However, the process of describing large resources with metadata is problematic: it is time-consuming for resource authors to carry out (Littlejohn, 2003; Richards, 2002).

How Learning Objects Support Student Learning.

While there are undoubtedly advantages to the development of these learning objects, most researchers have overlooked the most important aspect of the tools – how they support student learning. The discussion on learning objects thus far has focused largely on their design and technical development (Orrill, 2001).

A learning objects approach could be used effectively to support learning, however, learning is a complex affair, and much work has yet to be done to devise effective ways of building learning tools that encourage collaboration, or discovery learning, for example (Johnson, 2003). Moreover, the current practices which focus on the information delivery model of using learning objects fails to provide solutions for many learning environments (Orrill, 2001).

Size/Granularity.

The most difficult problem facing the designers of learning objects is that of “granularity” (Wiley, et al., 1999). The size of a learning object is crucial to achieving success in its reusability (Polsani, 2003). Traditional instructional designers may tend to gravitate towards large objects, while smaller objects are required for maximum reuse potential and flexibility (Douglas, 2001). In general, the smaller or more granular a resource, the greater the possibility of its being reused in another educational context. For example, an individual image is likely to be more readily reused than an entire course (Downes, 2000; Littlejohn, 2003). On the other hand, larger resources usually have greater educational value: it may be less time-consuming for a teacher to reuse a larger resource, such as a learning activity, rather than to construct an activity from many small, basic components (Littlejohn, 2003) (see Figure, 1).

Oliver (2001) argued that the notion of grain size and scope of learning objects is an area that requires immediate attention.

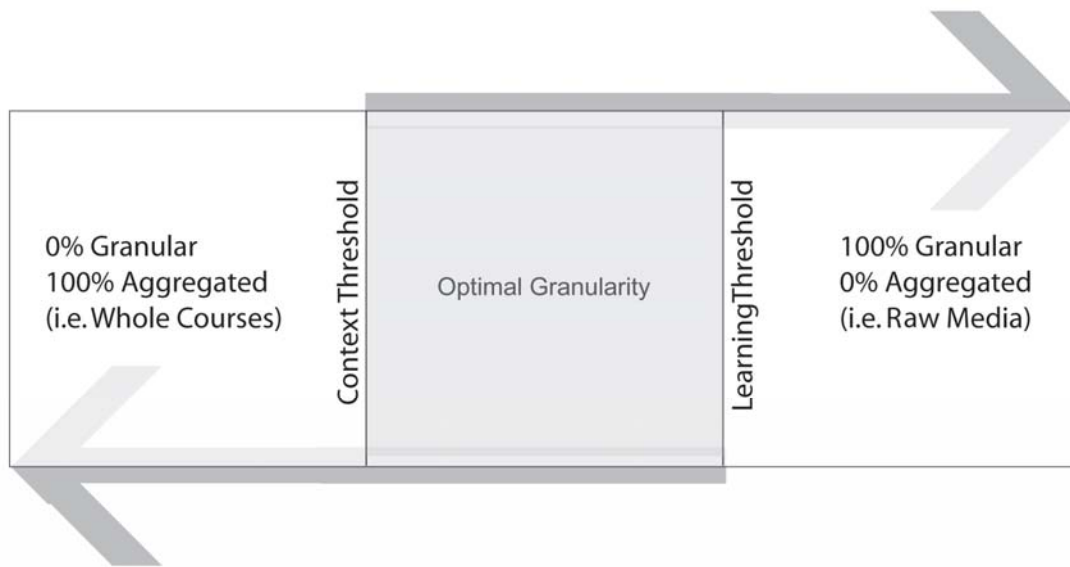


Figure 1. LO size, adapted from (Thorpe, Kubiak and Thorpe, 2003 p.113).

Context.

While modern learning theories increasingly emphasize the importance of context in learning, in contrast, the theory behind learning objects is that for maximum reuse, they should be context free and contain no information specific to a particular subject discipline (Naeve, 1999; Littlejohn, 2003).

Ideally, instructional designers should decontextualize a learning object and then learning object users should select and contextualize the appropriate object based on their needs. However, “Instructional designers of learning objects problematically focus on removing as much context as possible in order to maximize the reuse of the learning objects they create” (Wiley, 2003. p. 2). Extremely decontextualized media are actually more costly and difficult to utilize in instructional development because of (a) difficulties in indexing (tagging with

metadata) extremely decontextualized media for human discovery and use, and (b) computers' inability to make meaning, and therefore combine primitive media into instructionally meaningful units (Wiley, Recker, and Gibbons, 2001). The challenge is to effectively provide ways for designers and learners to decontextualize and contextualize respectively, the content of a learning object.

Ownership.

“For learning objects to be utilized and freely flow, issues related to ownership, copyright, and rights to use must be cleanly managed” (Stacey, 2003, Digital Rights section, para. 1). However, none of the major learning objects developers have adequately addressed ownership issues (CLOE, 2003). The issue of learning object ownership is very problematic. Many of the companies that own today's most popular content are eager to sell their content online. On the other hand, there is no easy, convenient e-business model for completing this transaction (Stacey, 2003).

The issue of ownership is very complicated. Moreover, permissions and fees for using digital content require a system for tracking and collecting, and such a system has not been developed (Stacey, 2003).

Evaluation of Learning Objects.

Williams (2002) argued that evaluating the object in one context does not necessarily answer the question of how it performs in another context.

Consistent with Williams's argument, Wiley, (2002) stated the following:

“There has been a clamor for an archive of peer-reviews of learning objects and other instructional materials, so that a busy teacher could drop in and find effective resources quickly. Unfortunately, most of what we currently know about evaluation tells us that the best evaluations are those most closely tied to the context of use of the evaluation data. This is problematic because evaluations of a learning object (supposedly useful in a variety of instructional contexts) must focus on a single instructional context (to be optimally useful), thus telling the teacher nothing about how the object will function in her own instructional context (unless she happens to be planning to deploy the object in exactly the same context as the reviewer foresaw) This has to be addressed.” (Wiley, 2002, para. 2).

Summary

There is currently considerable debate within the global teaching and learning community regarding the potential of reusable learning objects to fulfill diverse pedagogical requirements (Littlejohn, 2003). Learning objects will be reused only if they can be easily located, evaluated, and adopted by educational practitioners. In order to facilitate this process of resource description, discovery and evaluation it is crucial that learning objects be appropriately described; classified and indexed using standard metadata and vocabularies. Without metadata, teachers and learners will never have the opportunity to exploit the full potential of reusable learning objects (Littlejohn, 2003).

Instructional technology researchers have emphasized reuse of LOs as a way to increase teacher efficiency, lower development costs, reduce the level of technical skill required to create online instruction, and shorten development schedules (Sumner & Dawe, 2001). Although we are not generally accustomed

to reusing resources developed for one purpose for other purposes (Doiron & Davies, 1998), it is evident that learning objects are one of the most meaningful and effective ways of creating online learning resources (Polsani, 2003) and it is highly likely that the principles of learning objects will soon become common elements of online learning design and development at all levels (Oliver, 2001). However, there is as much work to be done in areas of implementation to optimize the use of learning objects in the worlds of education and industrial training (Richards, 2002).

Electronic Performance Support Systems (EPSSs)

According to the electronic performance support system approach, “knowledge and procedures are best learned on the job while being supported just-in-time digitally with tools and templates that are relevant to the tasks, mini-tutorials aimed at a specific sub-task, an information base of data and a set of guides to support the performance as it is being carried out” (Gery, 1991, p. 21).

Sacha Cohen (1998 p. 54) defines Electronic Performance Support System (EPSS) as “an integrated computer application that uses any combination of expert systems, hypertext, embedded animation, and/or hypermedia to enable a user to perform a task quickly in real time and with a minimum of support by other people”.

According to Gustafson (2000) organizations increasingly are showing an

interest in EPSSs as a means of enhancing worker performance. This interest is driven by a desire to promote quality performance by the most effective and efficient means possible. Examples of an EPSS may be a hypermedia database, a question-and-answer, on-line help system, or a more complete tutorial (Alessi, 1999).

An EPSS typically includes the following four components identified by Gery (1991) as in Leighton (1996):

Tools: productivity software (word processing, spreadsheet, etc.) used with templates and forms, such as a word processing document.

Information Base: on-line reference information (often called an "infobase"), hypertext on-line help facilities, statistical databases, multimedia databases, and case history databases.

Advisor: an interactive expert system, cased-based reasoning system, or coaching facility that guides a user through performing procedures and making decisions.

Learning Experiences: computer-based-training (CBT), such as interactive tutorials, as well as multimedia training using simulations and scenarios (Components of an EPSS section, para. 1).

Performance support, particularly in technology-rich work environments, shows considerable promise for helping users enhance their performance and accomplish things as they attempt to perform while reducing training time and costs (Gustafson, 2000; Hannafin, Hill, & McCarthy, 2000). Unfortunately, there is very little literature available in this relatively new field that describes how people have actually designed and developed EPSSs (Gustafson, 2000).

According to Wild (2000), EPSSs must be designed in such a way as to facilitate just-in-time learning that cuts the lag time from the moment of needing-to-know through task instruction and task practice to actual task performance. However, Alessi (1999) cautioned against the wholesale adaptation of the just-in-time learning principles. He argued that giving people easy access to information does not imply that they will learn it. The principle of just-in-time learning should also be balanced with the well documented learning principle that people learn better when they do so a little at time over a long period of time, rather than all at once (Alessi,1999). Next, two related Instructional Design theories are presented.

Review of Selected of Instructional-Design Theories

Learning theories are often confused with Instructional Design theories. In fact, Instructional Design theories are very different from learning theories. “Instructional design theories are design oriented, and are intended to provide direct guidance to practitioners about what methods to use to attain different goals, whereas learning theories are description oriented, and attempt to provide a deeper understanding of effects that result from phenomena” (Reigeluth,1999b p. 8).

According to Reigeluth (1999b), learning theory is far more difficult to figure out how to implement than it is to generate. In contrast, instructional-design theories provide guidelines for implementing learning theories. Reigeluth (1999) defined an instructional-design theory as a theory that offers explicit

guidance on how to better help people learn and develop.

Reigeluth (1999) identified the characteristics of an instructional-design theory as:

An orientation towards design, focusing on the means to attain goals for learning and development.

Identification of methods of instruction, which are ways to support and facilitate instruction, and the situations in which those methods should and should not be used.

The methods of instruction can be broken into more detailed component methods, which provide more guidance to educators.

The methods are probabilistic rather than deterministic, which means they increase the chances of attaining the goals rather than ensuring attainment of the goals.

An instructional-design theory's goal (or design) has a value or philosophy that underlies it (p 7).

According to Reigeluth and Frick (1999) there is need for instructional design theories to provide flexible guidelines for practitioners who design learning environments that provide appropriate combinations of challenge and guidance, empowerment and support, self-direction and structure (Reigeluth, 1999b).

The selected instructional-design theories have usefulness and relevance to this study for the following reasons: First, they provide guidelines to integrate resources in a learning environment. Second, each theory offers precise guidelines for the design and development of this study. Finally, constructivist-oriented theories support having rich resources available for learners to be used

in just-in-time manner.

The following are two selected instructional design theories.

Designing Constructivist Learning Environments

Objectivist conceptions of learning assume that knowledge can be transferred. On the other hand, constructivist conceptions of learning assume that knowledge is individually constructed and socially constructed by learners based on their interpretations of experiences in the world (Jonassen, 1999).

While objectivism and constructivism are usually conveyed as incompatible, that is not the assumption of Jonassen, (1999). Rather, he believes that objectivism and constructivism offer different perspectives on the learning process and he prefers to think of them as complementary design tools.

Jonassen (1999) developed a model for designing constructivist learning environments (CLEs). The CLEs model is intended to provide guidelines for designing learning environments to support constructive learning. The CLEs model conceives of a problem, question, or project as the focus of the environment, with various interpretative and intellectual support systems surrounding it. The goal of the learner is to interpret and solve the problem or complete the project. (Jonassen, 1999). CLEs assume that information makes the most sense in the context of a problem or application (Jonassen, 1999).

Jonassen (1999) provides the following major guidelines for building CLEs (See Figure 2).

- Use the question, case, problem or project as the focus for the

instruction. The problem, which drives the learning, needs to include three integrated components: the problem context, the problem representation or simulation, and the problem manipulation space.

- Provide related cases as examples to support understanding of the problem and suggest possible solutions.
- Provide rich and just-in-time information resources to help learners comprehend the problem and its principles and suggest possible solutions.
- Embed cognitive tools such as visualization, organization or automation tools to support learners' performance and provide knowledge representation formalisms that constrain the ways learners think about, analyze, and organize phenomena, and provide an environment for encoding their understanding of those phenomena.
- Support collaboration in case solutions through the use of computer-mediated communications to enable learners to negotiate and coconstruct meaning for the problem.
- Provide social/contextual support in the form of modelling, coaching, and scaffolding to help learners to implement the CLE.

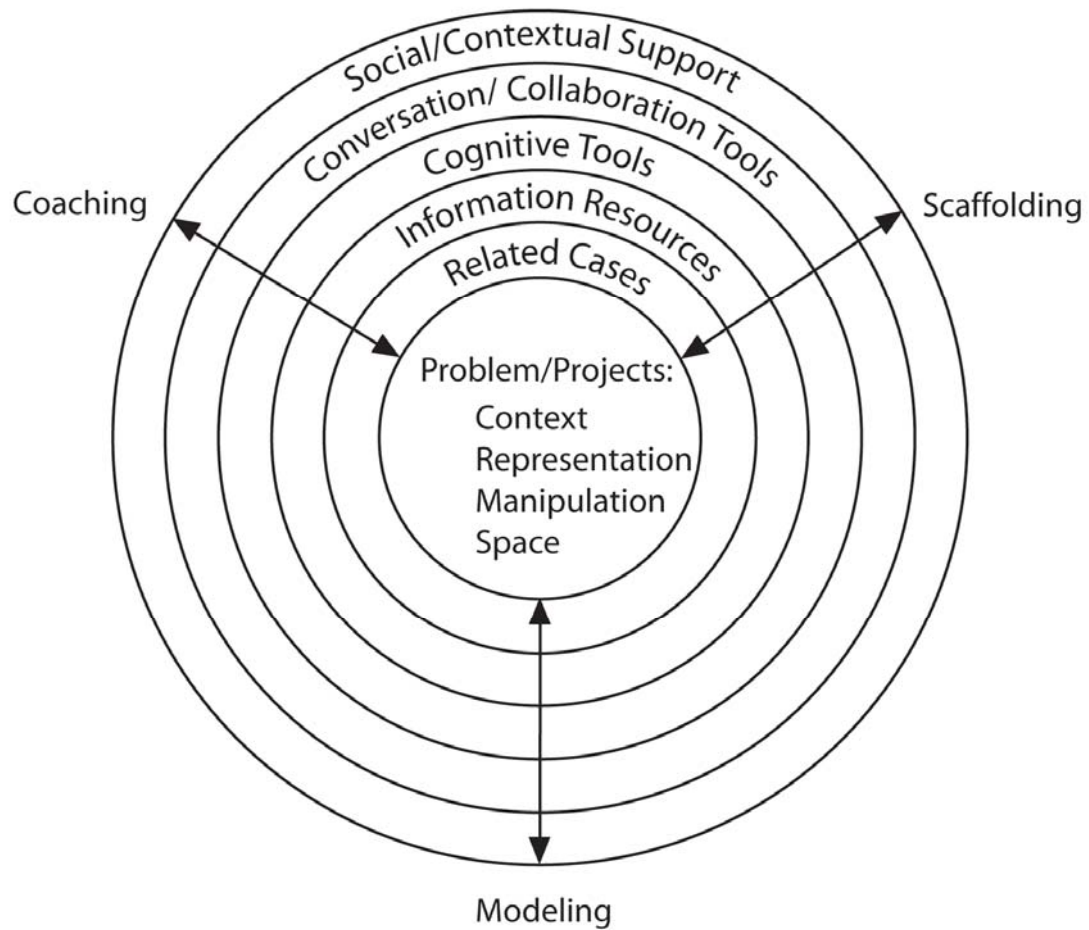


Figure 2. Model for designing CLEs adapted from Jonassen, (1999 p218).

The CLE model is intended to provide guidelines for designing learning environments to support question-based, issue-based, case-based, project-based, or problem-based learning (Jonassen, 1999).

Open-ended Learning Environment

Hannafin, Hall, Land, & Hill (1999) defined open-ended learning environments (OELEs) as learner-centered environments that facilitate the

unique efforts of learners to generate and refine meaning. The goal of an open-ended learning environment is "to immerse learners in rich experiences, using various tools, resources, and activities with which to augment or extend thinking" (Hannafin, Hill, & Land, 1997, p. 97).

In OELEs the learners become actively involved in their learning by interacting with their environment and actively constructing meanings to make sense of the world (Hannafin, Land & Oliver, 1999; Hill & Land, 1998). According to Hannafin, Land & Oliver, (1999) the OELE has the following assumptions:

- Multiple perspectives are valued over a single "correct" perspective.
- The students' determination of how, when and what to learn is supported.
- More responsibility for the learning process must be taken by learner.
- The intents and purposes of the individual are uniquely established and pursued.

Open-ended learning environments (OLEs) include the following four components:

- Enabling contexts: enabling contexts provide realistic frameworks wherein problems are situated;
- Resources: resources allow students to frame and resolve problems;
- Tools: help learning to manipulate features, processes and concepts and easy access to information in a just-in-time fashion.

- Scaffolds: scaffolds guide learners' problem-solving strategies or processes.

Open-ended learning environments (OELEs) use the capabilities of technology to provide students with opportunities to engage in authentic problem solving; generate, test, and revise hypotheses; explore and manipulate concepts; and reflect on what they know (Land, 2000).

Review of Existing Reusable Online Resources

Over the years, a number of online resources based on the idea of learning objects have been developed. Three of them are particularly important and will be reviewed here. The MERLOT (the Multimedia Educational Repository for Learning and Online Teaching), GEM (The Gateway to Educational Materials) and WORC (The Wisconsin Online Resource Center) were chosen to be discussed in this section because they have shown that the learning object approach can be useful in designing online learning resources. Additionally, those three projects provide a set of best practices and guidelines for online learning resources developers to incorporate a learning object approach in designing online learning resources.

MERLOT

Supported by twenty-three partner organizations in the U.S. and Canada, the Multimedia Educational Resource for Learning and On-Line Teaching (MERLOT) is a high quality collection of interactive learning objects designed

primarily to improve learning and teaching within higher education.

The Multimedia Educational Resource for Learning and Online Teaching -- is a free, peer-reviewed collection of over 8,000 different online learning objects including high quality simulations, animations, tutorials, exercises, and other organized learning materials developed primarily by faculty and students from all over the world. MERLOT's collection could be browsed by the following subject area; Arts, Business, Education, Humanities, Mathematics, Science and Technology, and Social Sciences.

Search Materials: [GO](#)
[advanced search](#) | [search more digital libraries](#) | [search tips](#)

[join now](#) | [log in](#)

[Home](#) | [Communities](#) | [Browse Materials](#) | [Contribute Material](#) | [Member Directory](#) | [Help](#)

Browse Materials by Subject

Click on the ► symbol to see sub-categories. Click on the category name to see items in that category.

Browse Path: All

► [Arts \(252\)](#) ► [Business \(1480\)](#) ► [Education \(1237\)](#)
► [Humanities \(1473\)](#) ► [Mathematics \(635\)](#) ► [Science and Technology \(4104\)](#)
► [Social Sciences \(752\)](#)

Browse By Subject Area:

To browse materials by subject, click the desired subject above. Categories with subcategories will have a triangle next to them. Clicking on this triangle will refresh the page with the subcategories. Clicking on the category links will display the materials in that subject category in place of this text. To continue browsing additional materials, click on the page numbers at the bottom of the hitlist. The numbers in parentheses indicate the approximate number of materials in each subject category. [More Help?](#)

[Request New Subject Category](#) | [View Subject Index](#)

[home](#) | [communities](#) | [browse materials](#) | [contribute material](#) | [member directory](#) | [help](#)
[site index](#) | [contact us](#)

Figure 3. Browse materials page captured from

(<http://www.merlot.org/artifact/BrowseArtifacts.po?firsttime=true>) Used with permission.

The following are some of the main characteristics of MERLOT:

- Reusability: MERLOT provides faculty, who do not have the time to develop learning objects, a way of easily and freely incorporating material into their course and syllabus.
- Metadata: Every learning object has descriptive information, metadata, allowing it to be easily found.
- Sharable: These learning objects can be shared through the Internet.
- High quality: Within each discipline, MERLOT faculty expert reviewers select and evaluate the learning objects; developing professional standards for online learning objects, engaging in peer review processes similar to those used for scholarly works, and providing a mechanism to validate and share high quality work. In addition, the usability and the effectiveness were evaluated by user's comments.

Items 1 - 10 shown.


Title	Author	Date Entered	Rating	Item Type
The Fugues of the Well-Tempered Clavier (Collection)	Author: Dr. Timothy A. Smith and Dr. David Korevaar			
The Fugues of the Well-Tempered Clavier is a site that provides interactive multimedia analyses of...				Peer Reviews (1) avg:★★★★★ Member Comments (none) Assignments (none) Collections (5)
Location: http://jan.ucc.nau.edu/~tas3/wtc.html				
Added: Jun 3, 2003				
Kennedy Center Millenium Stage (Collection)	Author: Kennedy Center for the Performing Arts			
Free Performances Every Day! No Tickets Required! Performance Time: 6 p.m. Eastern! The John...				Peer Reviews (1) avg:★★★★★ Member Comments (1) avg:★★★★★ Assignments (none) Collections (4)
Location: http://kennedy-center.org/programs/millennium/				
Added: May 16, 2001				
Acoustics and Vibration Animations (Animation)	Author: Dan Russell			
This site contains an excellent set of animations and notes on the behavior of sound and sound waves...				Peer Reviews (1) avg:★★★★★ Member Comments (2) avg:★★★★ Assignments (none) Collections (4)
Location: http://www.gmi.edu/~drussell/Demos.html				
Added: Jun 13, 2002				
Principals of Audio-Rate Frequency Modulation (Reference Material)	Author: Jeffrey Haas			
Introduction to the principals of frequency modulation.				Peer Reviews (1) avg:★★★★★ Member Comments (none) Assignments (none) Collections (2)
Location: http://www.indiana.edu/~emusic/fm/fm.htm				
Added: Jan 7, 2002				
DanceDrummer.com (Simulation)	Author: Kevin O'Sullivan			
This site contains a variety of movies, notation files, and links designed to introduce the...				Peer Reviews (1) avg:★★★★★ Member Comments (none) Assignments (none) Collections (1)
Location: http://www.dancedrummer.com/				

Figure 4. Browse materials page captured from

(<http://www.merlot.org/artifact/BrowseArtifacts.po?firsttime=true>). Used with permission.

There are three levels of participation in MERLOT:

- Anyone can use the OPEN resource to locate learning objects for incorporation into Web-enhanced or online courses.
- Individual members can locate and submit objects, write lesson assignments, and post user comments.
- Faculty Peer Reviewers can participate on discipline-based teams that conduct scholarly reviews of online learning materials.

The validated learning objects listed on MERLOT are available to faculty and students throughout the nation and world. The learning objects can be used in multiple contexts for multiple purposes.

The Gateway to Educational Materials

Sponsored by the U.S. Department of Education, The Gateway to Educational Materials (GEM) attempts to provide educators with quick and easy access to thousands of learning objects.

GEM's goal is to solve the resource discovery problem and improve the accessibility of the educational materials.

The four major objectives addressed by the GEM project (Sutton, 1998) were to:

- Define a semantically rich metadata profile and domain-specific controlled vocabularies necessary to the description of educational materials on the WWW;
- Develop a concrete syntax and well-specified practices for its application using current HTML specifications;
- Design and implement a set of harvesting tools for retrieving the metadata stored as HTML meta tags; and
- Encourage the design of a number of prototype interfaces to GEM metadata.

TheGateway.org ? Help Contact Us Home

The Gateway to Educational MaterialsSM

The key to one-stop, any-stop access to high quality lesson plans, curriculum units and other education resources on the Internet.

Try our experimental search engine.

1. Search by:

2. Search by:


Search by Broad Subject:

Search by Narrower Subject:

Select all grades / educational levels that apply:

<input type="checkbox"/> Pre-K	<input type="checkbox"/> K	<input type="checkbox"/> 1st	<input type="checkbox"/> 2nd	<input type="checkbox"/> 3rd	<input type="checkbox"/> 4th	<input type="checkbox"/> 5th
<input type="checkbox"/> 6th	<input type="checkbox"/> 7th	<input type="checkbox"/> 8th	<input type="checkbox"/> 9th	<input type="checkbox"/> 10th	<input type="checkbox"/> 11th	<input type="checkbox"/> 12th
<input checked="" type="checkbox"/> All	<input type="checkbox"/> Community College			<input type="checkbox"/> Vocational Education		
	<input type="checkbox"/> Higher Education			<input type="checkbox"/> Adult / Continuing Education		

I want ONLY free resources


 The Gateway to Educational MaterialsSM Project is sponsored by the
 U.S. Department of Education

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- Search
- Browse Subjects
- Browse Keywords

NEW & NOTEWORTHY

- New Resources

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Figure 5. The Gateway Search page captured from (<http://www.thegateway.org/>). Used with permission.

Visitors may browse the resources by subject or keyword by following the links in the left-side menu or searching by specific grade level and subject area using keywords, title, or description (Jobe, 2002).

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The Gateway to Educational MaterialsSM

Topics:

Arts
 Architecture, Art therapy, Careers, Computers in art, Dance, Drama/dramatics, Film, History, Informal education, Instructional issues, Music, Photography, Popular culture, Process skills, Technology, Theater arts, Visual arts

Educational Technology
 Audio-visual equipment, Careers, Educational media, History, Informal education, Instructional issues, Integrating technology into the classroom, Language laboratories, Multimedia education, Process skills, Staff inservice, Technology, Technology planning

Foreign Languages
 Alphabet, Bilingualism, Careers, Cultural awareness, Grammar, History, Informal education, Instructional issues, Linguistics, Listening comprehension, Process skills, Reading, Speaking, Spelling, Technology, Vocabulary, Writing

Health
 Aging, Body systems and senses, Careers, Chronic conditions, Consumer health, Death and dying, Disease, Environmental health, Family life, History, Human sexuality, Informal education, Instructional issues, Mental/emotional health, Nutrition, Process skills, Safety, Smoking, Substance abuse prevention, Technology

Language Arts
 Alphabet, Careers, Debate, Grammar, Handwriting, History, Informal education, Instructional issues, Journalism, Listening comprehension, Literature, Mechanics, Phonics, Process skills, Reading, Reading aloud, Speech, Spelling, Story telling, Technology, Vocabulary, Whole language, Writing (composition)

Mathematics
 Algebra, Applied mathematics, Arithmetic, Calculus, Careers, Discrete mathematics, Functions, Geometry, History, Informal education, Instructional issues, Measurement, Number sense, Number theory, Patterns, Probability, Process skills, Statistics, Technology, Trigonometry

Philosophy
 Aesthetics, Careers, Educational philosophy, Epistemology, Ethics, Existentialism, Hermeneutics, History, Informal education, Instructional issues, Logic, Marxism, Phenomenology, Platonism, Process skills, Semiotics, Technology

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Search by **Inktomi**

Figure 6. The Gateway browse subjects page captured from (<http://search.thegateway.org/>). Used with permission.

The GEM project seeks to meet the needs of educators with various levels of access to technology in the classroom, students and parents through development and wide deployment of the GEM standard in the form of a metadata element set, an accompanying array of controlled vocabularies, and a well-defined set of practices and their application” (Sutton,1998, p. 693).

The Wisconsin Online Resource Center

The Wisconsin Online Resource Center project is a Web-based teaching, learning, and assessment resource center for instructors to use when designing

or revising online courses (WORC, 2003). The goals of the project are to accelerate the development of quality online learning objects while, at the same time, minimizing the cost of course development by identifying and sharing best practices.



Figure 7. the WORC front page captured from (<http://www.wisc-online.com>). Used with permission.

Based on the notion of learning objects, the faculty of the Wisconsin Technical College System with the assistance of the Wisc-Online multimedia development team, developed “learning objects” (activities, text, animation,

graphics...) for each competency within the General Education courses of Communication Skills, Social Studies, Math, Science, and Adult Basic Education.

The Wisconsin Online Resource Center's definition for Learning Objects has the following components:

Each learning object can be taken independently.

A single learning object may be used in multiple contexts for multiple purposes.

Learning objects can be grouped into larger collections of content, including traditional course structures.

Every learning object is tagged with metadata that allowing it to be easily found by a search.

Learning objects let you have learning that is:

just enough - if you need only part of a course, you can use just the learning objects you need,

just in time - because learning objects are searchable, you can instantly find and take the content you need, and

just for you - learning objects allow for easy customization of courses for a whole organization or even for each individual (WISCOOnline, 2003, What are Learning Objects section, para. 1).

The screenshot shows the Wisconsin Online Resource Center website. At the top left is the logo for "Wisc-Online" with "Wisconsin Online Resource Center" underneath. To the right is the title "Wisconsin Online Resource Center" in a green, cursive font. Below the title is a search bar with the text "Search objects for:" and a "Search" button. Underneath the search bar are two links: "Sort objects alphabetically." and "Sort objects by date." On the left side, there is a vertical menu of buttons for various categories: ABE/ESL, Business, General Education (which is selected with a small black dot), Health, Professional Development, Service, Technical, Image Library, About, Contacts, Copyright, Faculty Builders' Resources, Linking Learning Objects, Teaching With Learning Objects, and Track Your Learning Object. The main content area displays a list of learning objects. The first object is titled "Circle of Familiars" by Gary Briggs-Deneen, dated 3/19/2001, from Lakeshore Technical College. The second is "Examining the Free Exercise Clause of the First Amendment" by Therese Nemeec, dated 2/22/2002, from Fox Valley Technical College. The third is "Families Around the World" by Therese Nemeec, dated 3/21/2002, from Fox Valley Technical College. The fourth is "Families Around the World - Birth Rates" by Therese Nemeec. Each object entry includes a small Wisconsin map icon and a "General Education" label.

Figure 8. Learning objects page captured from (<http://www.wisc-online.com>). Used with permission.

The learning objects are freely available online, instructors have the option to pick and choose from a menu of the learning objects to customize their online courses and their face to face courses.

The overall purpose of the Wisconsin Online Resource Center is to direct online learning resources toward the goal of increased access to high quality educational interactive learning objects.

Summary

Internet technologies offer considerable promise for educators due to the ability to catalog, reuse and classify digital resources (Hill & Hannafin, 2001). However, current practices may prove insufficient in optimizing and developing online resources. The literature review suggests that the instructional designer needs to move from an approach that is oriented towards creating large integrated packages such as a textbook, long instructional movies, and prepackaged instructional software programs, to one in which designers create smaller chunks of material by breaking down the content packages into smaller assets. The goal of this process is to make those objects reusable in a number of different contexts. While there are undoubtedly advantages to the use of learning object approach, there are challenges that facing the designers of learning objects such as standards, granularity, ownership and the evaluation and how learning object could be used to support student learning.

Based on the idea of learning objects, a number of online resource projects have been developed. Three of them are particularly important and will be reviewed here. The MERLOT (the Multimedia Educational Repository for Learning and Online Teaching), GEM (The Gateway to Educational Materials) and WORC (The Wisconsin Online Resource Center) were chosen to be discussed in this chapter because they have shown that the learning object approach can be usefully integrated in designing online learning resources. Additionally, those three projects provide the “best practices” models and guidelines for online learning resources developers to incorporate a learning

object approach in designing online learning resources.

Instructional design theories introduced in this chapter are intended to provide models, strategies and guidelines in designing learning resources. Jonassen (1999) developed a model which provides guidelines for designing learning environments to support constructive learning. A problem, question, or project is/are the focus of the environment, with various interpretive and intellectual support systems surrounding it. One of the main supports is the learning resource which provides rich and just-in-time information to help learners comprehend the problem and its principles and suggests possible solutions.

Hannafin, Land & Oliver (1999) also developed a model called open-ended learning environments (OELEs) where the learners become actively involved in their learning by interacting with their environment and actively constructing meanings to make sense of the world (Hannafin, Land & Oliver, 1999; Hill & Land, 1998). In open-ended learning environments, learner determine how, when and what to learn.

Finally, the literature clearly established the need for reusable online resources in general (throughout the research and development, further needs assessment will be conducted to establish the need for reusable online resources for the context of this study). The literature has also led the researcher to the conclusion that the online learning resources which include the identified principles of learning objects and function as EPSS is a viable solution to the research problem of this study. In addition, literature has also led the researcher

to answer the research question of this study by determining the characteristics of successful online resources. Figure 9 shows the relationship among different parts of this literature review.

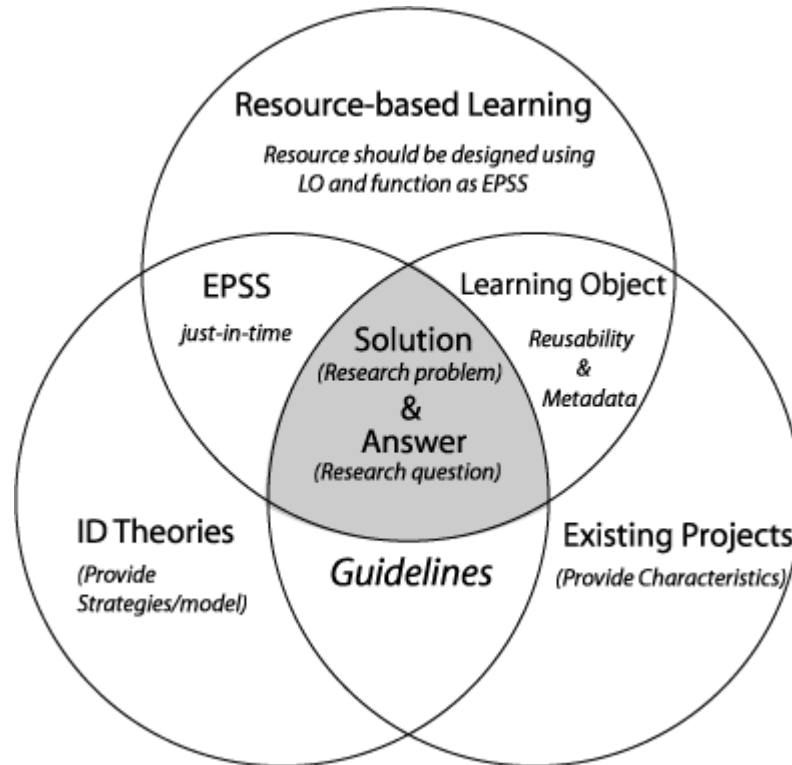


Figure 9. Shows the relationship among different part of literature review.

In this study, the reusable online resources to be developed in this study will function as an Electronic Performance Support System (EPSS). According to the EPSS approach, “knowledge and procedures are best learned on the job while being supported just-in-time with computer tools and templates that are relevant to the tasks, mini-tutorials that are relevant to a specific sub-task, an

information base of data and a set of guides to support the performance as it is being carried out” (Gery, 1991, p. 21).

Chapter Three: Methodology

This chapter discusses the research methodology used in this study. It first offers a brief outline of research and development methodology, and then continues with a detailed description of the research design for this study.

Using the research and development model (Borg and Gall, 1989), the researcher iteratively developed and revised the ID-RORs for instructional design students at ATC based on feedback gathered from experts and potential users through formative evaluation. Between each round of qualitative formative evaluation, the ID-RORs were revised based on analysis of the data.

The research and development (R & D) was chosen for the following reasons:

- The purpose of this study involves development of online resources. The R & D is the only recognized method that is appropriate for that purpose.
- Additionally, the R&D method has these features which fit well with both the researcher's beliefs about how to best develop software tools:
 - R&D involves continuous collaboration among researchers and practitioners.
 - Researchers and practitioners are equal partners in

investigating and understanding the usage of the prototype.

- Finally, the R & D methodology was found to be a very effective way to fill the gap between theory and practice.

A literature review of research and development (R & D) methodology (see the next section) has led me to conclude that R & D is most appropriate for the questions that are being asked, namely,

- What characteristics should valid and practical reusable online recourses for Instructional Design students have in the context of Abha Teachers' college?
- Can a set of learning objects be developed that meets these criteria for ATC Instructional Design students?

Research and Development Methodology

The traditional view of research used to be discovery of knowledge. Research and development is the translation of that knowledge into a useful form in practice (Richey & Nelson, 1996; van den Akker, 1999; Richey, 1997; Gall, and Borg, 1996). In reality, “a disconnect often exists between research and practice. The goal of R & D is to bridge the gap between research and practice to create field tested products that are ready for operational use in the schools” (Borg and Gall, 1989, p. 781).

R & D has been utilized by researchers for years to develop and validate educational products. R & D consists of studying research findings pertinent to the product to be developed, developing a preliminary version of the product based on these findings, field testing it in the setting where it will be eventually used, and revising it to correct the deficiencies found in the field-testing stage (Gall, and Borg, 1996).

Educational R & D is a cycle of continuing development, testing, evaluation, and revision. The major steps in the R & D cycle used to develop ID-RORs are as following: (1) research and information collecting, (2) planning, (3) development of a prototype,(4) preliminary field testing (expert evaluation), (5) product revision, and (6) main field testing (user evaluation) (Borg and Gall, 1989).

Research and Development Procedures

Using a research and development model based on Borg and Gall (1989), the researcher iteratively and collaboratively developed and revised ID RORs based on feedback gathered through formative evaluation. Between each round of qualitative formative evaluation, ID-RORs were revised based on analysis of the data.



Figure 10. a modified R & D model (Borg and Gall, 1989).

As shown in Figure 10, the R & D process is not a systematic process; rather it is a continuous and iterative design process. The use of this iterative solution design process allowed for increase efficiency and effectiveness in making ongoing refinements and improvements to the prototype (Schaffer, 2000, p. 10). In this process, participants and the researcher collaboratively worked together to develop a potentially valuable product, identify possible product improvements, and generally provide one another with guidance in the ongoing design of the product (Schaffer, 2000).

The R & D model used in this study follows the following Seven Phases:

Phase 1: Research and Information Collecting

The purpose of examining literature related to reusable online resources is to help to answer the research question by the determining the characteristics of successful online resources. Based on the literature review (see Chapter 2), the following characteristics were considered:

- In the context of this study, the learning resources will be reusable, and tagged with metadata.
- The content of the ID-RORs will be designed/chosen to be closely related to Instructional Design as s subject area and function as resources in just-in-time manner.
- The layout and design will be consistent.
- Organization and presentation of information will be clear.
- The navigation will be consistent and easy to use.
- The design and graphics will be aesthetically pleasing.

Phase 2: Needs assessment

The purpose of the needs assessment was to provide information to guide decisions about aligning an interactive learning system with important needs of specific audiences (Reeves, 2003 p,119)

A needs assessment was conducted to determine whether there was an important educational need for creating the proposed ID-RORs (see Chapter Four).

The selection of the experts was based upon the following criteria: a) currently in a position of instructional technology in a recognized SA university, b) agreed to participate in evaluation by signing informed consent forms (see Appendix A), c) knowledgeable about the context of this study, and d) had published paper(s) in one of the following area; learning object, e-learning, and/or instructional design.

Six experts met those selection criteria, four of them agreed to participate to be part of the experts' evaluation evaluate the ID-RORs.

Needs Assessment Procedures

At the start of each evaluation meeting, for about five to ten minutes, the researcher gave a brief introduction of the main aims of the ID-RORs as well as the aim of this evaluation.

After the introduction, each participant was invited to read the ID-ROR proposal (the first three chapters of this dissertation). After the participants finished reading the proposal, the researcher made sure that the participant had a clear understanding of the proposal by talking with them about it. In addition, any questions about the proposal were answered. Following that, a series of short interviews of each participant were conducted, separated by a day or two. In other words, each participant was interviewed separately in his office with no one else around, and then interviewed again in a couple of days. The participants' answers, comments and suggestions were documented in a MS Word file.

After each interview, the researcher summarized the main points of that discussion, and made sure that there was no misinterpretation of the participant's words by asking him to visit a summary of his words during the next interview.

In addition, the researcher shared his findings with the experts and discussed the findings. The same procedures were used for each interview during the needs assessment evaluation.

During the needs assessment, many comments and suggestions were collected from the participants. In the following section, the results of those comments and suggestions are summarized.

Phase 3: Prototype

Based on previous phases, a preliminary prototype was developed. Initial work was designed mainly using Flash MX, Adobe Photoshop 7, Adobe Illustrator 10, and Dreamweaver MX. The prototype was ready for field evaluation at the end of March 2004. Description of the prototype will be introduced in Chapter Four of this study.

Phase 4: Expert Evaluation

The main purpose of the expert evaluation was to determine whether the ID-RORs accomplish its design criteria within the immediate or short-term context of their implementation (Reeves & Hedberg, 2003, p 61). The second purpose was to obtain an initial qualitative evaluation of the prototype validity. The third purpose was to use the results of the evaluation to revise the product.

The same four experts who participated in the needs assessment were

invited to evaluate the ID-RORs. All of them agreed to participate. Each one received a small gift for participation. All participants were working at ATC.

Experts Evaluation Procedures

The aim of this part of the evaluation was briefly explained to the expert at the beginning of each meeting. Additionally, the expert was given a general idea of what ID-RORs were, and more specifically what were the aims, structure, functionality and design elements of this particular ID-ROR.

Each participant was individually asked to use the ID-ROR prototype in his office using his computer. During this process, informal short interviews (5 -15 min.) and observations were taking place simultaneously and iteratively while the expert was trying the ID-RORs. The discussion focused mainly on the validity of the ID-ROR for the intended target users at ATC.

As the researcher went from one expert to another asking questions about the ID-RORs, there were six rounds of this evaluation, each round focused on one part of the ID-RORs.

The discussion, suggestions, comments and field notes were entered into the MS word Hierarchical Classification System (see Appendix D) designed by the researcher. The data were organized and categorized into four categories, (suggestions, positive, negative and others) and documented in MS Word.

Afterwards the data were then simplified, concentrated and combined including only those data relevant to the evaluation questions and omitting

irrelevancies. After each interview, conclusions were drawn from the data. The researcher returned to the data sources to confirm and test the finding, checked the finding for accuracy and made sure there was no misinterpretation of the finding.

Then, the tested findings were transformed into improvements in the ID-RORs. The changes in the ID-RORs, based on the findings, were retested by having the modified ID-RORs as the starting point for the next round of the evaluation. As the same procedures were repeated for each meeting, the researcher shared his findings with the participants. The main points of the participants' comments and suggestions are described as follows.

Phase 5: Redesign

Revisions were made to the prototype based upon the recommendations of the experts.

Phase 6: User Evaluation

The best product designs result when the product's designers are involved in collecting and interpreting users data and appreciate what real people need (Beyer & Holtzblatt,1999). The purposes of the user evaluation were to: (a) measure the usability/practicality of the prototype, (b) identify users' needs, (c) identify strengths and weaknesses in the ID-RORs as well as ways to improve them, and (d) use the results of this evaluation to revise the prototype.

Eighty undergraduate male students were enrolled in the Instructional Design course for the summer 2004. Eleven of them agreed to participate in the

study. The following criteria were used to determine the selection of the students:

- a) they must be enrolled in the Instructional Design course for the summer 2004;
- b) they must agreed to sign an informed consent form (see Appendix A) before participating in the study;
- c) they must be familiar with using the computer and Web technology; and
- d) they must have an email account.

User Evaluation Procedures

The researcher followed a procedure similar to that used with the experts. The following procedures were performed in each evaluation meeting. Each interview focused on one part of the ID-RORs. The aims of this evaluation were briefly explained to participants at the beginning of each meeting. Additionally, the participants were given a general idea of what ID-RORs are, and more specifically its aims, structure, functionality and design elements.

Eighty undergraduate male students were enrolled in the Instructional Design course for the summer 2004. Eleven of them agreed to participate in the study. The participants who had agreed to participate in this evaluation were asked to take the Instructional Design course online and to integrate the learning objects in their Instructional Design activities. The participants were told in the first week of class that Internet access would be required for this course.

Informal short interviews and observations took place for all participants of the selected students while and/or after using the ID-RORs. During this process, participants were encouraged to discuss with the researcher about their

experience using ID-RORs. The discussion focused mainly on the advantages and disadvantages of a specific part of the ID-RORs, and how to improve it. There were five rounds of this evaluation. Each short interview focused on one part of the evaluation.

During the face-to-face observation/interview with students from the Instructional Design course (Summer, 2004) discussions, suggestions, comments and field notes as well as a thick description of the students' experiences and comments were documented in the MS word Hierarchical Classification System (see Appendix D), designed by the researcher.

Meanwhile, the researcher observed each student's working process through the records of the Web activities, and made notes of their questions, errors, comments and suggestions posted online and, periodically, interrupted them to discuss and clarify some aspect of work they performed.

The data were organized and categorized into four categories under each question, (user suggestions, user likes, user dislikes and other) and documented in MS Word. Afterwards, the data were simplified, concentrated and combined including only those relevant to the ID-RORs and omitting irrelevancies in such a way that conclusions could be drawn from.

After each round of this evaluation, conclusions were drawn from the data. The researcher returned to data sources to make sure there was no misinterpretation of the finding by asking the participant to revisit his words during the next round of evaluation.

The findings were transformed into revision of the ID-RORs. The changes in the ID-RORs, based on the findings, were retested through the next round of evaluations, by letting the users work with the modified ID-RORs with the new format. After five rounds of revision and testing, a satisfying and optimal prototype had been developed.

During the users' evaluation, many comments and suggestions were collected from the participants through observation and discussions. In this section, these comments and suggestions will be summarized.

Phase 7: Redesign

Revisions were made to the prototype based upon the results of users' evaluations.

Data Collection and Analysis Procedures

Collected data were recorded, categorized, reduced, interpreted and tested using the following qualitative data collection and analysis procedures:

1- Collecting Data

Data were collected using the contextual inquiry method developed by Beyer and Holtzblatt (1998). This strategy was used because of its ability to combine face-to-face interviews and observations where the researcher observed users performing their usual tasks in the context of their actual work situations and periodically interrupted them to discuss and clarify some aspect of

work just performed.

Additionally, in the contextual inquiry method, the users and the researcher are equal partners in investigating and understanding the usage of a product in the natural environment (Beyer & Holtzblatt, 1998). Finally, the contextual inquiry method is an excellent way to improve the researcher's understanding of users' needs, their work tasks, and their problems with existing products (Beyer & Holtzblatt, 1998).

Consequently, informal short interviews and live observations took place simultaneously and iteratively while user/users (individually or/and in groups) were using the ID-RORs.

2- Recording and Categorization of Data

Discussion, suggestions, comments and field notes as well as thick description of the students' experiences and comments were directly placed into the MS Word Hierarchical Classification system (see Appendix D) designed by the author. The classification system was designed according to (1) the ID-RORs central theme (learning objects content, interface) and (2) general attitude (positive, negative and suggestion).

3- Reduction and Interpretation

The researcher sorted, selected, focused, simplified, abstract concentrate, eliminated, and organized "raw" data in such a way that conclusions could be drawn from it (Miles & Huberman, 1984). Subsequently, the conclusions were transformed into actions to revise the ID-RORs.

4- Test the Finding

The researcher returned to relevant audiences and data sources to confirm and test the finding.

5- Apply the Finding

After each evaluation round of user testing, the tested finding was transformed into changes in the ID-RORs.

6- Retest the Finding

The changes in the ID-RORs based on the findings were retested through the next round of evaluation.

The Researcher's Role

Students might not speak honestly and openly about a product designed by their teacher. To avoid this problem, the researcher tried to make students feel that they could speak honestly and openly and that they were equal partners in investigating and understanding the usage of the ID-RORs. Additionally, the researcher made it clear to the participants, that their participation in the evaluation of the product would not be criticized or graded as part of the class.

The researcher taught the Instructional Design course during the summer 2004. The researcher role was, as an active learner who is trying to learn about ID-RORs from the participants' view by providing technical support to the participants. In addition to being the ID teacher, the researcher was introduced

as the ID-ROR designer and technical support person who was trying to test and improve the ID-RORs.

Trustworthiness

It has been argued that the traditional standards of reliability and validity regarding quantitative research are not always appropriate for judging the trustworthiness of a qualitative study (Guba & Lincoln, 1994).

Guba and Lincoln (1994) suggest four criteria to establish trustworthiness of a qualitative study: credibility, transferability, dependability, and confirmability. Considering Guba and Lincoln's four criteria, the following strategies were used to establish trustworthiness of this study.

- **Credibility:** Participants were asked to examine the interpretations of data for verification of the findings.
- **Transferability:** Rich, thick description of the research and development experiences, setting, participants, procedures, interactions are provided to allow others to decide if the findings are applicable to their situation.
- **Dependability:** Detailed records of data collection and data analysis decisions, field notes from interviews and observations, as well as any changes or shifts in the development and inquiry were maintained. These records are available upon request from the researcher.

- Confirmability: Triangulation was accomplished by using multiple sources of data (e.g. interview, observation and student work), and long-term observation. Finally, repeating the process of test-revise-test should help to avoid any type of misinterpretation of the gathered data.

Summary

Iteratively and continuously, the Research and Development methodology was used to design, develop, evaluate and revise the ID-RORs

Chapter Four: Results

The formative evaluation of ID-RORs consisted of three phases. The first evaluation group was comprised of four experts. The purpose of this evaluation was to conduct a needs assessment. The second phase, which used feedback from two experts and two Instructional Design teachers, was the expert evaluation. The purpose of this evaluation was to examine the validity of the ID-RORs. The third phase, based on feedback from 11 students, was the user evaluation. The purpose of this evaluation was to examine the practicality of the ID-RORs.

The results of the formative evaluations were translated into English. In this chapter, those results are presented. In addition, the developments following those results will be described. Additionally, screen shots are included in this chapter to reflect how the ID-RORs might look.

Authoring Tools Used

Macromedia Flash MX, Adobe Photoshop 7, Adobe illustrator, and Macromedia Dreamweaver MX 2004 were used in the development of the ID-RORs. Flash MX was used as the main authoring tool. Reload Editor tool (see www.reload.ac.uk) was used to generate the metadata files.

Adobe Photoshop was used to edit images. Macromedia Dreamweaver

MX 2004 was used to create the html code whereas Adobe Illustrator 9 and CorelDRAW 10 were used to create graphics. Camtasia Studio 2 was used to capture the necessary video clips in the learning objects.

Moodle (Modular Object-Oriented Dynamic Learning Environment) an Open Source courseware package (see www.moodle.org) for producing Internet-based courses was used to create the online course. Finally, MS Word 2002 was used to create some of the learning objects.

Needs Assessment

The purposes of this round was to assess the need for the ID-RORs at the ATC. Six experts were invited for the first round of evaluation. Four experts chose to participate. Each expert received a gift for participation. All participants were working at ATC.

The following main question was used to guide the interview: “Does the proposed product meet an important educational need for Instructional Design students, in the context of ATC? Why?”

Needs Assessment Results

In response to the needs assessment question, “Does the proposed product meet an important educational need for Instructional Design students in the context of Abha Teacher’s College? Why?” all participants strongly agreed that there was a need for such a product at Abha Teacher’s College.

One participant said, “No question about it, there is an immediate need for this kind of resource not just in the context of Abha Teachers College but throughout the kingdom of Saudi Arabia”.

Another participant indicated that “Yes, it is just-in-time project, at this time Instructional Design students have no access to any online support, so this would be a perfect solution”.

Another participant said, “Yes, this project will help the learner, learn better, and the teacher, teach better. This could help support the implementation of contemporary learning theory such as constructivism here (Abha Teacher’s College) and take advantage of the new technology we already have.”

Another expert said, “Yes, this would save time and effort, increase motivation, and focus on learning rather than teaching”.

The overall result from this question indicated that there was an immediate need for ID-RORs at Abha Teacher’s College.

Based on the result of the needs assessment evaluation, the initial ID-RORs prototypes were developed based on the design criteria set during the planning stage. In the next section, the main characteristics of the initial version of the ID-RORs are presented.

Overview of the Initial Version

The development of the ID-RORs started with the design of a paper prototype of the website interface (see [Figure 11](#)). The paper prototype was used because it allowed for faster changes of the interface. Based on this paper prototype the initial version of the ID-RORs was developed.

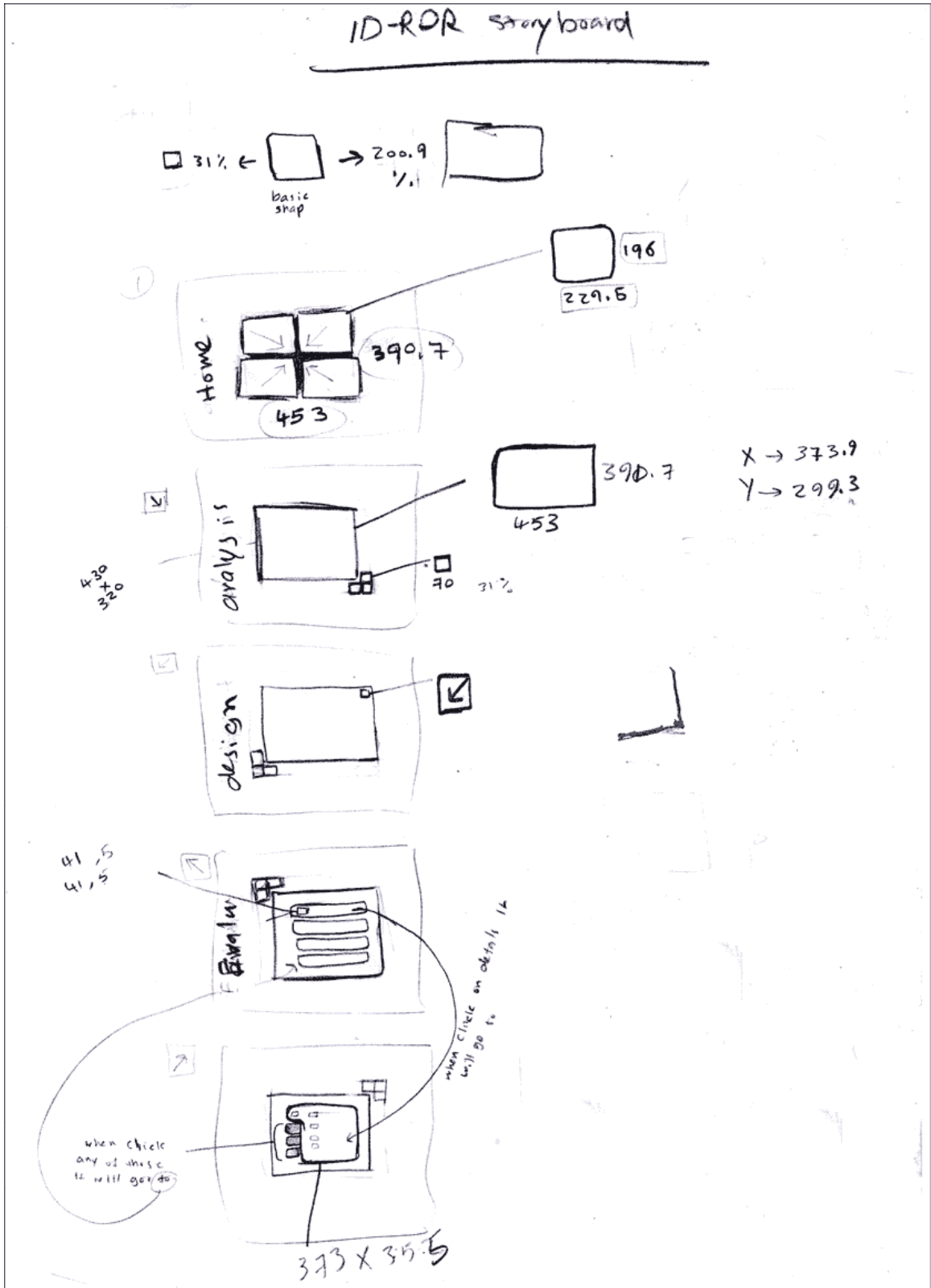


Figure 11. Paper prototype of the ID-RORs.

Initially, learning objects were developed and put together in a web site called ID-RORs (see Overview of the Final Version).

The main page of the ID-RORs contained four buttons (see [Figure 12](#)) linked to four main Instructional Design tasks: analysis, design, development and evaluation. The learning objects were organized according to the four main Instructional Design tasks. For each Instructional Design tasks, there was a list of resources, which included the learning objects related to that task.



[Figure 12](#). The front page of the flash version divided into for categories.

Once the user clicks on any of the four buttons on the main page, (see step 1, [Figure 13](#)), a related list of learning objects appears. When one clicks on any learning object title, a new window opens that includes the metadata of that learning object (see step 2, [Figure 13](#)), with two buttons-- one button labelled “open” (see step 3B, [Figure 13](#)) and the other one labelled “download” (see step 3A, [Figure 13](#)).

Depending on the user’s action, the learning object will either be shown in a new browser window, or downloaded to the user’s computer. Clicking the open button will result in a new window showing the learning object (see step 4B, [Figure 13](#)). If the user clicks on the download button, the user will have the option to save the zip package (see step 4A, [Figure 13](#)). The zip package includes the learning object file in addition to its metadata as an xml file.

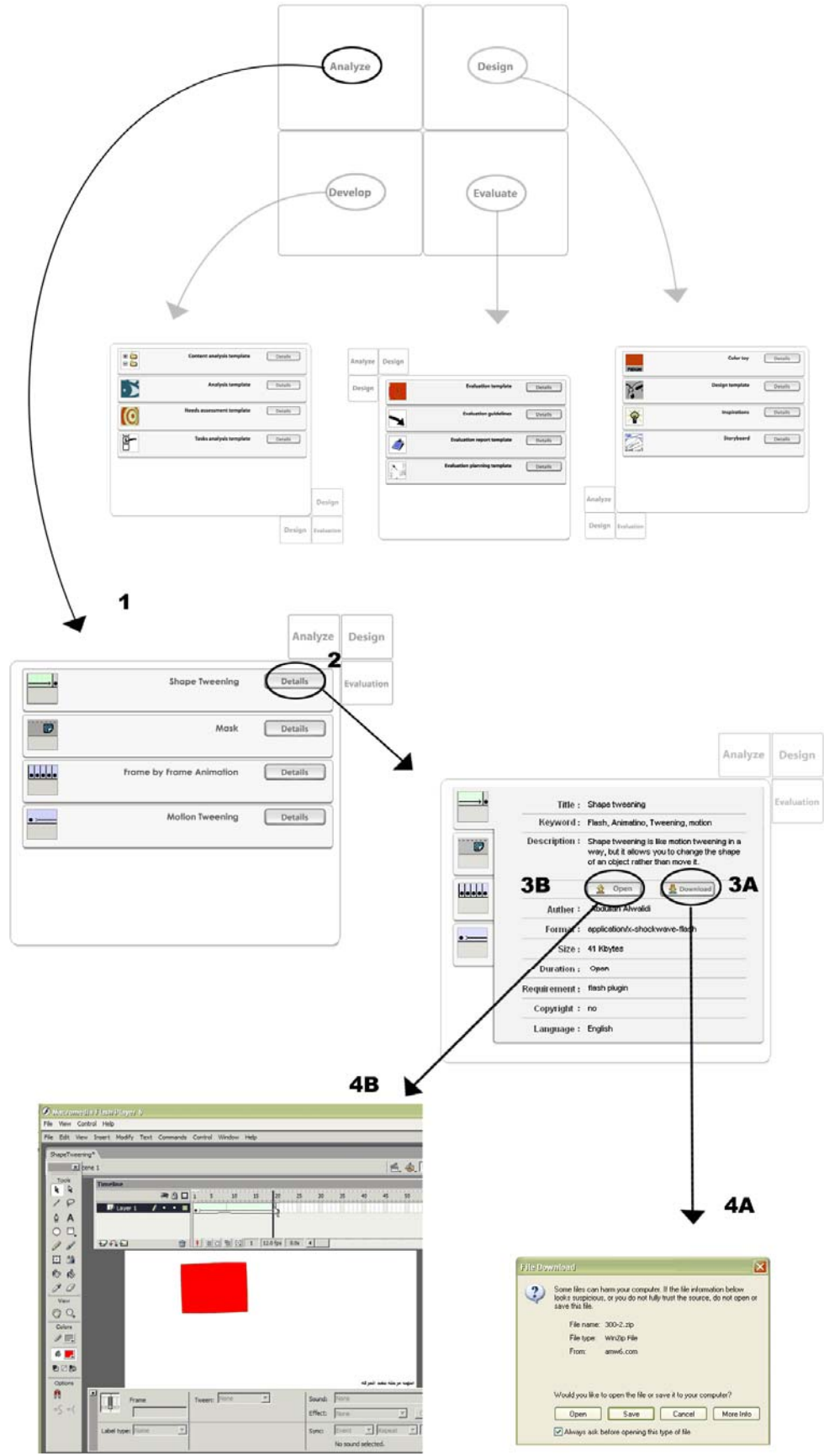


Figure 13. Storyboard show the navigation of the ID-RORs flash version.

Experts' Evaluation

During the expert evaluation, many comments and suggestions were collected from observations and discussions. In this section, these comments and suggestions, as well as the developments following them, will be summarized.

The chief purpose of the experts' evaluation was to obtain an initial qualitative evaluation of the prototype validity. The second purpose was to use the findings of the evaluation to revise the product.

The main question of this evaluation was "Are the ID-ROR prototypes valid for the intended target users? If not, what needs to be done to improve them?" In response to the question, all participants in general were satisfied with the initial design of the ID-RORs. However, some parts of the ID-RORs were modified based on the experts' feedback. Following is a summary of their suggestions and the developments that ensued.

SCORM-conformant

One expert was very interested in implementing SCORM-compliance. According to him, the main reason for that was to increase the reusability of the learning objects.

When sharing this idea with other experts, several experts had concerns about how that could be done and what the benefits would be of adding the

SCORM-compliance to the ID-RORs at Abha Teacher's College. Some experts argued that, as none of the Saudi Arabia universities and colleges have implemented SCORM, we won't be able to measure whether making ID-RORs SCORM conformant, would make them more reusable. In addition, we will not be able to share those learning objects with others.

As a result of several meetings, experts thought that further developments should explore the possibility of making the ID-RORs SCORM compliant.

Interface

The overall result showed that the experts agreed that the interface looked beautiful and clear. They thought the layout looked attractive and the design and graphics were aesthetically pleasing. Additionally, they thought that the layout and design were consistent. The same buttons are in the same positions on each different screen that could help the user experience the same interface and hence navigation in each screen.

They thought the navigation was very creative and easy to use; and that it would help users know where they are coming from and where they can go. In addition, the experts liked the idea of having a metaphor which was, according to them, used to help the user quickly understand the functionality of the buttons or screen.

Regarding the color, the experts thought that there was not enough contrast in interface color. As a result, more contrast was added to the interface color.

In addition, the experts suggested that the interface should be stretchable instead of a fixed size. According to them, this could help integrate this work in a different context. Therefore, the interface was designed to be scalable instead of a fixed size.

Reusable

Although one expert argued that the ID-RORs were subject-specific to Instructional Design, most of the experts thought that those learning objects were designed to be used in Instructional Design courses, and could be reused in other disciplines as well.

Regarding the reuse of ID-ROR learning objects, two ATC teachers thought that some of those learning objects could be reused in their courses for the following reasons:

- One of the most important reasons that encouraged them to use those learning objects was that they were validated by experts.
- Additionally, they believed the ID-RORs saved them time, money and expertise so instead of developing resources for each course, they could just use something already tested and then modify it if needed.
- The learning objects were not embedded within a “look” so that they could be repurposed within a different visual schema without losing the essential value or meaning of the text, data, or images.
- Further, as the content of those learning objects were broken down into smaller units this increases the chance for them to be reused in

different courses as well as to repackage and edit them.

Therefore, the overall result is that the ID–ROR learning objects were reusable within ATC. However, they believed that some learning objects were capable of covering a wide range of subject areas, while some were restricted to a few.

Metadata

The experts believed that the use of metadata was a very useful way to facilitate reusability.

In general, the experts liked the idea of having a metadata attached to each of learning object. Initially, the Dublin Core Metadata standard was chosen by the researcher to be attached within each learning object as part of the HTML code. The Dublin Core Metadata Generator v1.0.1, as an extension of Dreamweaver MX, was chosen by the researcher to be used to generate the metadata.

Even the experts agreed that using the Dublin standard is acceptable. They argued that most specifications and application profiles are aligning themselves with IEEE LOM, so choosing IEEE LOM would allow the ID-RORs metadata-tagged learning content to be compatible with all of them. Therefore, they recommended the use of IEEE LOM/IMS to describe the learning objects instead of Dublin metadata as a way to increase reusability. Reload Editor (see [Figure 14](#)) software was used in generating the metadata based on the IMS metadata/IEEE LOM standard.

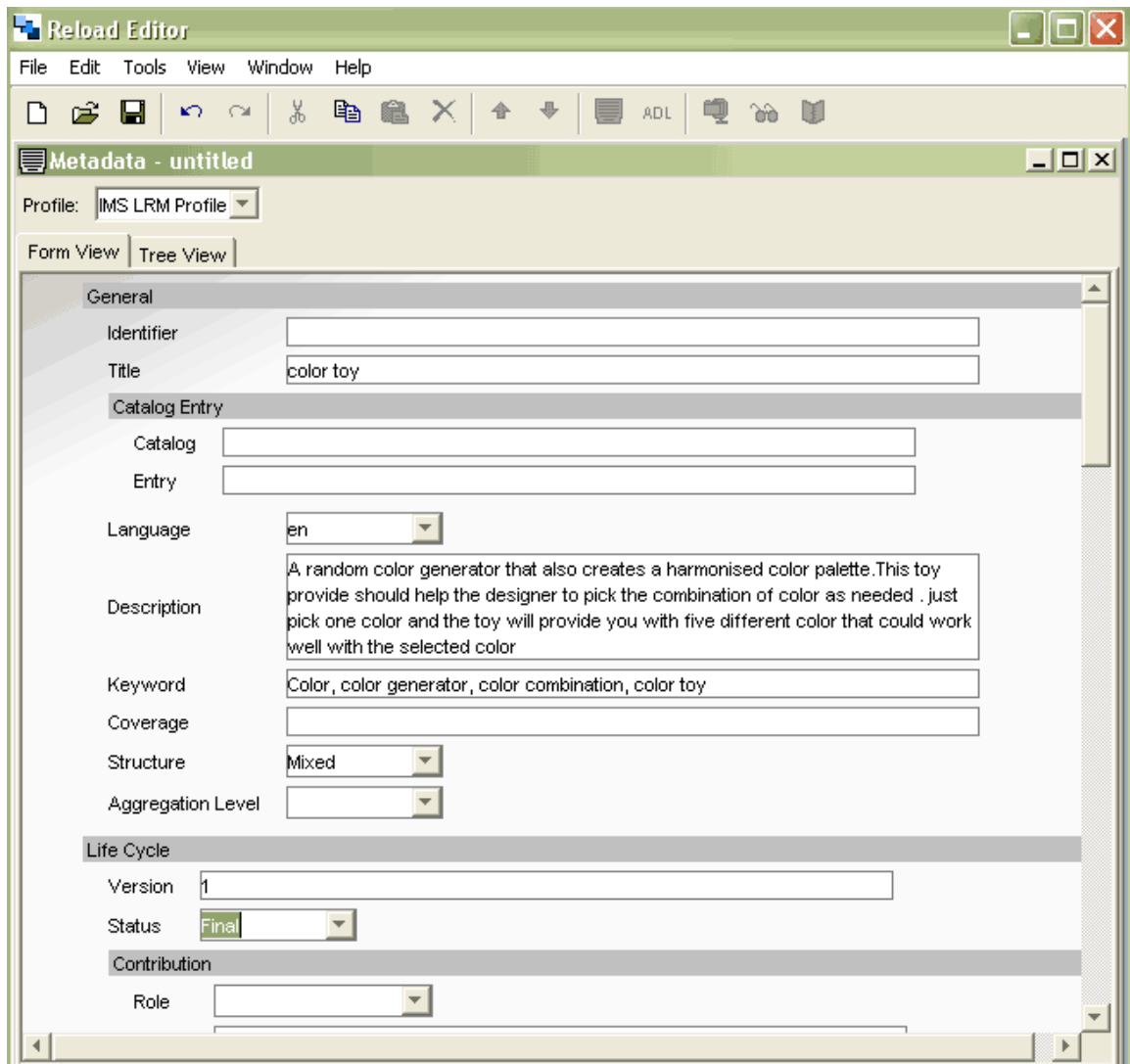


Figure 14. Reload Editor.

The metadata files (see Figure 15 for an example of XML file) were created and stored as an XML file, separately from the learning object. This has many advantages, but requires links between the metadata and the object it references. One advantage is that it is easier to update than the embedded metadata file. Also, storing metadata separately can simplify the management of

the metadata itself and facilitate search and retrieval. Metadata are commonly stored in a database system and linked to the objects described. However, the database system was not implemented as part of the ID-ROR due to the limited number of learning objects integrated in the ID-ROR.

```
<?xml version="1.0" encoding="UTF-8"?>
<!--This is a Reload version 1.2 Metadata document-->
<!--Spawned from the Reload Metadata Generator - http://www.reload.ac.uk-->
<lom xmlns="http://www.imsglobal.org/xsd/imsmd_v1p2" xmlns:xsi="http://www.w3.org/2001/XMLSchema
  <general>
    <title>
      <langstring xml:lang="en">Color toy</langstring>
    </title>
    <language>en</language>
    <description>
      <langstring xml:lang="en">A random color generator that also creates a
        harmonised color palette.This toy provide should
        help the designer to pick the combination of color as needed .
        just pick one color and the toy will provide you with five
        different color that could work well with the selected color</la
    </description>
    <keyword>
      <langstring xml:lang="en">color, design , instructional design</langstring>
    </keyword>
    <structure>
      <source>
        <langstring xml:lang="en">LOMv1.0</langstring>
      </source>
      <value>
        <langstring xml:lang="x-none">Mixed</langstring>
      </value>
    </structure>
    <aggregationlevel>
      <source>
        <langstring xml:lang="en">LOMv1.0</langstring>
      </source>
      <value>
        <langstring xml:lang="x-none">3</langstring>
      </value>
    </aggregationlevel>
  </general>
  <lifecycle>
  <version>
```

Figure 15. Part of the XML file.

Just-in-time Content

Most of the learning object contents were valid, accurate and up-to-data according to the experts. Since the content was mostly contributed by ID teachers and experts, there was no need to examine that content at this stage.

Most of the experts agreed that the content of the learning objects were related but not limited to Instructional Design and they could function as resources in just-in-time manner. However, some experts argued that having resources available in a just-in-time manner does not mean they would be utilized. Therefore, the experts discussed a way to encourage students to use them.

Instead of just providing students with learning objects, experts suggested Instructional Design teachers should help their students to integrate those objects into their projects. One suggested way to help students integrate those resources was to categorize the resources according to their use. Therefore, the learning objects were categorized into four main components: analysis, design, development and evaluation.

Moving to LMS

The experts thought that the Flash version was beautiful, attractive, and simple, and that moving into a learning management system was a new direction opened in the ID-ROR development process.

According to one expert, learning objects without an LMS are simply a collection of loosely related digital resources. The researcher was encouraged to integrate those learning objects in a learning management system (LMS).

Some of the experts argued for integrating the learning objects in an LMS. One said, "...instead of having all the learning resources available for learners to be used in a just-in-time, it would be more realistic to have them (learning

objects) available just-in-time according to the course timeline.” He then added “For example when they (ID students) learn, doing a project, taught about analysis, they would have access to analysis resources” when he asked “Why do you think this way would benefit students”, with no time he said “This will definitely reduce the level of confusion in using the Instructional Design learning resources.”

One option to use to implement this suggestion is Moodle (Modular Object-Oriented Dynamic Learning Environment) which is an Open Source software package for producing internet-based courses. Therefore, ID-RORs were integrated into a Moodle. (For further information about this system, see www.moodle.org). As a result of the experts’ evaluation, the Instructional Design resources were embedded within a learning management system called Moodle. So, Instead of organizing the learning resources according to subject such as analysis, design, development, and evaluation, they were organized according the course timeline. Therefore, each week of the course had its own learning resources. Figure 16 shows the main difference between the old and new version.

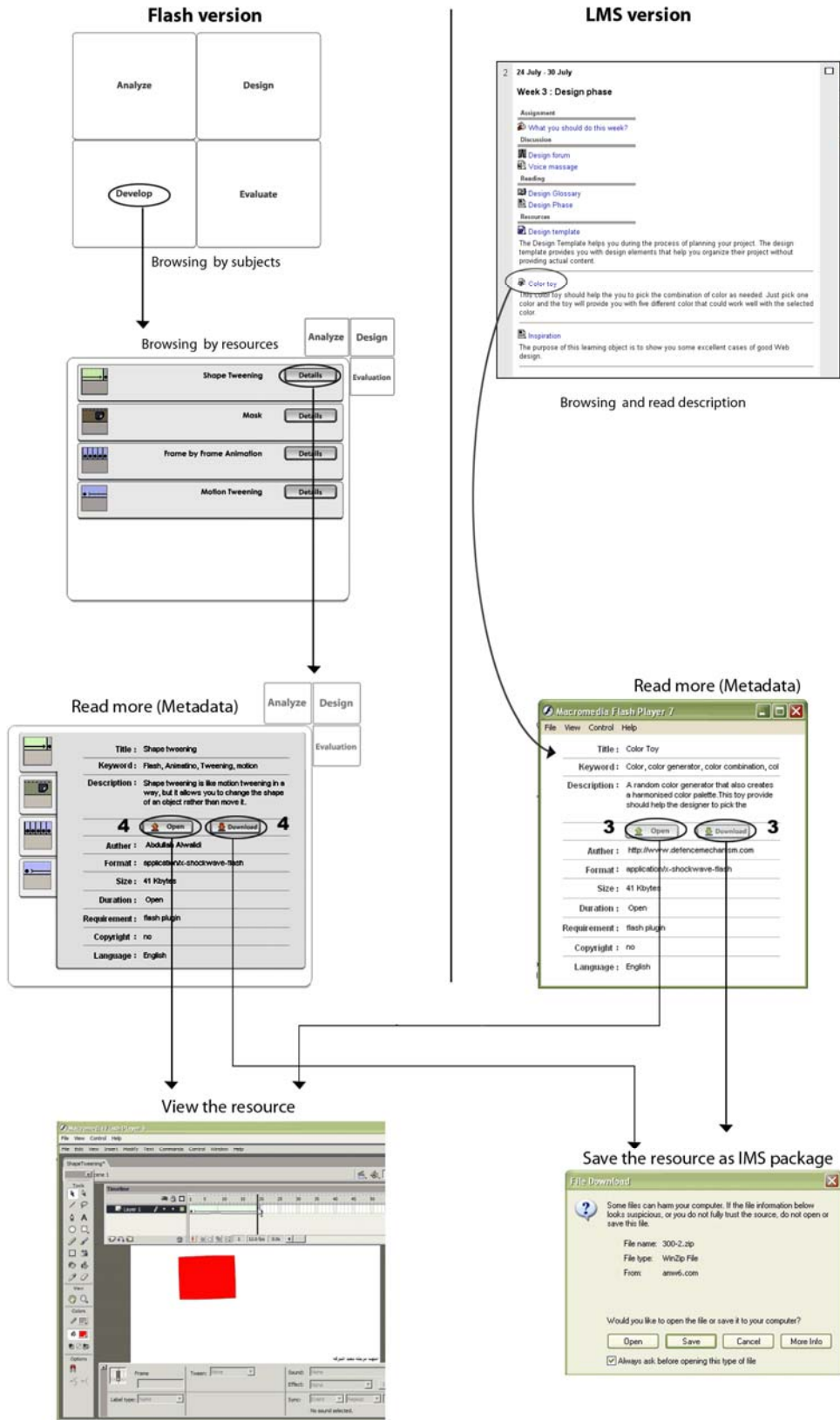


Figure 16. Storyboard shows the difference between the flash design and the LMS design.

Summary

The overall result of the feedback showed that all the experts were satisfied with the ID-RORs in general. However, there were several modifications made, based on some of the negative responses and suggestions from the experts. After those modifications were made, the prototype appeared to be valid for ATC Instructional Design students, according to the experts.

Target User Evaluation

The ID-RORs, as revised based on the experts' feedback, were used by students who were enrolled in the Instructional Design course offered by the Department of Educational Technology at Abha Teachers College during the Summer 2004 semester. Various data collection methods were employed in order to address the research questions: use of an online tracking system, observations, and students' feedback, collection of students' artifacts, and interviews with students.

The primary aims of the user evaluation were to measure the practicality of the ID-ROR prototype, identify users' needs, identify strengths and weaknesses in ID-RORs as well as ways to improve them, and to use the results of this evaluation to revise the prototype.

The main question of this evaluation was "Are ID-RORs working for you?"

If not, what needs to be done to improve them?”

The overall results

In general, the prototype seems to be practical for ATC Instructional Design students (easy to use, helpful, easy to understand and the content is consistent with the school curriculum). Users stated that the ID-RORs fit their practical needs for an Instructional Design course. Additionally, they reported that the ID-RORs provided them with just-in-time useful and satisfactory performance support during the Instructional Design course. However, there were several comments from users, which suggested some parts of the ID-RORs need to be improved.

Furthermore, they liked the idea of having the courses resources available online. One participant said, “Without those learning resources, I would have spent more time performing my class activities.” Another participant indicated that “Having access to those learning resources online was very useful and convenient for me.” Another participant said “Working perfectly with me.”

Participants were fairly successful in integrating and utilized the ID-ROR learning resources in their projects. Despite their success in integrating such resources, however, participants sometimes stated that they had some problems using the ID-RORs. Those problems were solved by revising the ID-RORs. Following are students’ feedback, regarding their experience using the ID-RORs.

Interface

The overall results of the target user evaluation showed that the interface

seems to be practical for the intended target users. In general, the students like the following attributes of the interface; simple, easy to use and easy to find. In addition, they like the way the interface offered consistent organization of the content. One participant said “I like the way those resources are organized...for example, I found them when I must need them.”

A few students commented specifically on the font size. Those remarks centred on its being too small. One participant said, “The only thing about the interface I want to tell you about is the font size, it is too small to be read. In fact, I had to increase the font size in my browser [Explorer 6] from medium to large to be able to read it easily.” As the researcher shared this comment with other participants, they had the same problem regarding the font size.

Regarding the organization of the resources, even participants like the organization of the content according the week, however one participant stated that, “there were too many titles in each week, he suggested organizing them into a group such as reading, discussion, assignment and resources.

Based on this suggestion, the materials of each week were categorized according to their use. Figure 17 represents the changes that took place in the interface, regarding the organization of the content. Additionally, the font size was change to be larger.

2 24 July - 30 July

Week 3 : Design phase

- What you should do this week?
- Design template
- Design forum
- Voice message
- Color toy
- Design Glossary
- Design Phase
- Inspiration

Updated Resource: Design template

Updated Resource: Color toy

Updated Resource: Inspiration

Online Users
(last 5 minutes)

Abdullah Alwaidi



2 24 July - 30 July

Week 3 : Design phase

Assignment

What you should do this week?

Discussion

Design forum

Voice message

Reading

Design Glossary

Design Phase

Resources

Design template

The Design Template helps you during the process of planning your project. The design template provides you with design elements that help you organize their project without providing actual content.

Color toy

This color toy should help the you to pick the combination of color as needed. Just pick one color and the toy will provide you with five different color that could work well with the selected color.

Inspiration

The purpose of this learning object is to show you some excellent cases of good Web design.

Updated Resource: Design template

Updated Resource: Color toy

Updated Resource: Inspiration

Online Users
(last 5 minutes)

Abdullah Alwaidi

Figure 17. ID-RORs before and after the interface modification.

Metadata

At the beginning of the target user evaluation, each learning object had an IMS metadata as an XML file which was recommended by experts. The purpose of those metadata was to facilitate the use and/or reuse of the learning objects. A learning object metadata are extracted from its external XML document and an internal representation of that metadata is created inside the Flash file.

On the other hand, some participants did not seem to pay any attention to the metadata. They felt it was not important part of their ID-ROR usage.

One participant said, “No I do not think I would need it.” The researcher asked him do you really know what this part is for? He said, “They give me more information about the object but I do not need that, the resources are easy to use I just need to use them.”

In this regard, another participant said, “The metadata make no difference for me, but they would be useful in the future”. Even if the metadata did not make such a difference for the target group.

Students did not have the motivation because they were not searching for the LO. If the LO were in a large LO repository then the person who wanted to search for a useful LO would be much more interested in metadata. it was decided to not remove them, based on the experts’ recommendations. As a result, no revision was made.

Reusability

Regarding reusability, a clear majority indicated that they would consider reusing some of those learning objects in their own future project development.

One participant said when asked if he consider reusing those resources he said, "Sure, I already have saved copies of them to use them when I need to." Another participant said, "I would love to reuse them because they could be used in almost any project development and they are not limited to this class, in fact I am planning to design my own website and some of those resources will support me to do that."

Instructional Design resources

Four type of learning resources were used; tutorials, inspiration, templates, and guidelines. Following are a brief description of those four categories as well as students feedback.

Tutorials.

Instructional Design teachers spent most of the class time helping their students learn the software instead of having them perform a task or assignment with that software. Initially, the researcher developed four tutorials. Those tutorials developed using Flash MX 2004. Each tutorial showed "how to do" one small task of the program. One advantage of those tutorials was their small size, which was about 45 Kbytes for each file. The first version of the tutorial used motion, images, and text.

The overall result showed that the online tutorials were extremely

important and useful. One student in the course stated that the online tutorials were a smart way of learning any computer software.

Another participant said, "One good thing about those tutorials was that you could learn the software in your own time and repeat them again and again." Another student said, "I found those tutorials to be very useful in helping me learn the software (Flash MX) in a very fast way."

However, most participants suggested adding sound to them. The researcher asked one participant that would consider waiting more time to get a tutorial with sound downloaded. He said, "Yes, as long as I can save them on my hard disk." As a result, the sound was added to the tutorials.

On the other hand, the results showed that there was a need for additional tutorials. One participant said, "I like this part of the course (tutorials) and I would love having access to more tutorials." When asking the other participants about adding more tutorials to the course, they strongly agreed. As a result, four more tutorials with sound were added to the course.

Inspiration.

According to one expert, the purpose of this section was to show the student some great cases of excellent projects/design. The observations showed that most of the participants did not understand the purpose of the inspiration learning object at the beginning of the projects. However, after the purpose was explained to them, they started looking at those learning resources in a completely different way.

When the researcher explained the purpose of the inspiration learning object to one participant, he said, “I did not know what those resources were for... I did not know they should inspire me with ideas. I think I would reconsider and look at them in a different way.”

However, one student had a different view than the other participants. He said, “Those resources showed us what could be good examples and how to combine colors (referring to the color toy); but I think good and bad are relative to one’s experience.” The researcher asked him, “What could be done to improve them and make them more useful?” he said “Nothing, but they may not work for all of us.” As a result, no revision was added to this section.

Templates.

Initially, five Instructional Design templates were developed using MS Word. The overall result showed that the participants were satisfied with the templates. One student said “I think they are great way to guide me in performing some Instructional Design tasks such as analysis and evaluation.”

Most of the participants thought those templates were useful and important. However, some users were confused as to what information to put in each section of the template. A short explanation was added to each section to avoid this confusion.

Guidelines.

As the experts thought the guidelines resources would be a very important aspect of the ID-ROR. This was not the view of the participants. Even though

more than half of the participants thought those resources were useful, they were not interested in using them as they do the other resources.

One student said, “I think they are good but I think I can do it without them.” Another student said, “The guidelines resources could be a good place to start with, or a good guide.” As a result, no revision was made.

Development

As a result of the participants’ comments and suggestions, the following main revision decisions were made:

- The participants were able to download a compressed version of the resources in addition to the ability to view them online.
- Two more video tutorials resources were added to the ID-ROR.
- The new version of the tutorial resources included sound.

Summary

The overall result of the target user evaluation showed that the prototype seems to be practical for the intended target users (easy to use, helpful, and easy to understand). In the next section, the main characteristics of the final version of the ID-RORs are presented.

Overview of the Final Version of ID-RORs

The main page of the course contained five boxes/sections. Each box on the main course page covers exactly one week of the course timeline as follows: Week 1: introduction, Week 2: analysis, Week 3: design, Week 4: development and Week 5: evaluation.

Each week had reading, tasks, discussion and resources (learning objects). The learning objects were placed under the resources section. These learning objects were uploaded into the ID-RORs website and then linked to from the course main page.

The learning objects were organized according to the subject being presented in the course as follows: analysis (week 2), design (week 3), development (week 4) and evaluation (week 5). Each week was focused on one main Instructional Design task. For each week and under the resources sections, there was a list of learning objects related to that week/part of the course. Each learning objects had title and short description.

The ID-RORs website keeps a log of all the activities undertaken in the website. The researcher was able to see what students had looked at, what they had done and when they last logged in. ID-RORs also provide some easy overviews that show exactly what the students had done and which assignments they still had to work on (see [Figure 18](#)).

Home » ID-ROR » Logs » All participants, All days

INSTRUCTIONAL DESIGN – REUSABLE ONLINE RESOURCES.: All participants, All days (GMT+3)

INSTRUCTIONAL DESIGN - REUSABLE ONLINE RESOURCES. All participants All days

All activities Show these logs

Displaying 4153 records

Page: (Previous) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 ...42 (Next)

Mon 9 August 2004, 11:20 PM	80.78.138.72	Abdullah Alwalidi	course view	INSTRUCTIONAL DESIGN – REUSABLE ONLI
Mon 9 August 2004, 11:20 PM	80.78.138.72	Abdullah Alwalidi	label add	
Mon 9 August 2004, 11:20 PM	80.78.138.72	Abdullah Alwalidi	course add mod	label 4
Mon 9 August 2004, 11:19 PM	212.138.47.26	ᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ	forum view discussion	ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ
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Mon 9 August 2004, 11:19 PM	212.138.47.20	ᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ	forum view forum	ᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ
Mon 9 August 2004, 11:18 PM	212.138.47.20	ᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ	forum add discussion	ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ ᄁᄁᄁᄁ
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Mon 9 August 2004, 11:14 PM	80.78.138.72	Abdullah Alwalidi	course view	INSTRUCTIONAL DESIGN – REUSABLE ONLI
Mon 9 August 2004, 11:13 PM	212.138.47.17	ᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ	course view	INSTRUCTIONAL DESIGN – REUSABLE ONLI
Mon 9 August 2004, 11:10 PM	212.138.47.16	ᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ	assignment view	ᄁᄁ ᄁᄁ ᄁᄁᄁᄁᄁᄁᄁ ᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ
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Mon 9 August 2004, 11:07 PM	212.138.47.11	ᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ	forum view forums	
Mon 9 August 2004, 11:06 PM	212.138.47.29	ᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ	forum view forum	ᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ
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Mon 9 August 2004, 10:59 PM	212.138.47.11	ᄁᄁᄁᄁ ᄁᄁᄁᄁᄁᄁ	forum view discussion	
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Figure 18. part of the logs page of the ID-RORs website.

As part of the learning management system (Moodle), Each week had its own forum. In addition, a general forum was created for frequent question and problem to help and support students using the ID-RORs (see Figure 19).

document and an internal representation of that metadata are created inside the Flash file.

In addition, the package includes a copy of a learning object(s) instead of just linking to the learning objects' URLs. This can help students learn to use and/or reuse those learning objects locally in their machines. At the course developer level, as this zip package was developed according to specific standard such as SCORM or IMS, this package is very important to distribute those learning objects among learning management systems as well as in adapting them. For instance, the developer of a set of learning objects could package those learning objects into a zip file include a XML(s) file describing the organization and the content of those learning objects (see last [Figure 20](#)).

24 July -30 July

Week 3 : Design phase

Assignment

What you should do this week?

Discussion

- Design forum
- Voice message

Reading

- Design Glossary
- Design Phase

Resources

- Design template

The Design Template helps you during the process of planning your project. The design template provides you with design elements that help you organize their project without providing actual content.

Color toy

This color toy should help you to pick the combination of color as needed. Just pick one color and the toy will provide you with five different color that could work well with the selected color.

Inspiration

The purpose of this learning object is to show you some excellent cases of good Web design.

Updated Resource: Design template
Updated Resource: Color toy
Updated Resource: Inspiration

Online Users
(last 5 minutes)
ABUSUJAH, A.Vaidis **1**

Macromedia Flash Player 7

Title: Color toy

Keyword: Color, color generator, color combination, col

Description: A random color generator that also creates a harmonized color palette. This toy provide should help the designer to pick the

3B **3A**

Author: http://www.defencemechanism.com

Format: application/x-shockwave-flash

Size: 41 Kbytes

Duration: Open

Requirements: flash plugin

Copyright: no

Language: English

Macromedia Flash Player 6

GENERATED

336A05

RED GREEN BLUE

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HISTORY

000000 SUBMIT RANDOM

V 1.5 DEFENCEMECHANISM.COM

File Download

Some files can harm your computer. If the file information below looks suspicious, or you do not fully trust the source, do not open or save this file.

File name: 300-2.zip
File type: WinZip File
From: amw6.com

Would you like to open the file or save it to your computer?

Open Save Cancel More Info

Always ask before opening this type of file

Figure 20. The usage of ID-RORs.

Description of the Learning Objects

The following is a brief description of the learning objects.

1- Basic Motion Tweening Tutorial.

Motion Tweening (see Figure 21) is a simple animation technique between two objects. The purpose of this tutorial was to show students how to make a simple animation between two objects using motion tweening. Motion pictures that simulate how to develop Motion Tweening were developed using Macromedia Flash MX. The size of this tutorial was about 31 Kbytes.

One advantage of this tutorial as well as the following three tutorials was the combination of small size and high quality images. However, the development of those four tutorials (1, 2, 3 and 4) was very time-consuming.

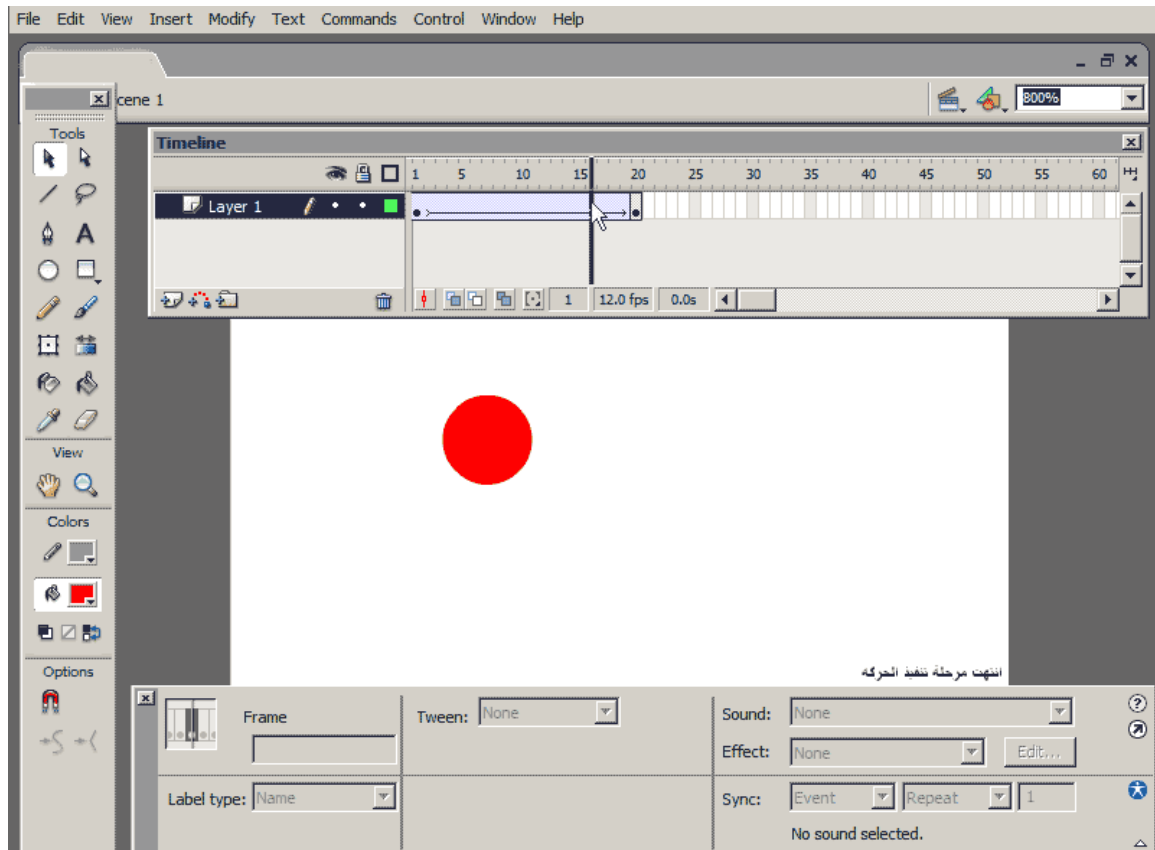


Figure 21. Basic Motion Tweening tutorial.

2- Basic Frame-by-frame Tweening tutorial.

Frame-by-frame is the most basic form of animation because it employs unique drawings in each frame. The purpose of this frame-by-frame tutorial was to show students how to make a simple animation using the frame-by-frame technique.

This tutorial (see [Figure 22](#)) was developed using Macromedia Flash MX to show students how to step-by-step develop Frame-by-frame Tweening. The size of this tutorial was about 44 Kbytes.

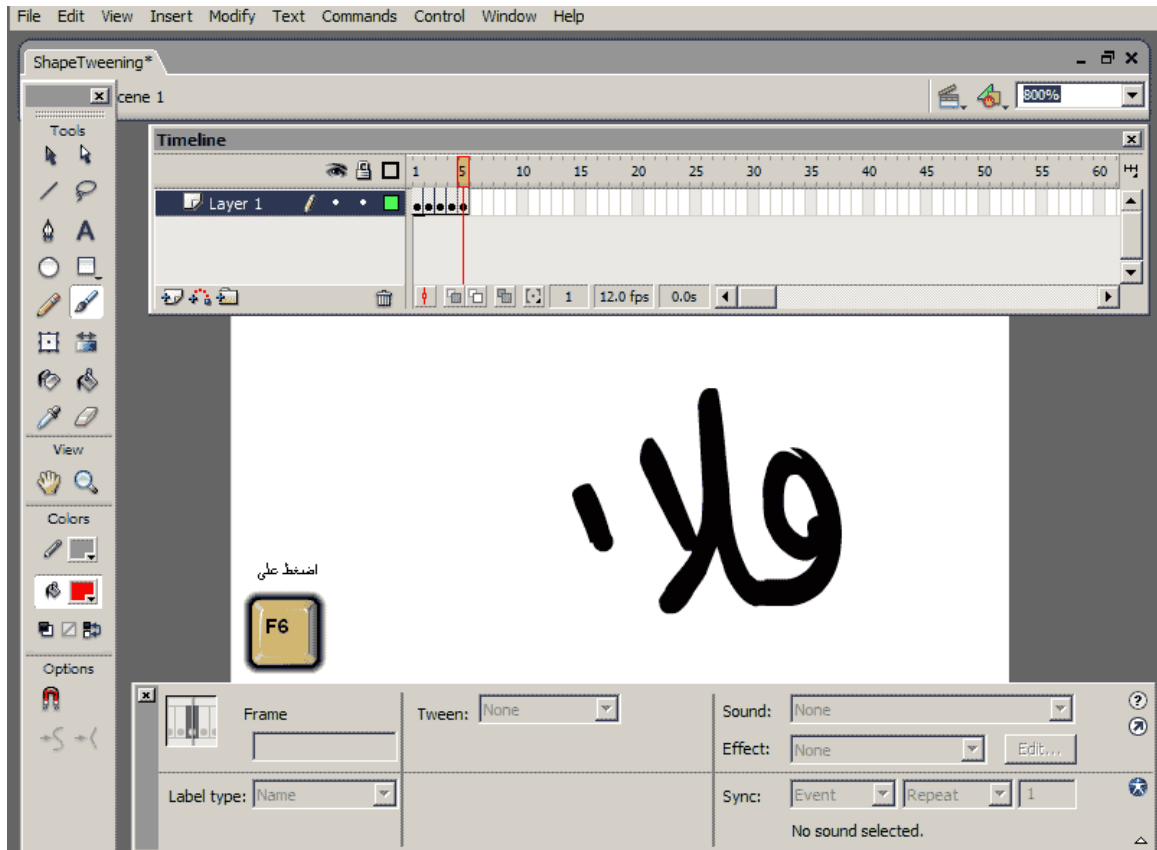


Figure 22. Basic Frame by frame tweening tutorial.

3- Basic Shape Tweening Tutorial.

Shape tweening is like motion tweening in a way, but it allows you to change the shape of an object rather than move it. Shape tweening is similar to morphing. With shape tweening, one shape appears to change into another shape over time.

The purpose of this tutorial was to show students how to make a simple animation with two shapes using shape tweening. This tutorial (see [Figure 23](#)) was developed using Macromedia Flash MX to show students how to develop

Shape Tweening. The size of this was about 27 Kbytes.

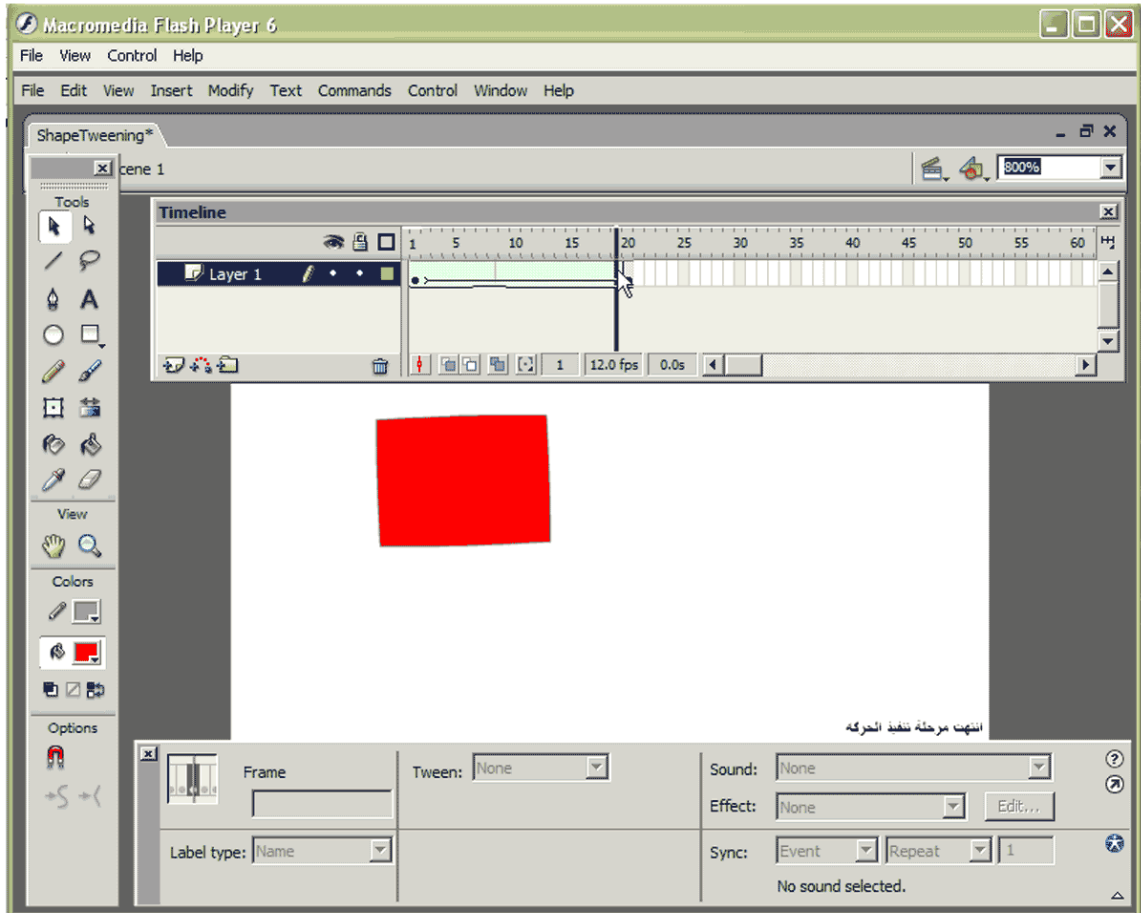


Figure 23. Basic Shape tweening tutorial.

4- Basic Mask Tutorial.

In Flash, a mask layer is used to define the visible area of layers nested beneath it. The aim of the tutorial is to show you how to make a simple mask in Flash MX. This tutorial (see [Figure 24](#)) was developed using Macromedia Flash

MX.

Motion pictures simulate step-by-step how to develop a mask inside Flash

MX. The size of this was about 25 Kbytes.

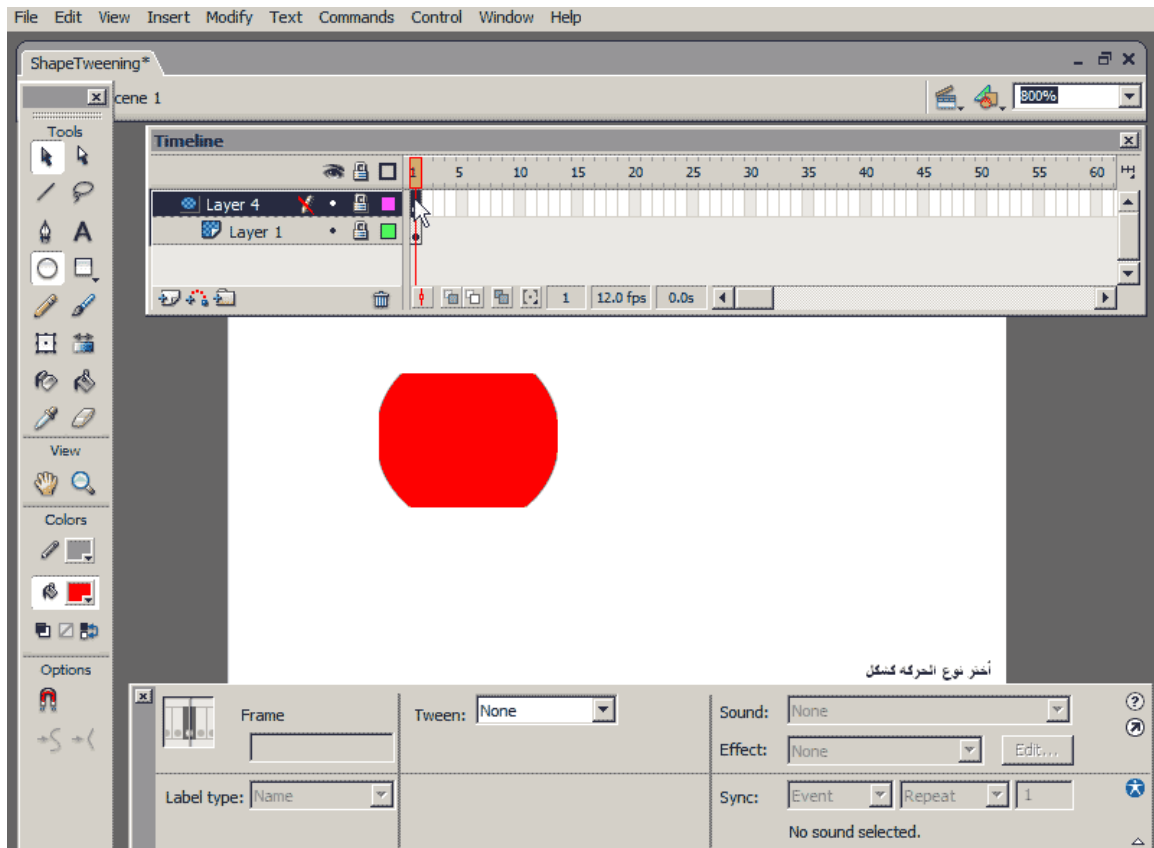


Figure 24. Basic Mask tutorial.

5- Designing a Simple Button in Flash.

The purpose of this tutorial was to show students how to draw a simple button. Camtasia Studio 2 was used to capture the necessary video clips for this tutorial.

One advantage of this tutorial (see [Figure 25](#)) was that it includes sound

and streaming video. However, the size of this tutorial was high (733 Kbytes).

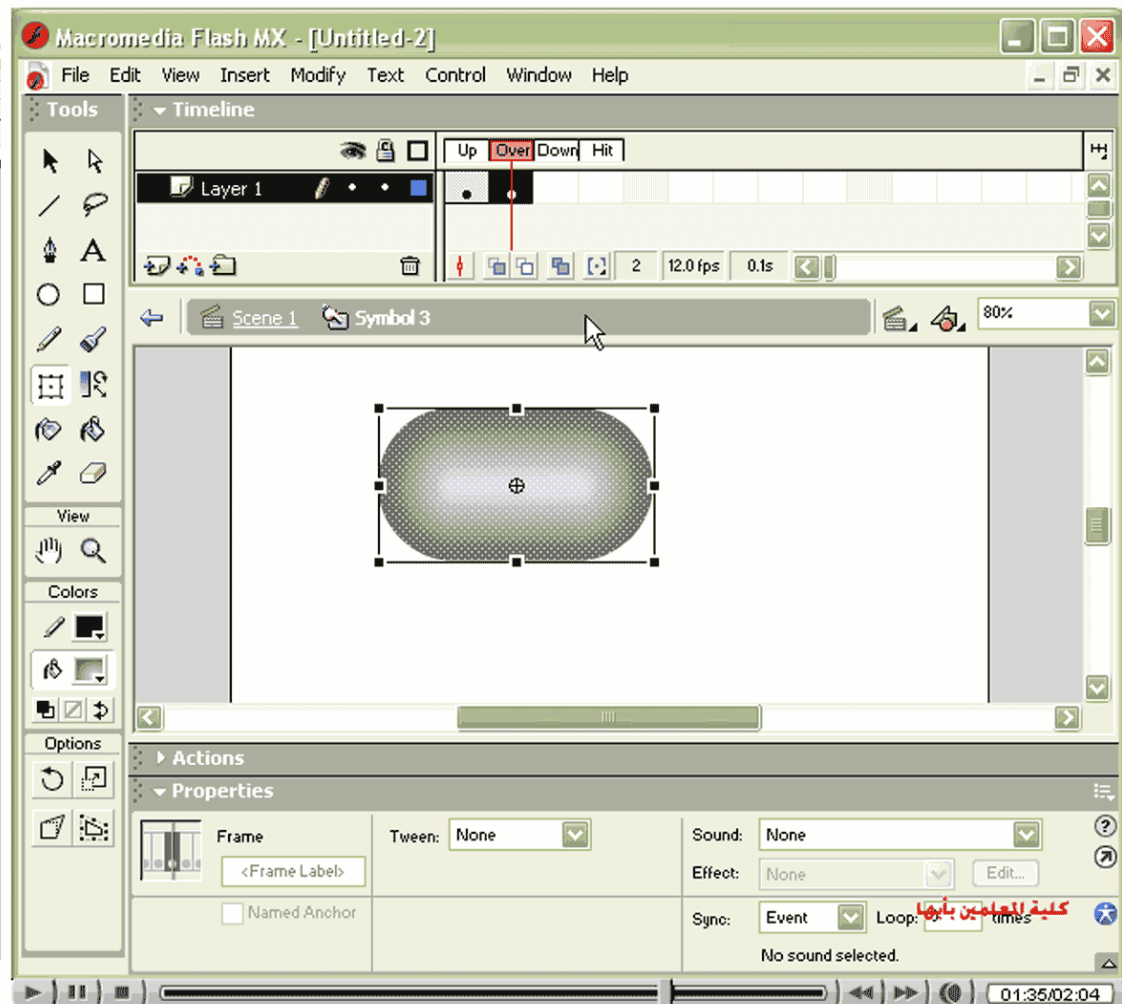


Figure 25. Designing a simple button in flash.

6- Go to ActionScript.

ActionScript is the scripting language of Macromedia Flash. A scripting language is a way to communicate with a program; you can use it to tell Flash what to do and to ask Flash what is happening as a movie runs.

The purpose of this tutorial was to show students how to use a simple Go to ActionScript.

Camtasia Studio 2 was used to capture the necessary video clips for this tutorial. As this tutorial (see [Figure 26](#)) included sound and real video, the size of this tutorial was relatively high (1831 Kbytes).

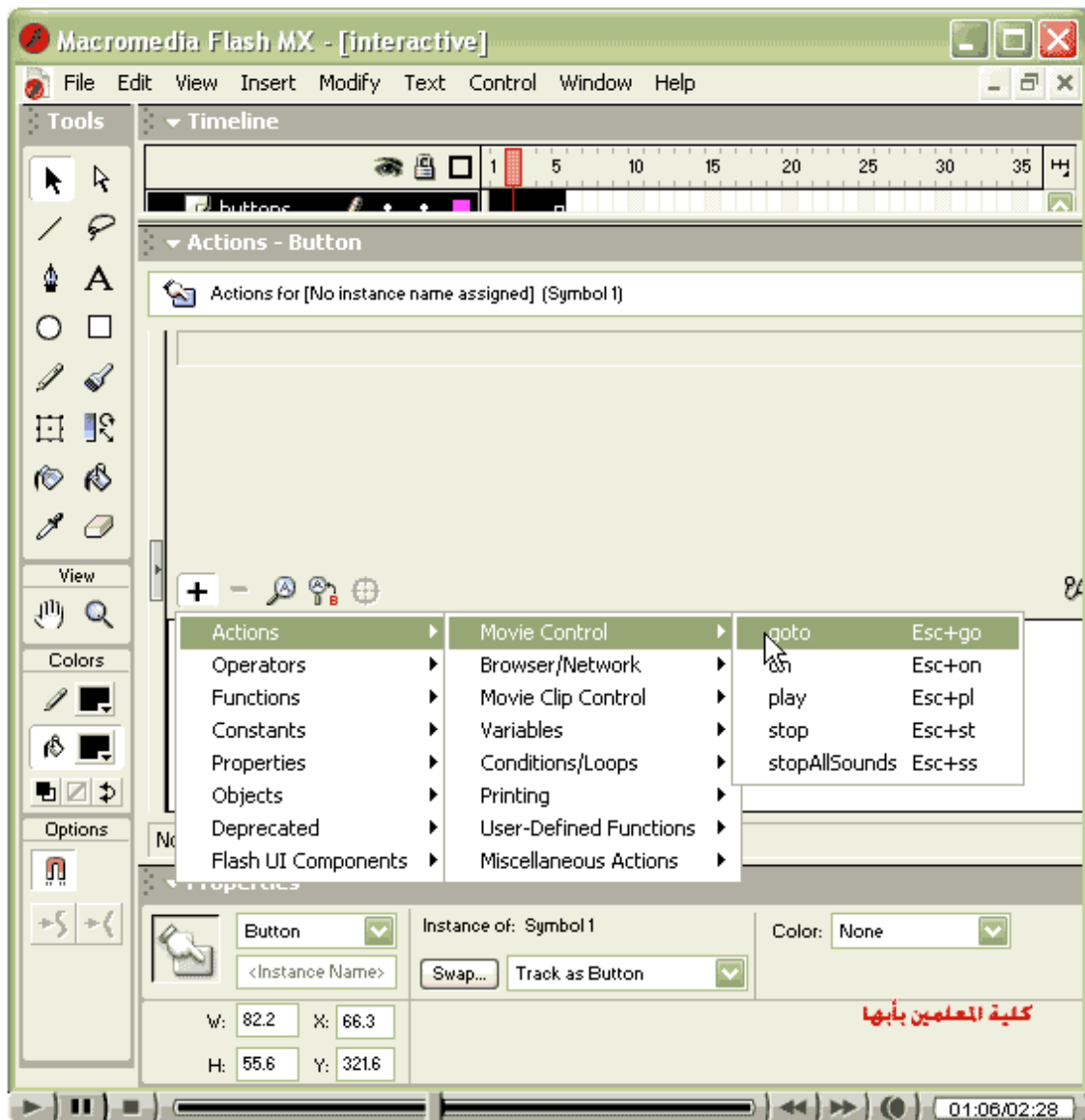


Figure 26. Go to ActionScript.

7- Inspiration.

The purpose of this learning object was to show the students some excellent cases of good Web design. This learning object was developed in 2002 by the researcher using Macromedia Flash MX. As shown in [Figure 27](#), the inspiration learning object was a collection of successful Web design cases. Those cases were categorized according to color, simplicity, typography, image, beauty, and organization.

simplicity	beauty	photography
organization	color	typography

Abdullah Alwalidi 2002

Figure 27. Inspiration.

8- Design Templates.

The Design Template helps the users during the process of planning their projects. The design template provides users with design elements that help them organize their project without providing actual content. Templates should support, simplify, and increase the speed of a student's design. This design template was developed using MS Word (see Figure 28).

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Here put short intro about the project	A
	B
	C
	D

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Figure 28. Design templates.

9- Analysis Template.

The analysis template was developed using MS word (See Figure 29).

This template should support the user during the process of analysis.

Analysis template	
Project	
<i>Project name:</i>	
Target audience	
<i>What are the characteristics of the target audiences?</i>	
.....	
.....	
.....	
.....	
.....	
.....	
Users' needs	
<i>What are the users needs regarding this project?</i>	
.....	
.....	
.....	
.....	
.....	
.....	
.....	
.....	
Problems	
<i>What are the problems?</i>	
.....	
.....	
.....	
.....	
.....	
.....	
.....	
.....	
Solution	
<i>What is the solution for the problems? What is your goal?</i>	
.....	
.....	
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Figure 29. Analysis template.

10- Evaluation Template.

The evaluation Templates should support users in the process of evaluation. This template was developed using MS Word (see [Figure 30](#)).

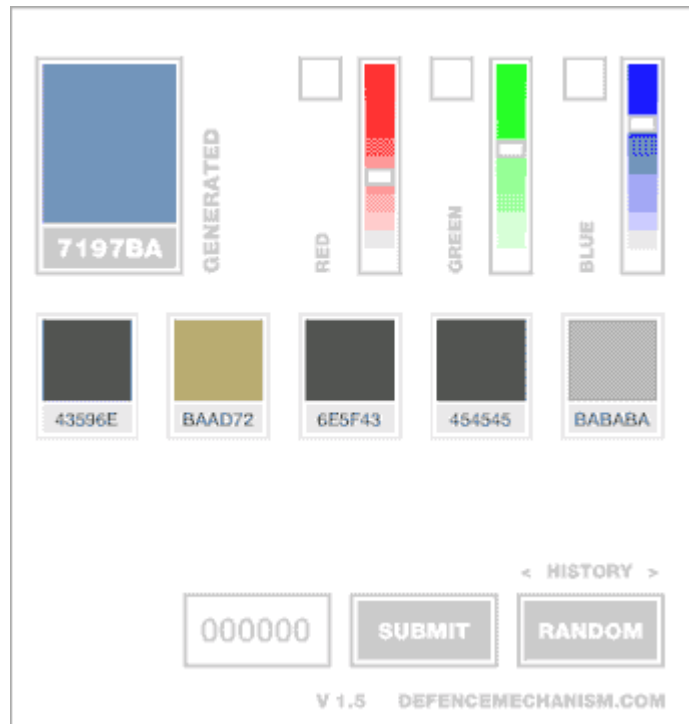
Evaluation guidelines	
The goal and objectives of the evaluation	
	<ul style="list-style-type: none"> o Identify your goal and objectives of the evaluation o Identify what information you want to find o The more you focus the better the result
The target user	
	<ul style="list-style-type: none"> o Start with small number of participants o Carefully chose your participants o Participants should be willing to help you o Reward them
Small components	
	<ul style="list-style-type: none"> o Divide your project into small components
Data collection	
	<ul style="list-style-type: none"> o decide the right method to collect data o Try to use multiple methods o Decide the right method to record data
Conducting the evaluation	
	<ul style="list-style-type: none"> o Work according to a timeline o What are the evaluation tasks
Data analysis	
	<ul style="list-style-type: none"> o The purpose of the data analysis is to find the results o Translate the finding into actions o Eliminate the non relative information
Evaluation report	
	<ul style="list-style-type: none"> o Report should include the following: <ul style="list-style-type: none"> o The evaluation goal o The evaluation questions o Data collection method o The result of your evaluation o Suggestions o Note: it is very important to share your finding with the participants

Figure 31. Evaluation guidelines.

12- Color Toy.

This learning object is available at <http://www.defencemechanism.com>. It is based on ColorMatch 5K by Kim Jensen which is an open-source project. Even this tutorial was not developed by the researcher, it was integrated in the ID-RORs as it is an important tool for designers in general. Define a single color that you like, and six matching harmonized colors will be calculated. This color

toy (see [Figure 32](#)) should help the designer to pick the combination of color as needed. Just pick one color and the toy will provide you with five different color that could work well with the selected color.



[Figure 32](#). Color toy.

Summary

The overall results of the needs assessment evaluation showed that the ID-RORs prototypes have met an important need at ATC. The overall result of the expert evaluation showed that the ID-RORs prototypes were valid for the context of ATC. Finally, the result of target user evaluation showed that the ID-RORs as revised with expert and user input were practical for the intended target users. Based on the results of this R & D study, it was possible to develop the ID-

RORs. The characteristics of ID-RORs are very similar to the characteristics of successful (valid and practical) reusable online recourses.

Chapter Five: Discussion and Conclusions

Discussion

The purpose of this research and development study was to develop valid and practical reusable online resources that could support Instructional Design students' learning, in the specific context of Abha Teachers' College.

This study followed the research and development model (Borg and Gall, 1989) as presented in Chapter 3. In accordance with this model, seven main research and development phases have been carried out: research and information collecting, a needs assessment, prototype development, expert evaluations, redesign, target user evaluations and redesign.

Literature Review

The purpose of examining related literature and review related to reusable online resources is to help to answer the first research question by the determining the characteristics of successful online resources.

The literature clearly established the need for reusable online resources in general. The literature also led the researcher to the conclusion that the online learning resources which include the identified principles of learning objects (see Chapter 3) and function as EPSSs are a viable solution to the research problem of this study.

Needs Assessment

A needs assessment was conducted to determine whether there was an important educational need for creating the proposed ID-RORs (see Chapter 4).

During the needs assessment stage, the main question for the experts was: “Does the proposed product meet an important educational need for Instructional Design students, in the context of Abha Teachers' College? Why?”

The results of the needs assessment evaluations showed that the ID-RORs prototype would meet important educational needs for Instructional Design students, in the context of Abha Teachers' College. ID students need to have access to Arabic reusable online resources to support their learning and enable them to address their unique learning interests and needs.

Prototype Development

Based on previous phases, a preliminary prototype was developed. Initial work was designed in January 2004 mainly using Flash MX, Adobe Photoshop 7, Adobe Illustrator 10, and Dreamweaver MX. The prototype was ready for expert evaluation at the end of February 2004. Description of the prototype was introduced in Chapter Four of this study.

Experts' Evaluation

The main purpose of the expert evaluation was to determine whether the ID-RORs accomplished their design criteria within the immediate or short-term

context of its implementation (Reeves & Hedberg, 2003, p 61). The second purpose was to obtain an initial qualitative evaluation of the validity of the prototype. The third purpose was to use the results of the evaluation to revise the product.

During the experts' evaluation stage, the main question for the participants was: "Are the ID-RORs valid for the intended target users? If not, what needs to be done to improve them?" During the experts' evaluation stage, the participants had the opportunity to use the prototype and make suggestions about modifications of the ID-RORs. Many of these suggestions were incorporated as the prototype was modified.

The overall result of the feedback showed that all the experts were satisfied with the ID-RORs in general. However, there were several modifications made, based on some of the negative responses and suggestions from the experts. After those modifications were made, the prototype appeared to be valid for Abha Teachers' College Instructional Design students, basing that conclusion on the opinion of the experts. (The results of the expert evaluations are given in detail in Chapter 4).

Redesign

As a result of the experts' comments and suggestions, the following main revision decisions were made:

The ID-RORs were embedded within a learning management system called Moodle.

More contrast was added to the interface color.

The interface was designed to be scalable instead of a fixed size.

The IEEE LOM/IMS standard was used to describe the learning objects instead of the Dublin core metadata standard.

The learning objects were categorized according to Instructional Design main components; analysis, design, development and evaluation.

Target User Evaluation

The purposes of the user evaluation were to: (a) measure the usability/practicality of the prototype, (b) identify users' needs, (c) identify strengths and weaknesses in the ID-RORs as well as ways to improve them, and (d) use the results of this evaluation to revise the prototype.

During the target user evaluation, the main question for the participants was: "Are those Instructional Design resources working/practical for the target users? If not, what needs to be done to improve them?"

The results indicated that the ID-RORs were practical for the target user evaluation, after some minor modifications had been made. (The results of the target user evaluation were given in detail in Chapter 4.).

Redesign

As a result of the target user evaluation, the following main revision decisions were made:

- The participants were able to download a compressed version of the

resources in addition to the ability to view them online.

- Two more video tutorials resources were added to the ID-RORs.
- The learning objects were categorized according to the class timeline.
- The materials of each week of the course were categorized into: reading , discussion, assignment and resources. The learning objects were placed under resources section.
- The font size was increased.

Context and reusability

Even though most of the suggestions from experts and users were to increase the context the learning objects (see Chapter 4) , nevertheless, one of the main points about LO reusability is to decrease context.

The most successful learning object will be able to provide not only a relevant context for the learning object but also a reasonable level of reusability. To make this possible, I believe there is need for a balance between contextlizing and decontextlizing a learning object. How much contextualization can and should be built into a learning object? And how do we determine the right balance? These questions will remain a challenge for LO developers.

Research Questions

1- What characteristics should valid and practical reusable online resources for Instructional Design students have in the context of Abha Teachers'

College?

Based on the results of this R & D study, the following are the characteristics of successful valid and practical reusable online resources:

- Learning resources content should be broken down into small standalone chunks that can be reused in various learning environments.
- The learning resources should be tagged with appropriate descriptive metadata.
- The content of the ID-RORs should be designed/chosen to be closely related but not limited to Instructional Design as a subject area and to function as resources in just-in-time manner.
- The layout and design should be consistent.
- Organization and presentation of information should be clear.
- The navigation should be consistent and easy to use.
- The design and graphics should be aesthetically pleasing.
- The development process of learning objects should involve continuous collaboration among researchers, experts and users.
- The learning objects should not be locked into one particular look or feel. If they are not embedded within a “look,” they can be repurposed within a different visual schema without losing the essential value or meaning of the text, data, or images.

2- Can a set of learning objects be developed that meets these criteria/characteristics for ATC Instructional Design students?

Based on the results of this R & D study, the answer is yes. ID-RORs were developed. The characteristics of these ID-RORs are very similar to the characteristics of successful (valid and practical) reusable online resources.

Conclusions

An analysis of the data reported in this study suggested the following conclusions, regarding the performance of ID-RORs.

- It was possible to develop a reusable online learning resource that meets the design criteria. The final version of the ID-RORs was found to be needed, valid and practical, in the context of ATC.
- ID Students were pleased to be involved in the process of the development of the ID-RORs. They loved having ownership of the ID-RORs development process.
- A Learning management system is the ideal place to put a set of learning objects together online for the context of ATC. Learning objects without an LMS are simply a collection of loosely related digital resources.
- SCORM was not implemented at this time for the context of this

study because there was no benefit of adding the SCORM-compliance to the ID-RORs at ATC. In addition, none of the Saudi Arabian universities and colleges has implemented SCORM. Finally, there was no way to measure whether making ID-RORs SCORM conformant, would make it more reusable.

- White and grey colors were found to be the most reusable colors that can visually fit within multiple contexts. This is due to the flexibility of those two colors.
- Even though the learning object approach was time-consuming, it was a valid and a practical way to design online learning resources considering the long-term reusability.
- Providing students with the just-in-time resources does not imply that they will learn it. Guiding students in the process of using just-in-time resources was found to be helpful.
- Online video tutorials proved to be the most practical, desirable and needed type of resource for ID students in the context of ATC. Using those tutorials one could learn the software in his own time and repeat them again and again.

Recommendations

The results of this study lead to the following recommendations.

- Further research and development of the ID-RORs or similar projects should enable future users with the potential to go beyond just using the resources, to contributing to each other's learning through collaborative activities. By adding a tool that helps students create learning objects, that tool should allow learners to create artifacts that could become learning objects, if posted to the system, and tagged according to standards to allow further discovery, retrieval and manipulation.
- Further research and development of the ID-RORs should seek to outline the processes and strategies needed to ensure the reusability of future resources and provide a framework for this. This process should not only lead to improved systems for re-use; it should also make a significant contribution to a deeper theoretical understanding of the nature of online learning environments.
- It is recommended that the IEEE LOM standard should include description of "how learning objects could be used." This description of how to use the learning object could be very helpful for the potential users.
- Further research and development should explore the potential of having the metadata file be more dynamic in order to capture the opinions of the learning object users about their experiences using the learning object.

- Further study should explore the potential of making the ID-RORs SCORM compliant.
- The field-testing of the ID-RORs has been limited to Abha Teacher's College. Further field-testing with Instructional Design students from other teachers' colleges, would broaden the scope of the study, and assure the utility of the ID-RORs with a wider audience.
- Further study should explore the potential and the benefits of making learning objects open-source.
- Most learning object research focuses on the information delivery model, which fails to provide solutions for many current learning environments. Constructivist learning principles, as applied to learning objects, currently appear to have not been thoroughly researched. Further research and development should focus on this important area.
- In this study, the ID-RORs have turned out to be valid according to the expert evaluations. The program has also been shown to be quite practical for the target group users at ATC. However, the effectiveness has not been assessed yet. It is recommended that a follow-up study be undertaken, to further investigate the long-term effectiveness of the ID-RORs.

Lastly, this study should be seen as a first step in a continuous process of design, development, and evaluation of the ID-RORs. The results of this study

should provide insights for future development of the ID-RORs or other similar projects.

Dissemination and Implementation

This study focused on the research and development of a set of ID-RORs for Instructional Design teachers and students in Saudi Arabia. Final testing of its effectiveness, any changes resulting from such testing, and making the ID-RORs available for wider use, remain to be accomplished after the completion of this study. Some strategies under consideration are:

For further development:

- Use of the current version to teach with and taking notes on student problems in order to continue the process of ID-ROR improvements.
- Creating an online forum for ID-ROR developer community to share ideas and concepts about learning object.
- Creating an online forum for ID-ROR user groups to share their experiences using the ID-RORs.
- Publication of the ID-RORs on the World Wide Web for interested users to view and download.
- Placing the ID-ROR in the hands of the Instructional design

teachers at SA teacher colleges.

For wider distribution:

- Send out a beta version to 20 Arabic speaking ID teachers who volunteer to try it out.
- Offer it to an international repository for Arabic LOs.
- The result of this study will be shared with professionals

Reflections of the researcher

Even though using research and development methodology was a time-consuming process. I found the R & D methodology to be a very effective way to fill the gap between theory and practice. Additionally, the R & D methodology involved continuous collaboration between me and practitioners. I and the practitioners were equal partners in investigating and understanding the usage of the ID-RORs. However, it was very hard for me to maintain a balance between the research and development elements, regarding the specific time spent on each. Most of the time, development required much more time.

I believe the combination of qualitative evaluation and research and development method helped me increase the quality of ID-RORs and understand

the ID-RORs from the participants' perspective.

As I and my PhD committee members have tried to make this work as perfect as possible, I accept the possibility of having made mistakes. I hope this study is a valuable contribution in helping other researchers in the field of educational technology to improve the quality of learning using technology.

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Appendices

Appendix A: Informed Consent

Dear participants,

Please read and sign the following informed consent form. This form is required as part of completing research involving human subjects. By signing it you acknowledge that you are participating in the study voluntarily and acknowledge that all data gathered will be analyzed and reported in a way that does not connect it to you personally and that you can withdraw from the study at any time.

You are invited to participate in this research and development study because it designed to support your learning and performances in the instructional design course.

Your participation in this study will help to improve the design of ID-RORs. In addition, you will be able to use the ID-RORs after the study.

As part of the study, for approximately one semester, you will be observed and interviewed while using ID-RORs.

There are no foreseeable negative consequences to your participation in this study. All data gathered during this study will be kept confidential. Additionally, the researcher will not criticize, grade or assume authority over anyone in any manner.

If you have questions about this research and your rights as a participant, please contact Abdullah Alwalidi (the researcher) at ama3015@ksu.edu, 05-7731764 or Dr. Diane McGrath (Abdullah's advisor) at dmcgrath@ksu.edu (785)532-7686.

I, the undersigned, have consented to participate in this research and development study for the Spring 2004 at ATC with Abdullah Alwalidi, for the purposes of evaluating the ID-RORs.

Signature line

Date

Appendix D: MS Word Hierarchical Classification System

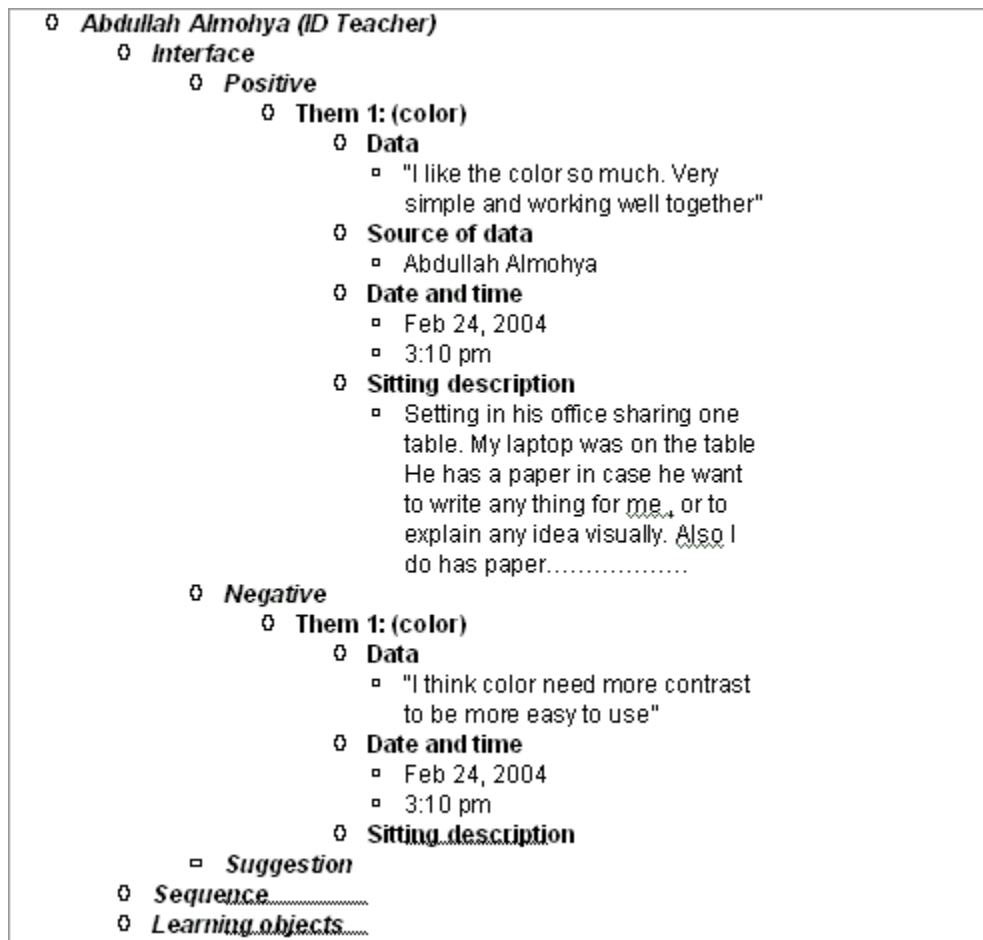


Figure 33. screenshot of MS word Hierarchical Classification system

Appendix E: Experts' Information

Dr. Abdurrahman Foysial	
Position	Dean of ATC
Specialization	Educational Technology
Experience	Has published several papers in the area of online learning, educational technology, Internet and learning. Member of several educational technology associations Professor of educational technology (PhD from USA)
Dr. Ibrahem Assiri	
Position	Chair of the Department of Computer Science at ATC
Specialization	e-learning & Learning objects
Experience	Consultant to the Arab Bureau of Education for the Gulf States Consultant to the Minister of Education in Saudi Arabia Member of the Future School Project at the Ministry of Higher Education in SA Member of the National Educational Technology Initiative in SA Has published several papers on the area of learning objects Professor of Computer Science (e-learning) (PhD from UK)
Abdullah Mohaya	
Position	Lecturer at the Department of Educational Technology, ATC
Specialization	Instructional designer & Instructional design teacher
Experience	Has developed educational technology guidelines for teachers' colleges in SA Teaching instructional design course at ATC MA in educational technology (MA from SA)
Ismial Saif Aldain	
Position	Lecturer at the Department of Educational Technology, ATC
Specialization	Instructional design teacher
Experience	B.A and MA in educational technology (B.A & MA from Egypt) Member of the Educational technology centre in Egypt

Appendix H: Timeline

Activity	Duration	Begin	End
Research and Information Collecting	9 months	April 2003	December 2003
Proposal		February 6, 2004	
IRB approval		February 17, 2004	
Needs assessment	10 days	February 12, 2004	February 22, 2004
Create prototype	4 weeks	February 25, 2004	Mar 14, 2004
Expert review	4 weeks	Mar 16, 2004	April 30 , 2004
Make revisions	23 days	May 2	May 25
Target user evaluation	8 weeks	June 10	August 10
Make revisions	4 days	August 11	August 15
Write up report	50 days	August 16	October 4, 2004
Defend dissertation		November 29, 2004	
Make revisions		December, 2004	
Submit final version		December 7, 2004	